

THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

MANUFACTURING STRATEGY FORMULATION IN SMALL AND
MEDIUM-SIZED ENTERPRISES

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ABSTRACT

Small and medium-sized enterprises (SMEs) are the backbone of any national economy and key drivers for economic growth. To sustain their competitiveness, it is essential that SMEs take advantage of their capabilities and support market requirements. This research encourages an increased focus on work with manufacturing strategies in SMEs. The purpose of this research is to increase our understanding of manufacturing strategy formulation in SMEs. To provide SMEs with useful advice on how to work with manufacturing strategies, this research focuses on internal and external key factors that are considered to be significant for manufacturing strategy formulation in SMEs. Manufacturing strategy formulation was investigated in three case studies in Sweden and two supplementary case studies in Singapore. The results in this research are presented in six papers and are encapsulated and extended in the summarising chapters of the compilation thesis.

Internal key factors for manufacturing strategy formulation are mainly identified from the literature about larger companies and are categorised in the following ways: procedure (what should be done), alignment (consistency between strategies, manufacturing strategies and manufacturing decisions), management (how the formulation is managed) and realisation (how the formulations are executed). The internal key factors seem to be of general value for all kinds of companies, but how the internal key factors are reflected in each individual company's manufacturing strategy formulations may vary due to the characteristics that SMEs exhibit. The internal key factors are synthesised into a model that provides practical guidance for manufacturing strategy formulation and aims at facilitating learning in SMEs through a structured way of working.

External key factors are addressed in two of the appended papers and the influence of these factors is further analysed in the summarising chapters. The external key factors identified were macro environment, industry, supplier, competitive environment and national culture. Two of these external key factors, competitive environment and national culture, were found to be more influential for manufacturing strategy formulation in SMEs.

Keywords: Manufacturing strategy, manufacturing strategy process, formulation, SMEs

PUBLICATIONS

Appended papers

The appended papers constitute the basis of this thesis. Paper titles and references are followed by a specification of the author's contribution.

Paper 1 Löfving, M. (2014), "The homogeneity of choices in manufacturing strategy decision categories in subcontractor SMEs". Submitted to *Journal of Manufacturing Technology Management*.

Löfving conducted the survey, the data analysis and the writing.

Paper 2 Löfving, M., Säfsten, K. and Winroth, M. (2014), "Manufacturing strategy frameworks suitable for SMEs", *Journal of Manufacturing Technology Management*, Vol. 25, No. 1, pp. 7-26.

Löfving and Säfsten initiated the paper. Löfving conducted the literature review, the data analysis and the initial writing. Säfsten and Winroth collected the empirical data. Säfsten and Winroth reviewed and quality assured the paper.

Paper 3 Löfving, M., Säfsten, K. and Winroth, M. (2012), "Manufacturing strategy formulation process: evidence from SMEs", *Proceedings of the 4th Joint World Conference on Production & Operations Management/19th International Annual EurOMA Conference*, 1-5 July, 2012, Amsterdam, Holland.

The paper was initiated by Löfving. Löfving did the literature review, the data analysis and the writing. All authors collected data. Säfsten and Winroth reviewed and quality assured the paper.

Paper 4 Löfving, M., Säfsten, K. and Winroth, M. (2013), "The Contextual Role for Manufacturing Strategy Formulation in Small and Medium-Sized Enterprises", *Proceedings of the 20th International Annual EurOMA Conference*, 9-12 June, 2013, Dublin, Ireland.

The paper was initiated by Löfving. Löfving did the literature review, the data analysis and the writing. All authors collected data. Säfsten and Winroth reviewed and quality assured the paper.

- Paper 5** Löfving, M., Säfsten, K. and Winroth, M. (2013), “Leadership style, organisational culture and manufacturing strategy formulation”, *Proceedings of the 22nd International Conference on Production Research (ICPR22)*, 28 June -1 August, 2013, Iguasso Falls, Brazil.

The paper was initiated by Löfving. Löfving did the literature review, the data analysis and the writing. All authors collected data. Säfsten and Winroth reviewed and quality assured the paper.

- Paper 6** Löfving, M., Säfsten, K., Winroth, M. and Lim. R. (2014), “The use of a manufacturing strategy tool and the role of national culture”, Paper accepted for the *21st EurOMA Conference*, 20-25 June, 2014, Palermo, Italy.

Löfving and Säfsten initiated the paper and did the literature review. Löfving, Säfsten and Winroth collected data in the Swedish companies. Löfving collected data in the Singaporean companies. Löfving analysed the data and wrote the paper.

Additional publications

- Löfving, M., Johansson, C. and Winroth, M. (2008), “Manufacturing Characteristics of Subcontractor SMMEs – an Empirical Study”, *Proceedings of the 41st CIRP Conference on Manufacturing Systems*, 26-28 May, 2008, Tokyo, Japan.
- Löfving, M. and Winroth, M. (2008), “Are Small and Medium sized Manufacturing Enterprises a Homogenous Group? – An Empirical Study of Manufacturing Characteristics”, *Proceedings of the 18th International Conference on Flexible Automation and Intelligent Manufacturing (FAIM 2008)*, 30 June - 2 July, 2008, Skövde, Sweden.
- Löfving, M. and Winroth, M. (2008), “Classification of Competitive Priorities in Small and Medium sized Manufacturing Enterprises”, *Proceedings of the Swedish Production Symposium 2008*, 18-20 November, 2008, Stockholm, Sweden.
- Löfving, M. (2009), *Enhancing competitiveness in small and medium-sized manufacturing enterprises – A study of the manufacturing situation of subcontractors in Sweden*, Licentiate thesis, Department of Technology Management and Economics, Chalmers University of Technology, Gothenburg, Sweden.
- Winroth, M., Säfsten, K., Löfving, M. and Edh, N. (2012), “A tentative comprehensive manufacturing strategy framework adapted to the requirements in SME”, *Proceedings of the 23rd Annual Conference of the Production and Operations Management Society*, 20-23 April, 2012, Chicago, IL.
- Säfsten, K., Winroth, M. and Löfving, M. (2012), “Requirements on manufacturing strategy frameworks for SMME”, *Proceedings of the Swedish Production Symposium 2012*, 6-8 November, 2012, Linköping, Sweden.
- Säfsten, K., Winroth, M. and Löfving, M. (2014), “Development of a manufacturing strategy framework for SMEs”, Paper accepted for the *21st EurOMA Conference*, 20-25 June, 2014, Palermo, Italy.
- Säfsten, K., Winroth, M. and Löfving, M. (2014), STRATEGO Produktionsstrategier som stöd för konkurrenskraft i små och medelstora tillverkande företag – en handbok, *JTH Research Report, 2014/002*, ISSN 1404-0018, Jönköping, Sweden.

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Malin Löfving

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INTRODUCTION

The topic of the research is introduced by a background and problem description, followed by the purpose and research questions. The chapter ends with delimitations and a thesis outline.

“Specifically, in spite of the changes to manufacturing practices, we suggest that the process of formulating and implementing strategy has not kept pace with such changes over time. A more detailed focus on the formulation process thus makes an important contribution to the strategy process within volatile competitive conditions.” (Brown *et al.*, 2010, p. 4193)

1.1 BACKGROUND

During the last decades, the business environment in which manufacturing companies compete has undergone tremendous change. Today, manufacturing companies face challenges from changing customer patterns and globalisation. Markets are changing rapidly and customers are expanding their requirements such as short product life cycles and short time-to-market as well as customisation. Globalisation has resulted in an almost limitless flow of information and communication and to be competitive it is no longer sufficient to be the leading manufacturer in a country. To be able to maintain manufacturing industry in Sweden, manufacturing companies must be competitive on a global market and efficiently provide what customers demand. A majority of all manufacturing companies are small or medium-sized; they are the backbone of any national economy and thus key drivers of economic growth. This calls for special attention to the conditions for small and medium-sized enterprises (SMEs). Despite their prevalence, SMEs are more vulnerable to external influences than larger companies, as they lack market power, compete on domestic markets and are often subcontractors to larger companies (Man *et al.*, 2002; Gunasekaran *et al.*, 2011). A major challenge for manufacturing SMEs is to remain competitive in the long term in this highly competitive environment. Therefore, it is essential that SMEs take advantage of their capabilities and meet market requirements (Hudson Smith and Smith, 2007). Previous research on SMEs suggests that SMEs should focus on operational activities and spend little time focusing on more long-term and strategic issues (Beaver and Jennings, 2000; Cagliano and Spina, 2002; Ates, 2008; Wiesner and Millett, 2012). If SMEs merely focus on operational activities, they are unlikely to remain competitive in the long run (Ates, 2008).

To become and remain competitive, companies must understand market demands (Porter, 1985; Slack and Lewis, 2011). In order to satisfy changing market requirements, companies must achieve superior manufacturing. Since Skinner’s (1969) seminal article about the importance of manufacturing in an organisation, most companies agree that manufacturing must support the overall objectives of a company. Skinner (1969) claims that the manufacturing decisions a company makes would have an effect on business strategies and, in the end, on competitiveness. Since Skinner’s (1969) article, it has

become clearer that manufacturing may constitute a major competitive advantage (e.g. Hayes and Wheelwright, 1984; Slack 2005; Hill and Hill, 2009). To gain and maintain a competitive advantage, it is important to make the right decisions in manufacturing that support the overall objectives of the company and meet the market requirements. In order to achieve this, working with manufacturing strategies is necessary. In this thesis, manufacturing strategy is defined according to Slack and Lewis (2011, p. 22): “[manufacturing] *strategy is the total pattern of decisions that shape the long-term capabilities....and their contribution to overall strategy through the reconciliation of market requirements with [manufacturing] strategy*”.

1.2 MANUFACTURING STRATEGIES IN SMES

Manufacturing is often crucial for SMEs and among the vast number of subcontractors even a core competence. Despite this, previous investigations show that it is mostly larger companies that are aware of the role of manufacturing for competitiveness and therefore work with manufacturing strategies (Winroth, 2004). Löfving (2009) studied 20 SMEs in Sweden and found little evidence of companies working with written manufacturing strategies.

Historically, manufacturing strategy research has predominantly focused on large companies (e.g. Skinner, 1969; Hayes and Wheelwright, 1984; Dangayach and Deshmukh, 2001; Acur *et al.*, 2003; Miltenburg, 2005). Previously it was generally assumed that manufacturing practices and performance are equally applicable in SMEs and large companies (Cagliano *et al.*, 2001). Research has shown that SMEs exhibit different characteristics from those of larger companies and they are certainly not just small versions of large businesses (Storey, 1994; Cagliano *et al.*, 2001; Bridge *et al.*, 2009). This implies that a scaled-down version of work with manufacturing strategies in large companies might not be fully applicable in SMEs. Therefore, it is crucial to investigate how SMEs work with their manufacturing strategies.

1.3 CURRENT RESEARCH ON MANUFACTURING STRATEGY FORMULATION

In the area of manufacturing strategy, it is common to distinguish between *content*, i.e. what a strategy consists of, *process*, i.e. how a strategy is formulated and implemented (Voss, 1995), and *context*, i.e. in what setting strategic change occurs (Pettigrew *et al.*, 1989).

During the last two decades, much research has focused on manufacturing strategy content, and manufacturing strategy process has gained limited research interest (Leong *et al.*, 1990; Dangayach and Deshmukh, 2001; Rytter *et al.*, 2007; Brown *et al.*, 2010, Demeter and Boer, 2011). Leong *et al.* (1990, p. 117) summarise the need for more manufacturing strategy process research: “[p]rocess research has been relatively neglected conceptually and almost totally neglected empirically”. A similar situation is still reflected in academia. Brown *et al.* (2010) state that the manufacturing strategy process has not kept pace with the changes in manufacturing practice and that there is still a lack of research on the manufacturing strategy process. Therefore, this thesis will contribute to an increased understanding of the manufacturing strategy process in general and manufacturing strategy formulation in particular. Manufacturing strategy formulation is essential since it provides a framework linking plans, activities and objectives (Papke-Shields *et al.*, 2006; Slack and Lewis, 2011). The manufacturing strategy formulation is the practical process that is concerned with how to reconcile market requirements with manufacturing resources over the long term (Slack and Lewis, 2011).

When manufacturing strategy formulation is described in theory, it is often in terms of manufacturing strategy frameworks (e.g. Skinner, 1969; Platts and Gregory, 1990; Miltenburg, 2005; Hill and Hill, 2009; Slack and Lewis, 2011). The manufacturing strategy formulation in manufacturing strategy frameworks is described as a structured and linear process (e.g. Skinner, 1969; Miltenburg, 2005; Hill and Hill, 2009). Most of the existing frameworks were developed for and with larger companies, and there is little evidence of actual use of manufacturing strategy frameworks in SMEs. However, manufacturing strategy formulation is so much more than just a multi-stage framework, as it is also essential to consider how the strategy formulation should be carried out in terms of organisational and managerial issues (Platts, 1994). The manufacturing strategy formulation in practice is described as complex, iterative and a messy reality (Maruchek *et al.* 1990; Rytter *et al.*, 2007; Slack and Lewis, 2011) and needs to be further investigated.

A vast number of studies on manufacturing strategy formulation have been carried out over the years (Maruchek *et al.* 1990; Platts, 1990; Swamidass *et al.*, 2001; Barnes, 2000; 2002a; 2002b; Acur *et al.*, 2003; Nielsen-Englyst, 2003; Rytter *et al.*, 2007; Kiridena, 2009; Kiridena *et al.*, 2009). A majority of these studies describe manufacturing strategy formulation without considering company size (Maruchek *et al.* 1990; Platts, 1990; Swamidass *et al.*, 2001; Rytter *et al.*, 2007; Kiridena *et al.*, 2009). The conclusions in these studies are thus often generalised to suit all kinds of companies. Some of these studies include SMEs as case companies, however without specifically focusing on the size aspect (Swamidass *et al.*, 2001; Kiridena, 2009). Barnes (2000, 2002a, 2002b) investigates in more detail how and why manufacturing strategy is formulated and implemented in SMEs in the UK. Barnes (2002a, 2002b) presents no evidence of a structured manufacturing strategy process in any of his case companies. Overall though, manufacturing strategy formulation in SMEs “*is a little researched topic and is, in consequence, poorly understood*” (Barnes, 2002b, p. 134).

1.4 KEY FACTORS FOR MANUFACTURING STRATEGY FORMULATION

How a company conducts its manufacturing strategy formulation can be captured by different factors, in this research called key factors. The key factors considered during the formulation can potentially reduce risks involved and facilitate a more successful manufacturing strategy formulation (O'Regan and Ghobadian, 2004). Researchers have adopted a number of factors considered for manufacturing strategy formulation, but no consensus has yet been reached. For example, Papke-Shields *et al.* (2006) identify best practice from planning characteristics and Platts (1994) describes desirable characteristics for manufacturing strategy formulation. Acur and Englyst (2006) propose a list of success criteria for assessment of strategy formulation. They also suggest directions of future research in the development and exploration of success criteria, particularly with a context perspective. The recognition of the need to include context in manufacturing strategy research has increased (see e.g. Barnes, 2002a; Ketokivi and Schroeder, 2004; Sousa and Voss, 2008; Kiridena, 2009). Nevertheless, “[o]ne of the major weaknesses in the field is that, in spite of the increasing variety of organizing operations, [manufacturing] strategy theory is relatively contextual and largely fails to take into account the influence of factors” (Demeter and Boer, 2011). There is a need to further apply a holistic view of key factors for manufacturing strategy formulation, as previous research studies show that the appropriate manufacturing strategy for an organisation can be selected if the manufacturing strategy is formulated in accordance with the context (Acur *et al.*, 2003). Pettigrew *et al.* (1989) divide context into inner and outer context. The inner context

consists of internal factors within an organisation (Donaldson, 2001), while the outer context consists of external factors in the environment, with which a company must interact to survive (Pettigrew *et al.*, 1989). Surprisingly, previous research studies rarely apply a more holistic view that includes both internal and external key factors for manufacturing strategy formulation. Most of the research studies that address key factors focus on internal key factors (see e.g. Anderson *et al.*, 1991; Platts, 1994; Papke-Shields *et al.*, 2006).

1.5 PURPOSE AND RESEARCH QUESTIONS

This research focuses on SMEs since they constitute a major part of all manufacturing companies and it is of vital concern that they remain competitive in their turbulent environment. From the introduction so far it can be concluded that manufacturing strategy formulation in SMEs has gained limited research interest. The work with manufacturing strategies in SMEs in practice is also not well understood. This leads to the purpose of this thesis.

The purpose is to increase the understanding of manufacturing strategy formulation in SMEs

In order to meet the purpose and to provide SMEs with useful advice on how to work with manufacturing strategies, it is essential to identify key factors for manufacturing strategy formulation. This can help SMEs to understand what issues are important to deal with in the manufacturing strategy formulation. The following definition of key factors was chosen: *a key factor is an area, activity or other attribute considered significant for (the outcome of) manufacturing strategy formulation* (inspired by Elfving, 2007, p. 15). This thesis divides key factors into internal and external key factors. So far, the internal and external key factors for manufacturing strategy formulation in SMEs have not been investigated in depth, despite their necessity for the understanding of manufacturing strategy formulation. From this, the following research questions have been formulated:

Research question 1 (RQ1): What are the internal key factors for manufacturing strategy formulation in SMEs?

Research question 1 addresses the need to identify internal key factors considered significant for manufacturing strategy formulation in SMEs. The internal key factors broadly equate to Pettigrew *et al.*'s (1989) inner context. The internal key factors are factors within the manufacturing strategy formulation. To answer Research question 1, internal key factors for manufacturing strategy formulation are investigated both in theory and practice.

Research question 2 (RQ2): What external key factors influence manufacturing strategy formulation in SMEs?

Research question 2 focuses on the need to identify external key factors considered significant for manufacturing strategy formulation in SMEs and the external factors that influence manufacturing strategy formulation in SMEs. The external key factors broadly equate to Pettigrew *et al.*'s (1989) outer context. The external key factors are factors in the environment that may influence manufacturing strategy formulation in SMEs. To answer Research question 2, external key factors are investigated both in theory and practice.

1.6 DELIMITATION

A corporate strategy concerns market sectors of all business units. SMEs often consist of one business unit or one manufacturing site (Ghobadian and Gallear, 1997; Hudson *et al.*, 2001). Therefore, a distinction is not made between corporate strategy and business unit strategy. Hereafter the corporate and business strategy is called strategy.

The studies here were conducted in the context of small and medium-sized enterprises (SMEs) in Sweden and Singapore. There are several reasons for comparing manufacturing strategy formulation in SMEs in Sweden and Singapore. Most importantly, there are few empirical research studies that compare manufacturing strategy formulation in SMEs in different business environments in Europe and Asia. Sweden and Singapore differ in several aspects such as national culture (Hofstede and Hofstede, 2005) and business environment. Sweden has a long history of industrialisation and development, whereas Singapore is a relatively newly industrialised country (Blomström *et al.*, 2002; Zhou *et al.*, 2009). Further, Sweden has based its initial economic development on primary products and manufacturing, while Singapore's economic development has always been directly linked to its role as a trade hub in Southeast Asia (Blomström *et al.*, 2002). There are also similarities between Sweden and Singapore as they are smaller countries in terms of population (*ibid.*). In addition, both countries face the same challenges from globalisation and the volatile competitive environment (Lim *et al.*, 2006; Menkhoff and Wah, 2011; Vinnova, 2014).

1.7 THESIS OUTLINE

This thesis consists of two parts: (1) the summarising chapters and (2) the appended papers. The thesis connects the six papers with the summarising chapters.

Part 1 of the thesis consists of the summarising chapters including six chapters.

Chapter 1 addresses the subject of this research with a brief overview of the challenges and the problems of manufacturing strategy formulation in SMEs. From this, the purpose is derived and thereafter the research questions are formulated and further described.

Chapter 2 includes relevant theories to answer the research questions and concerns small and medium-sized enterprises, strategy, manufacturing strategy, internal key factors for manufacturing strategy formulation and external key factors.

Chapter 3 presents the research methodology used in this research. It describes the overall research process and the research design of the two studies and discusses the quality criteria.

Chapter 4 provides a description of the participating companies and their manufacturing strategy formulation.

Chapter 5 presents the analysis and the results from the literature review and the case studies.

Chapter 6 includes a discussion of the results and the chosen methods. In the chapter, the conclusions and contributions to theory and practice are presented and suggestions for future research are presented.

Part 2 of the thesis includes six papers. Paper 1 summarises the conclusions drawn in the licentiate thesis and describes the background for this thesis. Paper 2 examines manufacturing strategy frameworks and requirement of frameworks in SMEs. Paper 3 focuses on the manufacturing strategy formulation in practice. Papers 4, 5 and 6 elaborate on the relationship between internal and external factors and manufacturing strategy formulation.

THEORETICAL CONSIDERATIONS

An overview of the theoretical considerations of the research is given here. The chapter includes theoretical descriptions and definitions of SMEs, strategy, manufacturing strategy, manufacturing strategy formulation and internal and external key factors. Since some of the theoretical concepts and models are presented in the appended papers (Papers 1, 2, 3, 4, 5 and 6), summaries of these concepts and models are presented with reference to the appended papers.

“It is not an excuse to say that ‘this precise issue has not been studied before’. There is always some relevant literature to refer to.” Voss et al. (2002, p.216)

2.1 SMALL AND MEDIUM-SIZED ENTERPRISES

2.1.1 Definition of SMEs

There is no single uniform definition of what constitutes a small or medium-sized enterprise (McCartan-Quinn and Carson, 2003; Carter and Jones-Evans, 2006), and the definition differs from country to country (Yusof and Aspinwall, 2000; Carter and Jones-Evans, 2006). SMEs in Europe are categorised according to the European Commission’s (2014) definition (Table 1). In this definition, autonomy is included. To be considered autonomous, another company must not own more than 25 % of the company or the company must not own more than 25 % of another company (European Commission, 2014).

Table 1. The European Commission’s definition of small and medium-sized enterprises (European Commission, 2014)

Enterprise category	Headcount	Turnover	Balance sheet
Medium-sized	<250	<€50 m	<€43 m
Small	<50	<€10 m	<€10 m
Micro	<10	<€2 m	<€2 m

On the other hand, SMEs in Singapore are defined according to SPRING Singapore’s (2013) definition, which includes two parameters:

- Annual sales turnover of no more than S\$ 100 million¹
- Employment size of no more than 200 workers

¹ S\$ 100 m = €58 m (OANDA, 2014).

This research does however not follow any of these two definitions strictly, as a small unit within a larger organisation may very well be managed as a company within the company, thus facing the same problems as an independent company (Yusof and Aspinwall, 2000; Säfsten and Winroth, 2011). The ownership type is presented in Paper 1. In this thesis, small companies consist of between 11 and 49 employees and medium-sized companies employ between 51 and 249 people (see Headcount in Table 1).

2.1.2 SME characteristics

It is easy to compare SMEs with large companies, although many researchers state that small businesses are not smaller copies of large businesses (Welsh and White, 1981; Bridge *et al.*, 2009). Undoubtedly, SMEs differ from large companies on the number of employees. However, there are more differences between SMEs and large companies than just the number of employees. Previous research studies on SMEs in different contexts reveal that SMEs exhibit characteristics that distinguish them from larger companies (e.g. Storey, 1994; Ghobadian and Gallear, 1997; Hudson *et al.*, 2001; Mc Cartan-Quinn and Carson, 2003; Grando and Belvedere, 2006; Hudson Smith and Smith, 2007; Bridge *et al.*, 2009; Ates *et al.*, 2013). The characteristics of SMEs are presented in Papers 1 and 2 and synthesised in this frame into four main characteristics, management practices, organisational environment, limited resources and operational focus. These four characteristics are described further below.

Management practices

A primary characteristic that distinguishes SMEs from larger companies is the personalised management, i.e. the ability, experience, knowledge and intuition of the manager (Ghobadian and Gallear, 1997; Beaver and Jennings, 2000; Daily *et al.*, 2002; Barnes, 2002a; Cagliano and Spina, 2002; Hudson Smith and Smith, 2007; O'Regan and Lehmann, 2008; Ates, 2008; Ates *et al.*, 2013). The success of SMEs often depends on the personalised management rather than the practices that are used to manage the company (Storey, 1994; Cagliano and Spina, 2002). According to Beaver and Jennings (2000, p. 399), “[i]n the smaller firm, management efforts are concerned not on predicting and controlling the operating environment, but on adapting as quickly as possible to the changing demands of that environment and devising suitable tactics for mitigating the consequences of any threatening changes that occur.”

A way to describe management practice is through the leadership style of the managing director. Leadership style refers to the practices adopted by a leader and how the leader interacts with his or her employees (Burton and Obel, 1998). Leadership style influences the way and time required to make decisions, decide on level of delegation and control activities (Garengo and Bitici, 2007). Leadership style is one of the key aspects to understand organisational culture (Pheysey, 1993; Cameron and Quinn, 2011). An organisation's culture derives from its leadership, while culture influences development of its leadership (Bass and Avolio, 1993). Pheysey (1993) developed a model including both leadership style and organisational culture, shown in Figure 1. The model relates different leadership styles to types of organisational culture. The organisational cultures and leadership styles are described more in depth in Paper 5 and are briefly presented here. In the support culture, commitment and teamwork are dominant attributes (Pheysey, 1993). The predominant leadership styles in the support culture are the team builder style (Cameron and Quinn, 2011), the participative style and the democratic style (Pheysey, 1993). The leader in the support culture is employee-oriented, caring and democratic (Figure 1) (Bitici *et al.*, 2006). Role culture (Figure 1) is pyramid-shaped with a

hierarchical structure and focuses on logic and formal rules (Pheysey, 1993). The predominant leadership style is that of the empirical expert, who keeps track of all details, contributes to expertise (Figure 1) (Bitici *et al.*, 2006) and sells in ideas (Pheysey, 1993). Another leadership style that can be found is laissez-faire (Pheysey, 1993), where the leader is invisible and not involved in decision-making. The power culture is externally oriented and control is the keyword (Pheysey, 1993). The predominant leadership styles are the authoritative and autocratic styles (Figure 1), where leaders have the power and tell subordinates what to do (Pheysey, 1993). Achievement culture is both task- and people-oriented (Pheysey, 1993). Predominant leadership styles in the achievement culture are consultative and rational achiever styles (Figure 1) (Pheysey, 1993).

Support culture (employee-oriented)	Role culture (logic-oriented)	Power culture (output-oriented)	Achievement culture (mixed task- and people-oriented)
<i>Predominant leadership styles:</i>	<i>Predominant leadership styles:</i>	<i>Predominant leadership styles:</i>	<i>Predominant leadership styles:</i>
Participative	Laissez-faire	Authoritative	Consultative
Democratic	Empirical expert	Autocratic	Rational achiever
Existential team builder	Sell	Tell	
Delegate			

Figure 1. Organisational culture aligned with predominant leadership styles. Based on Pheysey (1993, p. 154).

It is proposed in theory that SMEs have informal and centralised decision making and that decision making rests primarily with one person, usually either the owner-manager or a managing director (Daily *et al.*, 2002; Hudson Smith and Smith, 2007), due to the flat organisation with few management layers (Ghobadian and Gallear, 1997; Yu, 2001; Daily *et al.*, 2002; Ates, 2008). The top management usually consists of a limited number of managers, or sometimes even one manager, working alongside the employees, and therefore consequently has the opportunity to build close relationships with employees (Ghobadian and Gallear, 1997). The main outcome of this, according to Grando and Belvedere (2006), is a non-structured and non-formal decision-making process. However, staff participation in decision making is rare and it is often the top management that makes most of the decisions (Bridge *et al.*, 2009).

Organisational environment

Other factors that distinguish SMEs from larger companies are the organisational environment that relates to the flat organisation with few hierarchical levels and the organisational environment in which they operate, which is largely defined through the underlying organisational culture (Hudson Smith and Smith, 2007). Organisational culture can be defined as the basic assumptions and beliefs that the members of an organisation share, which influences how those members perceive, think and act (Schein, 1985). According to Pheysey (1993), there are four organisational cultures, support culture, power culture, role culture and achievement culture. They are further described in Paper 5 and shown in Figure 1.

Previous research studies about organisational culture in SMEs do not agree on which is the most common organisational culture in SMEs. For example, Handy (1985) assumes that most SMEs have a power culture, while Hudson Smith and Smith (2007) argue that

SMEs tend to have a culture similar to support culture. Bitici *et al.* (2006) and Garengo and Bitici (2007) investigated SMEs by using Pheysey's (1993) organisational cultures, but found no evidence of consistency in the companies' organisational cultures. Three of their case companies had a power culture prior to implementing performance measurement systems, and after the implementation these three companies shifted more towards an achievement culture. Their fourth case company had a support culture.

Limited resources

Another distinguishing characteristic of SMEs is limited resources in terms of time, humans and financials (Hudson Smith and Smith, 2007; Bridge *et al.*, 2009; Ates *et al.*, 2013). Hudson *et al.* (2001) and Garengo *et al.* (2005) noted that all staff are involved in the daily activities and have no extra time for additional activities. According to Robinson and Pearce (1984), SMEs lack time as the managers do not allocate time for strategic issues since the focus is on solving day-to-day operational problems.

Operational focus

SMEs are proposed to have an operational focus (Beaver and Jennings, 2000; Cagliano and Spina, 2002; Ates, 2008; Wiesner and Millett, 2012; Ates *et al.*, 2013). Ates (2008, p. 29) states, “[t]he focus on technical aspects and operational issues seems to emerge from a conviction that the only real determining factor for competitive success is the technical excellence of the product and production processes”. This also influences the communication of strategies as studies have seen an absence of communication of strategies in SMEs (Tallon *et al.*, 2000; Ates *et al.*, 2013). The operational focus also tends to lead to a shorter time horizon as considerable time is spent on fire-fighting activities, and strategic long-term issues easily slip down on tomorrow's ‘to do’ list (Jennings and Beaver, 1997; Ates *et al.*, 2013).

2.2 STRATEGY

The word “strategy”² is used in a variety of settings with a range of definitions (Hayes and Wheelwright, 1984; Mintzberg *et al.*, 2003; Johnson *et al.*, 2012). In this thesis strategy is defined as “...the direction and scope of an organization over the long term, which achieves advantage in a challenging environment through its configuration of resources and competences with the aim of fulfilling stakeholder expectations” (Johnson *et al.*, 2008, p. 3).

2.2.1 Strategic planning process and emergent process

The traditional corporate strategy approach, so-called strategic planning, is influenced by the military field. Military strategy is managed top-down, i.e. planned by generals and implemented by subordinates as planned (Chandler, 1962; Porter, 1985). Key aspects of strategic planning are a long time horizon, formalisation, strategies in written form, use of strategic tools, and formal and planned meetings where strategic decisions are made in a logical and rational manner by the top management (Table 2) (Stonehouse and Pemberton, 2002; Harris *et al.*, 2000; de Wit and Meyer, 2005; Kraus *et al.*, 2006). Strategies are developed from forecasts on what should happen (Table 2). Researchers, advocating strategic planning, argue that strategies should be intended (planned) and realised as

² Derived from the military theory about utilisation of resources, long-term planning and development to ensure victory and security (Mintzberg *et al.*, 2003).

planned, i.e. deliberate (Mintzberg and Waters, 1985; de Wit and Meyer, 2005), see Figure 2.

Mintzberg (1978) and Mintzberg and Waters (1985) challenge traditional strategic planning and state that a strategy can be formed over time by a sequence of decisions called emergent process (Figure 2). Strategies do not always develop in a logical sequence of rationality and analysis (Johnson *et al.*, 2012) and can emerge from incremental, ad hoc or even accidental actions (Mintzberg and Waters, 1985; Johnson *et al.*, 2012). These emergent strategies can also be realised as shown in Figure 2. Key aspects in an emergent process is an absence of written strategies, an absence of strategic tools and planned meetings; decisions evolve as good ideas and opportunities derive from practical experience at the bottom of the organisation (Harris *et al.*, 2000; de Wit and Meyer, 2005; Kraus *et al.*, 2006; Johnson *et al.*, 2012). Strategies are developed from what really happens both in the organisation and in the environment (Table 2). Researchers advocating the emergent process argue that formulation and implementation cannot always be separated. Pettigrew (1997) states that the consequences of the implementation of today’s strategies affect tomorrow’s strategies. According to Johnson *et al.* (2012, p.14), “[i]t is not just a matter of putting strategic choices into action in a logical sequence leading from strategy formulation to strategy implementation. [...] Implementation can lead to formulation as well.”

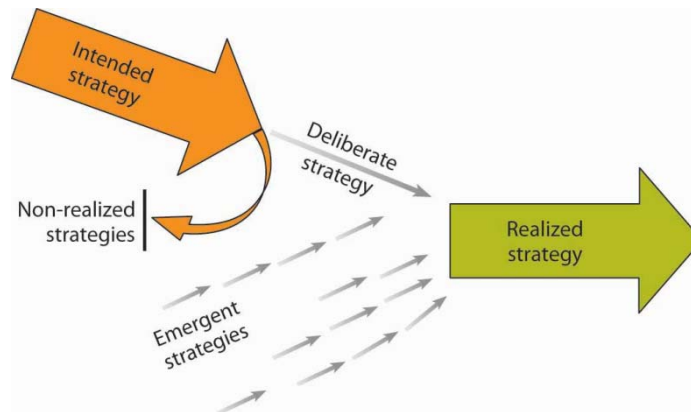


Figure 2. Deliberate and emergent strategies (Mintzberg and Waters, 1985).

Table 2. Strategic planning process versus emergent process (based on Harris *et al.*, 2000; de Wit and Meyer, 2005; Kraus *et al.*, 2006)

	Strategic planning process	Emergent process
View of future	Long-term orientation, forecast and anticipate Strategies in written form	Partially unknown and unpredictable Unwritten strategies
Emphasis on Decision making Process	Deliberateness Hierarchical Scheduled, formal planning meetings and events	Emergence Dispersed Ad hoc, unplanned and unstructured occurrences
Strategic focus	What should happen	What does happen
Process of analysis	Decisions and actions are clearly preceded by analysis in a staged manner	Evolves as a result of continual interplay between thinking, analysis and decision
Use of strategic tools	Yes	No

2.2.2 Strategy formulation in SMEs

Research about the strategy process in SMEs often describes formulation and implementation as intertwined, and therefore the actual formulation is quite difficult to distinguish in most of the research studies about the strategy process in SMEs (e.g. Harris *et al.*, 2000; Ates, 2008; Blackburn *et al.*, 2013). Previous research studies on the strategy process in SMEs have focused on different aspects in the strategy process such as degree of formalisation, planned or emergent strategy process, use of strategic tools and existence of written strategies, consistent with Table 2. The results of these studies are often contrasting, for example whether written strategies or non-written strategies are most common in SMEs (Wiesner and Millet, 2012). It is argued that strategies in SMEs “*emerge through incremental learning processes and tactical decisions, which are aimed at acquiring critical resources and building distinctive capabilities that are valued by customers, rather than being crafted through formal long-term planning processes*” (Cagliano *et al.*, 2001, p. 470). It is also assumed that SMEs have a less formalised³ strategic planning process (Robinson and Pearce, 1984; Berry, 1998; Harris *et al.*, 2000; Cagliano and Spina, 2002; O’Regan *et al.*, 2006; Verreynne, 2005; Ates, 2008). On the contrary, some studies show that SMEs have a more formalised strategic planning process (Gibson and Cassar, 2002; Gibbons and O’Connor, 2005). Many of these research studies, however, conclude that the strategy process in SMEs consists of both planned and emergent processes (e.g. Stonehouse and Pemberton, 2002; Harris *et al.*, 2000; Bellamy, 2009).

Previous research studies about the strategy process in SMEs highlight the poor use of strategy frameworks and tools in SMEs (Stonehouse and Pemberton, 2002; Woods and Joyce, 2003; Ates, 2008). These research studies often conclude that it is the lack of knowledge about strategy frameworks and tools that prevents managers in SMEs from using them. Robinson and Pearce (1984) state that one of the problems for managers in SMEs to start the strategy formulation was the managers’ lack of experience and knowledge of strategy formulation. However, none of the previous studies about the strategy process in SMEs (Stonehouse and Pemberton, 2002; Woods and Joyce, 2003; Ates, 2008) has actually investigated what strategy frameworks and tools are suitable for SMEs. Woods and Joyce (2003, p.184) “*looked at several books on strategy ... and picked out a range of strategic tools mentioned. We did not attempt to use every single tool we came across or make an assessment of how useful the tools were. We did this because we wanted to test the extent to which the specialized vocabulary had been transmitted to managers in small businesses*”.

2.2.3 Manufacturing strategy

Strategies in an organisation are divided into three levels: corporate strategy, business unit strategy and functional strategy (Hayes and Wheelwright, 1984; Hill and Hill, 2009). Corporate strategy is concerned with the market sectors in which the whole company decides to compete (Hill and Hill, 2009). When a (large) company comprises different business units, its strategic direction, i.e. business unit strategy, concerns competition in one specific unit and it sets the competitive factors that should be fulfilled (Hill and Hill,

³ A seminal definition of formalisation is “*the process through which the desired behavioral standards of one actor (or set of actors) for the other(s) become reified in such a way that they are readily remembered and understood over time without the need for the first actor to repeat them, or for the other even to know that the first actor originated them*” (Walsh and Dewar, 1987, p. 219, also quoted in Achtenhagen *et al.*, 2014, p. 3).

2009). A business comprises different functions, such as sales and marketing, research and development and operations (Hill and Hill, 2009). Functional strategies should be linked to and coordinated with the business strategies. If they are not linked together, decisions taken in each function might not correspond to each other or the business strategies. This can lead to misdirection and prevent the company from reaching its objectives (Winroth, 2004; Hill and Hill, 2009). The focus of this thesis is manufacturing strategies, which is one area of the functional level strategies.

As said in Chapter 1, manufacturing strategy is divided into content, process and context. Manufacturing strategy content and process are further described in this section. Thereafter, there is a chapter about manufacturing strategy formulation. Manufacturing strategy context is described in Paper 4 and in the chapter about external key factors.

Manufacturing strategy content

The predominant model for manufacturing strategy content is summarised by Leong *et al.* (1990). Leong *et al.*'s (1990) model identifies two major constituents of manufacturing strategy content, competitive priorities and decision categories. Hill and Hill (2009) acknowledge these two key aspects of manufacturing strategy content in their definition of a manufacturing strategy as “*a series of decisions concerning process and infrastructure investment, which, over time, provide the necessary support for the relevant order-winners and qualifiers of the different market segments of a company*” (Hill and Hill, 2009, p. 61). The competitive priorities are met through different sets of decision categories (Miltenburg, 2005; Slack and Lewis, 2011). The decision categories consist of a few alternative manufacturing choices (Choudhari *et al.*, 2010). A company must make the appropriate choices within the decision categories to support the competitive priorities and competitiveness (Skinner, 1969). Competitive priorities are described in Löfving (2009), and decision categories are described in Paper 1.

Manufacturing strategy process

The manufacturing strategy process is “*a pattern or procedure in which manufacturing strategy is developed and implemented*” (Dangayach and Deshmukh, 2001, p. 887) but can also be viewed as a sequence of decisions in the company's decision-making behaviours (Paiva *et al.*, 2008, 2012). The manufacturing strategy process is commonly divided into formulation and implementation (Leong *et al.*, 1990; Platts, 1994; Mills *et al.*, 1995, Papke-Shields *et al.*, 2006; Paiva *et al.*, 2008, 2012), even though these can be intertwined (Barnes, 2002a; Kiridena, 2009). Manufacturing strategy formulation concerns different ways of aligning competitive priorities with decision categories, while manufacturing strategy implementation concerns the execution of the manufacturing strategies (Slack and Lewis, 2011).

Typically, different approaches exist as top-down versus bottom-up (Leong *et al.*, 1990; Slack and Lewis, 2011) or market-based versus resource-based (Gagnon, 1999; Hill and Hill, 2009). Traditionally, the basic approach to the manufacturing strategy process has been the top-down and market-based approach. The market-based approach implies that manufacturing is regarded as a perfectly adjustable system following the rules dictated by the market (Gagnon, 1999). The predominant model is the hierarchical one starting with strategies and environmental scanning. It is the most common approach in the manufacturing strategy frameworks (presented in Paper 2). In the resource-based approach, “*resources that can lead to competitive advantage are those that are valuable and non-substitutable, from the point of view of customers, and unique and inimitable, from the point of view of competitors*” (St. John *et al.*, 2001, p. 148). The resource-based

approach is related to the bottom-up approach. The resource-based view *leads* the strategy of the firm (St. John *et al.*, 2001). From this approach, the company adjusts its strategy in order to support, protect and leverage the unique resources of manufacturing instead of letting the market dictate the rules (Gagnon, 1999; St. John *et al.*, 2001). In addition, it has been stated that the market-based and resource-based approaches can be combined (Gagnon, 1999; Hill and Hill, 2009; Slack and Lewis, 2011). Thus, according to Hill and Hill (2009, p. 30), “*being aware of the need to protectively seek ways to drive markets and exploit resource-based opportunities is an essential element of the strategic task in times when markets are increasingly different and competitive*”.

2.3 MANUFACTURING STRATEGY FORMULATION IN SMES

Manufacturing strategy formulation can be defined as “*the practical process of articulating the various objectives and decisions that make up the strategy*” (Slack and Lewis, 2011, p. 281). Manufacturing strategy formulation can also be considered as a continuous and intentional process of decision events (Pettigrew, 1997) or as a process comprising both structured and unstructured strategy formulation (Adam and Swamidass, 1992).

Previous empirical studies on manufacturing strategy formulation focusing on SMEs were briefly described in the introduction (Chapter 1.3). These empirical studies (Swamidass *et al.*, 2001; Barnes, 2000, 2002a, 2002b; Kiridena, 2009) do not include any definition of SMEs, but they give the number of employees. Swamidass *et al.*'s (2001) smallest company was a subsidiary with 170 employees, i.e. medium-sized in this thesis. Barnes's (2000, 2002a, 2002b) case companies had between 50 and 250 employees, also characterised as medium-sized in this thesis. Four of Kiridena's (2009) case companies had between 13 and 180 employees (*Ventico A, Tronsico, Ventico B, Technico*) and are described as small and medium-sized in this research.

Barnes (2000, 2002a, 2002b) analyses manufacturing strategy formulation and implementation in SMEs in the UK. In Barnes (2000), the focus is on investigating implementation events in SMEs. The later empirical studies by Barnes (2002a, 2002b) address both formulation and implementation. The link between strategies and manufacturing objectives is emphasised in the studies by Barnes (2002a, 2002b). He states that the case companies had a rational process for identification of manufacturing objectives and that the manufacturing manager played a major role in translating the manufacturing objectives into decisions and actions. The findings from his case studies indicate that none of the companies investigated had a formal manufacturing strategy process and three of the companies described had a formal strategy formulation.

Swamidass *et al.* (2001) illustrate examples of manufacturing strategy formulation in different companies in the UK and one of their companies was an SME. Kiridena (2009) studies deeper structures of manufacturing strategy formulation and implementation in companies in Australia. Kiridena (2009) describes the actual manufacturing strategy process in the case companies before identifying deeper structures such as initiation and realisation. This study was inspired by Barnes's (2002a) study mentioned above.

2.4 INTERNAL KEY FACTORS FOR MANUFACTURING STRATEGY FORMULATION

Manufacturing strategy formulation is often described by means of manufacturing strategy frameworks. The concept of manufacturing strategy framework is used to signify any kind of structure or procedure that supports strategy formulation. A manufacturing strategy framework answers the question ‘how to’ and provides an overall way forward (Yusof and Aspinwall, 2000), while a manufacturing strategy tool is the actual implementation of a framework in, for example, Excel (Säfsten *et al.*, 2014a). The existing manufacturing strategy frameworks are examined in Paper 2.

Less research addresses internal key factors for manufacturing strategy formulation. In 1989, Adam and Swamidass noted that there was no consensus in the literature in the use of terminology of internal key factors for manufacturing strategy formulation. This is still valid, see Table 3.

Table 3. Terms in previous research about manufacturing strategy formulation

Terms	Previous research
Process variable	Adam and Swamidass, 1989
Issues	Marucheck <i>et al.</i> , 1990
Critical success factors (describing Marucheck <i>et al.</i> 's (1990) issues).	Kim and Arnold, 1996
Desirable characteristics	Platts, 1994
Assertions or guiding principles	Platts, 1994
Process attributes	Anderson <i>et al.</i> , 1991
Items/strategic initiatives	Lee, 2002
Planning characteristics	Papke-Shields <i>et al.</i> , 2002, 2006
Phases	Kiridena, 2009
Characteristics	Lindström, 2008
Criteria	Lindström, 2008

The terms listed in Table 3 are derived from research studies about manufacturing strategy formulation. Some of the research studies presented in Table 3 approach the terms on different levels (e.g. Platts, 1994; Lindström, 2008). Lindström's (2008) criteria are subordinated characteristics and Platts's (1994) desirable characteristics are synthesised in assertions or ‘guiding principles’.

The terms listed in Table 3 can be sorted into three groups in an attempt to both choose and motivate the choice of the term used in this thesis.

- Terms (characteristics, criteria, critical success factors and guiding principles) that can be seen in the light of providing more successful manufacturing strategy formulation. Lindström (2008) investigates what criteria comprise a good manufacturing strategy and Platts (1994, p. 94) identifies “*characteristics of manufacturing strategy formulation processes which were felt by practitioners to lead to the successful creation of strategies*”. Papke-Shields *et al.* (2002, 2006) aim at providing more insights into managerial interventions that can achieve desirable planning outcomes.
- Terms that are used to compare and analyse either previous literature or empirical data (process variable, issues, process attributes, items).
- Terms (phases) that a manufacturing strategy formulation consists of.

The terminology applied in this thesis, internal key factors for manufacturing strategy formulation, was chosen because it is neutral from the other terms in Table 3 and can be

applied to all three groups. Internal key factors are determined according to the definition of key factors in Chapter 1.5.

Research studies that include internal key factors for manufacturing strategy formulation are further described below.

Adam and Swamidass (1989) investigate a number of manufacturing strategy formulation 'process variables' in existing manufacturing strategy process literature. They find no consistency in either frequency of variables or terminology in literature. Due to this, they group together identified terms into single variables as follows:

- Infrastructure (e.g. decision categories)
- Manufacturing task (e.g. manufacturing objective)
- Order-winning criteria (e.g. competitive priorities)
- Role of manufacturing managers
- Definition of manufacturing strategy
- Consistency between
 - manufacturing and business strategies
 - manufacturing and other functional strategies
 - manufacturing task and infrastructure

Adam and Swamidass (1989) use the process variables to identify future research areas in manufacturing strategy. They propose a list of issues that research about manufacturing strategy process should focus on, such as leadership and organisation.

Marucheck *et al.* (1990) study how manufacturing strategy is formulated and implemented in six larger companies. To understand the manufacturing strategy process, Marucheck *et al.* (1990) use a predefined set of common issues concerning manufacturing strategy formulation, which the executives in the case companies were asked to describe. The set of common issues concerning formulation is described as follows (Marucheck *et al.*, 1990, p. 113):

- Company's definition of manufacturing strategy
- Objectives of manufacturing strategy
- Responsibility for formulation
- Relation to corporate strategy
- Relation to marketing
- Elements (major categories) of strategy
- Area of analysis

Thereafter the manufacturing strategy process in Marucheck's *et al.*'s (1990) case companies is modelled and described through these issues.

Platts (1990, 1994) investigates manufacturing strategy formulation in eight manufacturing companies in two studies (hereafter called Platts's case companies). The desirable characteristics for successful manufacturing strategy formulation are divided into four aspects: point of entry, participation, project management and procedure, and the aspects include Platts's characteristics shown in Table 4. The characteristics are summarised by a set of assertions or 'guiding principles'.

Table 4. Desirable characteristics of methodologies for manufacturing strategy formulation (Platts, 1994, p. 96)

Point of entry	Participation	Project management	Procedure
Clearly defined expectations	Individual and group participation	Adequate resourcing	Well-defined
Understanding and agreement of managing group	Achieve: Enthusiasm Understanding Commitment	Identify different working groups	Stages: Gathering information Analysing information Identifying improvements Simple tools and techniques
Commitment	Workshop-style meetings Decision-making forum	Agreed timescale	Written record

Anderson *et al.* (1991) examine the manufacturing strategy process in practice using a questionnaire addressed to 53 manufacturing executives in the USA. The questionnaire consists of questions regarding manufacturing strategy process attributes. Anderson *et al.* (1991) describe the manufacturing strategy process as consisting of analysis, organisation and implementation. They argue that the manufacturing strategy is part of the business strategy and influenced by external and internal inputs. Considering this, their attributes are identified from existing strategy process literature as follows:

- Managerial leadership
- Organisational involvement
- Resource allocation and reward systems
- Formalisation and communication
- Strategy-planning anchors (links to foundational bases like budgets)
- Decision aids (frameworks that aid the development of strategies)

Lee (2002) developed a survey questionnaire for Korean and Japanese companies regarding business strategies and manufacturing strategies. One part of the survey includes questions about the manufacturing strategy process focusing on how manufacturing strategy is formulated. Lee (2002) defines the following items regarding different manufacturing strategic initiatives:

- Accidental or ad hoc reasons
- Manufacturing strategy department's initiative
- A formal planning process
- Competitors' pre-emptive decisions
- Top management decisions
- Long-term marketing decisions
- Company-wide business strategies

Papke-Shields *et al.* (2002, 2006) examine planning characteristics for best practice for manufacturing strategy formulation based on strategy and manufacturing strategy theory. Papke-Shields *et al.* (2006) emphasise that all companies should strive for ‘best practice’. ‘Best practice’ is proposed to include a ‘rational adaptive’ planning approach, by which a company strives to include all the planning characteristics in the formulation that are suggested by Papke-Shields *et al.* (2002, 2006) in Table 5. The two planning approaches reflect the planning process and the emergent process. The planning process achieves rationality through a formal and structured planning process that flows from the top management and is comprehensive (Papke-Shields *et al.*, 2006). The emergent process facilitates the adoption of a strategic plan through interaction among a wide range of participants.

Table 5. Planning characteristics for best practice in manufacturing strategy formulation (Papke-Shields *et al.*, 2002, 2006, p. 423)

Planning characteristics	Definition
Rational characteristics	
Flow	Locus of authority for strategic planning
Formality	Extent to which the planning process is structured, through written procedures, schedules and other documents, and the extent of documentation resulting from the planning process
Comprehensiveness	Extent to which all possible strategic alternatives are identified and considered
Focus	Extent to which control, usually seen as a tight link with budgets, rather than creativity is emphasised
Horizon	Length of time considered in strategic planning
Adaptive characteristics	
Intensity	Magnitude of resources committed to planning as evidenced by frequency and richness of meetings
Participation	Variety of individuals involved in strategic planning

Lindström (2008) identifies characteristics with underlying criteria for manufacturing strategy formulation from literature. Lindström (2008) bases her literature review on Platts’s (1994) characteristics, listed in Table 3 above, and includes other researchers like Hayes and Wheelwright (1984) and Baines *et al.* (2005). Lindström’s (2008) characteristics and criteria are listed in Table 6.

Table 6. Characteristics and criteria for manufacturing strategy formulation (Lindström, 2008, p. 90)

Characteristics	Criteria
Procedure	Gathering and analysing information, visibility, identification of opportunities for improvements, documentation
Participation	Individual and group participation, workshop-style meetings, decision-making forum
Point of entry	Clearly defined expectations, full agreement of management, demonstration of the necessity to proceed with the full process
Project management	Adequate resourcing, an agreed timescale
Tools and techniques	Simple and easily understood tools and techniques, visualization
Efficiency, time duration	2-3 days, iteration
Effectiveness, focus	Necessary steps that are value-creating, reflection
Information consistency	Logical input to output, use of same measures and criteria

Kiridena (2009) studies deeper structures in manufacturing strategy formation (formulation and implementation) processes in nine companies in Australia. To identify and define the deeper structures, Kiridena (2009) describes the case companies' manufacturing strategy formation process in practice. From this, he identifies four broad phases with strategic initiatives as a basis. *“The ways in which the strategic initiatives emerged, progressed, and were realized, and the types and roles of actors involved, can be described in terms of multiple progression across four broad phases: initiation, consolidation, commitment, and realization”* (Kiridena et al., 2009, p. 398). Kiridena (2009) identifies three modes of initiation: forced, opportunistic and evolutionary, see Table 7. The forced initiatives are often initiated by top management and are forced by reactions to external factors like competitor moves, compliance with regulatory requirements or as directives from the parent company (*ibid.*). In contrast, evolutionary initiatives are based on growth-based or improvement needs or operational problems (Table 7). These initiatives are set in motion by personal aspirations at lower levels of management or entrepreneurial behaviour. In addition, opportunistic initiatives are launched by senior management and are driven by new technology developments, changes in market or customer requirements, or entrepreneurial insights.

Table 7. Initiation modes based on Kiridena (2009, pp. 182-183)

Initiation modes		
Forced:	Evolutionary:	Opportunistic:
<i>Parent company directives</i>	<i>Growth-based</i>	<i>Event-triggered</i>
<i>Top managers' initiatives</i>	<i>Improvement needs</i>	<i>Technology-driven</i>
<i>Reactions to competition</i>	<i>Operational problems</i>	<i>Market- or customer-driven</i>
<i>Regulatory requirements</i>	<i>Entrepreneurial behaviour</i>	<i>Entrepreneurially driven</i>
	<i>Personal aspirations</i>	

Consolidation (progression of initiatives) and commitment are described as parts of initiation, while realisation is about implementation and execution of the strategic

initiatives. Due to this, Kiridena's (2009) realisation is not further investigated in this thesis. The four phases were also divided into different modes. The strategic paths of all of Kiridena's (2009) case companies were investigated considering the phases and the modes, and all case companies ended up with different alternative paths.

The internal key factors from the research studies described above are summarised in Table 8. All the internal key factors identified are approached on the same level in Table 8.

Table 8. Internal key factors identified in previous studies

Internal key factors	Reference
Defining manufacturing strategy	Adam and Swamidass, 1989; Marucheck <i>et al.</i> , 1990
Manufacturing task (e.g. manufacturing objective)	Adam and Swamidass, 1989; Marucheck <i>et al.</i> , 1990
Infrastructure (e.g. decision categories)	Adam and Swamidass, 1989; Marucheck <i>et al.</i> , 1990
Order-winning criteria (e.g. competitive priorities)	Adam and Swamidass, 1989
Role of manufacturing managers	Adam and Swamidass, 1989
Consistency between manufacturing and business strategies	Adam and Swamidass, 1989; Marucheck <i>et al.</i> , 1990
Consistency between manufacturing and other functional strategies	Adam and Swamidass, 1989; Marucheck <i>et al.</i> , 1990
Consistency between manufacturing task and infrastructure	Adam and Swamidass, 1989
Responsibility for formulation	Marucheck <i>et al.</i> , 1990; Anderson <i>et al.</i> , 1991; Papke-Shields <i>et al.</i> , 2006
Area of analysis	Marucheck <i>et al.</i> , 1990
Point of entry/initiation	Platts, 1994; Lindström, 2008; Kiridena, 2009
Clearly defined expectations	Platts, 1994; Lindström, 2008
Understanding and agreement of managing group	Platts, 1994; Lindström, 2008
Commitment	Platts, 1994; Kiridena, 2009
Participation/organisational involvement	Platts, 1994; Anderson <i>et al.</i> , 1991; Papke-Shields <i>et al.</i> , 2006; Lindström, 2008
Individual and group participation	Platts, 1994; Lindström, 2008
Workshop-style meetings	Platts, 1994; Lindström, 2008
Decision-making forum	Platts, 1994; Lindström, 2008
Project management	Platts, 1994; Lindström, 2008
Adequate resource allocation	Platts, 1994; Anderson <i>et al.</i> , 1991; Papke-Shields <i>et al.</i> , 2006; Lindström, 2008
Identification of working groups	Platts, 1994
Agreed timescale	Platts, 1994; Lindström, 2008
Procedure	Platts, 1994; Lindström, 2008
Well-defined stages	Platts, 1994; Lindström, 2008
Stages of gathering and analysing information and identifying information	Platts, 1994; Lindström, 2008
Simple tools and techniques	Platts, 1994; Lindström, 2008
Written record	Platts, 1994; Papke-Shields <i>et al.</i> , 2006
Formalisation	Anderson <i>et al.</i> , 1991; Papke-Shields <i>et al.</i> , 2006
Communication	Anderson <i>et al.</i> , 1991
Strategic planning anchors/focus	Anderson <i>et al.</i> , 1991; Papke-Shields <i>et al.</i> , 2006
Decision aids	Anderson <i>et al.</i> , 1991
Strategic initiatives	Lee, 2002; Kiridena, 2009
Comprehensiveness	Papke-Shields <i>et al.</i> , 2006
Horizon	Papke-Shields <i>et al.</i> , 2006
Meetings	Papke-Shields <i>et al.</i> , 2006
Time duration	Lindström, 2008
Information consistency	Lindström, 2008

2.5 EXTERNAL KEY FACTORS

External factors are defined as the factors in the environment with which a company must interact to survive (Pettigrew *et al.*, 1989). External key factors are the external factors that are considered significant for the manufacturing strategy formulation in SMEs and are specified according to the definition of key factors in Chapter 1.5. External key factors are presented in Papers 4 and 6. In this chapter, competitive environment and national culture are described more in detail.

2.5.1 Competitive environment

A company must interact with the environment to survive (Pettigrew *et al.*, 1989). One of the most prominent theories about how an organisation is related to its competitive environment derives from Porter (1985) and his competitive forces: new entrants, substitute products, suppliers and buyers. In this thesis new entrants, substitute products and buyers (markets) are included in the competitive environment. Suppliers are described further in Paper 4.

Previous research studies on SMEs (Papadakis *et al.*, 1998; Beaver and Jennings, 2000; Ghobadian and O'Regan, 2000; Raymond, 2005; Verreynne, 2005; Hudson Smith and Smith, 2007; Ates, 2008) emphasise the importance of the competitive environment for SMEs. SMEs are often closer to the customer, enabling a more personal relationship (McAdam, 2000). However, this is tempered by their limited customer base (Ghobadian and Gallear, 1997; Hudson Smith and Smith, 2007). Considering this, SMEs are more vulnerable to external influences than larger companies due to lack of market power, a changing business environment and emerging global markets (Man *et al.*, 2002). To be able to sustain competitiveness in dynamic and unstable markets, a company must be aware of increasing uncertainties in their environment (Raymond, 2005). Thus, Ates (2008) found that SMEs seem to attach significant importance to analysing the external environments in the strategy formulation.

SMEs are considered to be flexible and adaptable to market changes (Ghobadian and Gallear, 1997; Yu, 2001; Ates, 2008). However, SMEs often have only a limited overview of the markets in which they operate, leading to a lack of control over their competitive position (Hudson Smith and Smith, 2007). But, according to Hudson Smith and Smith (2007, p. 394), “[t]hey are unable to drive the market, but instead, must react and adapt to market changes over which they have no influence”. This was also assumed by Ates (2008) as she found evidence of more market-based approaches in SMEs. Hudson Smith and Smith (2007) suggest that there is some correlation of SMEs with the market culture (see Figure 1) due to this approach.

Manufacturing strategy is the force that mediates between operation and its competitive environment, and therefore the competitive environment is supposed to influence manufacturing strategy (Swamidass and Newell, 1987; Anderson *et al.*, 1991; Raymond, 2005; Slack and Lewis, 2011). To be able to sustain competitiveness in dynamic and unstable markets, a company must be aware of increasing uncertainties in its environment (Raymond, 2005). Kiridena (2009) defines two dimensions of environmental factors that mainly describe these uncertainties in the environment:

- market condition (stable or volatile)
- competitive rivalry (high, moderate, low)

Kiridena (2009) investigates the market condition and competitive rivalry in all his case companies, but there does not seem to be any pattern considering size and competitive environment. Nor did he investigate the influence of the competitive environment on

manufacturing strategy formulation. However, Kiridena (2009) states that company *Technico* reviewed or developed new manufacturing plans as responses to changes in markets or company growth.

2.5.2 National cultural dimensions

National culture is assumed to play an important role in strategy and manufacturing strategy formulation, as it derives from assumptions regarding relationships with the environment as well as relationships among people (Schein 1985; Pettigrew *et al.*, 1989). Pettigrew *et al.* (1989) proposed that the ‘dominant frames of thoughts’ (values and assumptions of powerful groups in the company) affected the strategy process. Dominant frames of thoughts correspond to culture since culture can be defined as the basic assumptions and beliefs that are shared by members of an organisation, influence how people perceive, think and act and distinguish the members of a group or category of people from those of another (Hofstede, 1984; Schein, 1985). This definition applies to both national and organisational level (Hofstede and Bond, 1988).

A few different models describe and classify differences in national culture (e.g. Hofstede, 1984; Trompenaars and Hampden-Turner, 1998; House *et al.*, 2002; Hofstede and Hofstede, 2005). Thus the models show some resemblance among suggested dimensions. In this thesis Hofstede’s (1984) classification of national cultural dimensions is used. Hofstede’s (1984) widely used classification of national cultures is based on a survey among IBM employees in 72 countries, which generated four dimensions based on the characteristics of culture (Hofstede, 1984; Hofstede and Hofstede, 2005): power distance index (PDI), individualism (IDV), masculinity versus femininity (MAS) and uncertainty avoidance index (UAI). Later on a fifth dimension was added, long-term orientation (LTO), identified through studies based on Chinese values (Hofstede and Bond, 1988; Hofstede and Hofstede, 2005; Hofstede, 2013). The country scores on the dimensions are relative – societies are compared with other societies. The dimensions are defined in Table 9 and included in Paper 6.

Table 9. Hofstede's national cultural dimensions (Hofstede 1984, 2013; Hofstede and Bond; 1988; Hofstede and Hofstede, 2005)

National cultural dimension	Definition
Power distance index (PDI)	The extent to which the less powerful members of a society accept and expect that power is distributed unequally.
Individualism (IDV)	The extent of interdependence a society maintains among its members and considers whether people act as individuals or act in a group.
Masculinity-femininity (MAS)	The issue of this dimension is what motivates people – wanting to be the best (masculine) or liking what you do (feminine)
Uncertainty avoidance index (UAI)	To what extent a culture programmes its members to feel comfortable or not in uncertain situations.
Long-term orientation (LTO)	The long-term orientation dimension can be interpreted as dealing with society’s search for virtue.

The studies in this research were conducted in SMEs in Sweden and Singapore with different national cultures. Figure 3 presents a chart comparing Swedish and Singaporean values from Hofstede’s five national cultural dimensions (Hofstede, 2013). As seen in Figure 3, Singapore has a high PDI, which means that power and decision making are

centralised, control is expected and attitude towards managers is formal. Power distance reduces employees' participation in decision making. Sweden scores high in the IDV dimension (Figure 3), which means that Sweden is an individualistic society. In these societies individuals take care of themselves and the employer/employee relationship is a contract based on mutual advantage; hiring and promotion decisions are supposed to be based on merit. Singapore scores quite low and is a collectivistic society meaning that the group to which a person belongs is more important than each person. Sweden has the lowest MAS in the world. Low masculinity values stand for a preference for cooperation; caring for others and quality of life are the signs of success. Masculinity tends to reduce teamwork and is also related to power distance (Cagliano *et al.*, 2011). Sweden has also a low preference for avoiding uncertainty and has a more flexible approach to rules and norms. Sweden like many Western countries has a short-term orientation (LTO) with great respect for traditions, and an impatience for achieving quick results. Singapore has a higher LTO than Sweden as Singaporeans support long-term investments, but at the same time they are open for options (Hofstede, 2013).

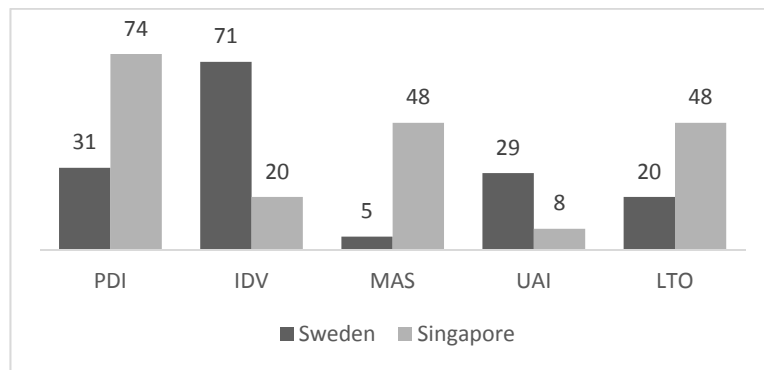


Figure 3. Swedish and Singaporean values from Hofstede's five national cultural dimensions (Hofstede, 2013).

RESEARCH METHODOLOGY

In this chapter the research methodology is presented with a focus on the overall process, research design and the methodological choices that were made. The chapter concludes with a discussion about the quality of the research.

“Finally, learning is the essence of all research. What we learn is articulated in the theoretical framework combined with the matching case. This is generally considered by far the most important outcome of the research process. How we learn is only occasionally discussed in a research report.” (Dubois and Gadde, 2002, p. 560)

3.1 RESEARCH PROCESS

The research process can be divided into two parts; the first part aimed at the licentiate thesis and the second part aimed at the doctoral thesis. The research process is schematically illustrated in Figure 4.

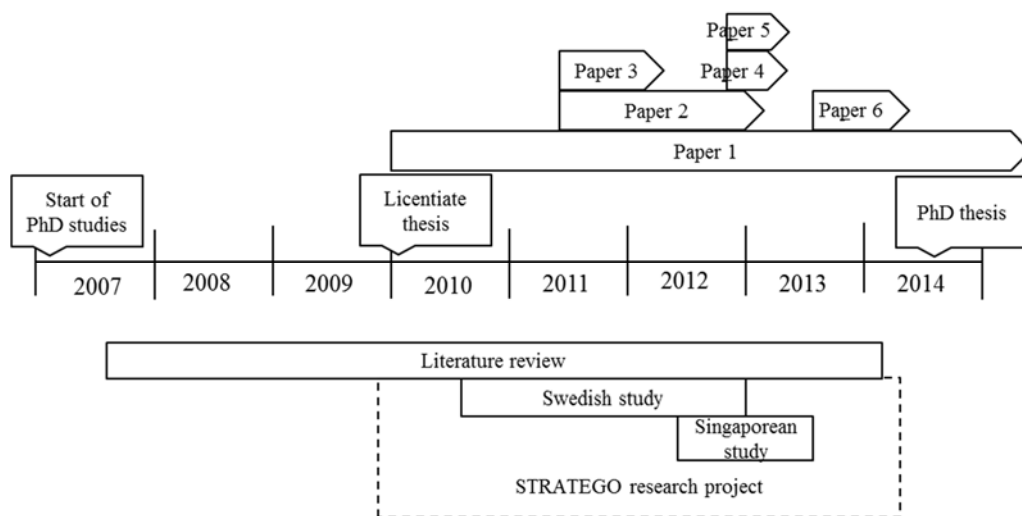


Figure 4. The research process.

The research subject (manufacturing strategies in small and medium-sized enterprises) has been the same since the author started her research in 2007. Over this period the research focus has, however, evolved and become more diversified. The objective of the research towards the licentiate thesis (Löfving, 2009) was to identify characteristics in the manufacturing system in SMEs that need to be improved to remain competitive in the future. The empirical data were gathered from 20 subcontractor SMEs in Sweden. This research resulted in a list of recommended manufacturing improvements concerning competitive priorities and decision categories. The conclusions from the licentiate thesis were that a majority of the companies studied had no written manufacturing strategies, and

to remain competitive, SMEs should improve flexibility, delivery and quality. The licentiate thesis is regarded as a separate contribution in the research process and therefore not included in this thesis.

The second part of the research process started at the beginning of 2010 (Figure 4), with this thesis as its objective. The research presented in this thesis began with the STRATEGO project (see Appendix A). Based on the recognised needs in both theory and practice described in the STRATEGO project, the research subject and aim were defined. The aim of the research was to investigate manufacturing strategy formulation in SMEs more deeply. This is in line with the STRATEGO project, as the aim of the project was to make knowledge about manufacturing strategies available and applicable to SMEs. In the STRATEGO project a manufacturing strategy tool was developed with the purpose of simplifying the use of manufacturing strategies in SMEs. The tool is labelled the STRATEGO tool and described in Säfsten *et al.* (2014a, 2014b). The STRATEGO project was a three-year project that started in December 2009 and ended in April 2014 (prolonged due to maternity leave). The author's role in the project is described further in Appendix A. As an extension to the STRATEGO project, a collaboration research project was carried out in Singapore (see Figure 4). This project focused on testing the STRATEGO tool at companies in Singapore. The project was carried out between December 2011 and September 2013. The Singaporean project and the author's role are described in Appendix B.

This thesis is a contribution to the STRATEGO project. The empirical data were collected in accordance with the research approach to the STRATEGO project. This thesis was, however, designed and planned independently. The data collection for this thesis was divided into literature review and empirical data collection. As illustrated by Figure 4, a review of the literature has been going on throughout the research process. The literature review is presented in Chapter 3.2. The data collection includes two studies, a Swedish study and a Singaporean study. The Swedish study includes three case companies and the Singaporean study includes two case companies as presented in Figure 4. The studies are described further in Chapters 3.3 and 4.

The doctoral thesis includes six appended papers, as shown in Figure 4. How the appended papers relate and contribute (in terms of literature and empirical data) to the two research questions is illustrated in Table 10.

Table 10. Appended papers and their theoretical and empirical contribution to the research questions.

	Paper 1	Paper 2	Paper 3	Paper 4	Paper 5	Paper 6
RQ1	Literature: SME characteristics	Literature: Assessment criteria (first version of internal key factors) SME characteristics	Literature: OS matrix	Literature: Ownership, leadership style and organisational culture	Literature: Leadership style and organisational culture	
RQ2	Literature: Competitive environment	Empirical studies: Swedish study	Empirical studies: Swedish study	Empirical studies: Swedish study	Empirical studies: Swedish study	Literature: National cultural dimensions
		Empirical studies: Swedish study	Empirical studies: Swedish study	Literature: External key factors such as competitive environment	Empirical studies: Swedish study	Empirical studies: Swedish and Singaporean studies

3.2 LITERATURE REVIEW

The literature review in this research resembles Jesson *et al.*'s (2011) traditional literature review approach, which aims at providing a broad understanding and description of the topic. The traditional review has no defined paths, the search is tentative and moves from one study to another to follow up leads (Jesson *et al.*, 2011). In this review approach, selection and assessment are based on the reviewer's opinion (*ibid.*). The literature review in this thesis comprised four parts. Each part followed the same process based on the three steps in traditional literature review presented by Jesson *et al.* (2011): obtain publications, read and assess, and spot the knowledge gap. A number of databases were selected to cover a range of publications (e.g. journals, books, dissertations). The databases included Scopus, Web of Science, ABI/INFORM and Primo (Jönköping University's database). These databases were chosen as they are recommended by the library at Jönköping University, since they cover a great variety of journals and articles in the field of operations management.

During the first part of the literature review, literature about manufacturing strategy formulation was sought. First, keywords were identified including 'manufacturing strategy' or 'operations strategy', 'formulation', 'formation', 'planning', 'framework' and 'process'. When relevant publications were found, references and citations were crosschecked to follow up leads (Jesson *et al.*, 2011). Publications including service companies were excluded as this research focuses on manufacturing companies. A number of publications included manufacturing strategy process, formation, deployment or manufacturing strategy content. These publications were first scanned, and here some publications were excluded when the manufacturing strategy formulation could not be distinguished. The publications in which the formulation could be distinguished were selected for further analysis.

The second part of the literature review focused on finding empirical studies about manufacturing strategy formulation in SMEs. Keywords used in this review were the same as above with the addition of 'SME', 'small firms', 'small businesses' and 'small and medium-sized enterprises'. The publications found were scanned, and publications including empirical studies (case studies) about manufacturing strategy formulation in SMEs were read and assessed. The criterion used to assess these publications was whether a formulation procedure could be distinguished. Few publications were found by using this criterion (Barnes, 2000, 2002a, 2002b). Therefore, the publications identified in the first part of the literature review were read again to examine if they included case studies on SMEs. First, the publications including case studies were selected. The number of employees in the case companies in these publications was assessed based on the definition of SMEs used in this thesis (see Chapter 2.1.1). Three publications were found to contain one or more case companies with less than 249 employees (Swamidass *et al.*, 2001; Kiridena, 2009; Kiridena *et al.*, 2009).

The third part of the literature review focused on internal key factors for manufacturing strategy formulation. Here the identified publications about manufacturing strategy formulation (from part one) were read to investigate whether they included internal key factors or similar terminology. Additionally, there were new searches for further publications in the databases described above. Keywords used in the searches were 'key factors', 'critical factors', 'characteristics', 'aspects' and 'success criteria' in addition to the keywords used in the first part. Publications including critical success factors in the meaning of competitive priorities as well as publications dealing with key factors for strategy formulation were disregarded. Some of the identified publications included internal key factors for the manufacturing strategy process. These were further scanned

and read. Publications were excluded when the internal key factors for formulation could not be discerned in separate stages. Therefore dimensions such as those by Rytter *et al.* (2007) were excluded. On the other hand, Kiridena's (2009) phases could be discerned as it was explicitly stated that realisation included implementation. Publications describing the stages and steps to formulate manufacturing strategies as manufacturing strategy frameworks were also not included. Finally, eight publications containing a specification of internal key factors for manufacturing strategy formulation were chosen for further investigation (see Chapter 2.4).

The fourth stage of the literature review addressed the external key factors. External key factors for both strategy formulation and manufacturing strategy formulation were searched for in the recommended databases. This literature review is presented in Papers 4 and 6.

A literature review containing the characteristics exhibited by SMEs was first conducted in Löfving (2009), and additional literature reviews about SME characteristics are presented in Papers 1, 2 and 5.

3.3 EMPIRICAL DATA

3.3.1 Research approach

One of the challenges in operations management (OM) research, which manufacturing strategy is part of, is how to combine practical relevance with academic contribution (Barnes, 2001; Karlsson, 2009). According to Karlsson (2009, p. 14), “[e]ven if researchers in OM face a quest for contribution both to the academic and to the practitioner’s world, the degree and extent of involvement in practice may vary substantially from gathering data to taking action”. One way to overcome this challenge is to have an interactive research approach, since such an approach aims at contributing to both practical use and theory development (Ellström, 2007). The interactive approach aims at joint learning (Svensson and Aagaard Nielsen, 2006), as the focus is to do research and to create knowledge *with* practice rather than *for* practice (Ellström, 2007; Winroth and Säfsten, 2013). The researcher’s main role in this approach is not to solve problems at companies, but to define and analyse them (Svensson and Aagaard Nielsen, 2006). The interactive approach should be considered as a perspective, as it is a certain way of understanding and conducting research rather than a set of methods (Larsson, 2006). Ellström (2007) proposes a model for knowledge creation through interactive research (Figure 5). The model consists of two interacting loops, the research system and the practice system. One basic issue with the model is conceptualisations and interpretations of the research object that are fed back to the next cycle of problem-solving activities (Ellström, 2007).

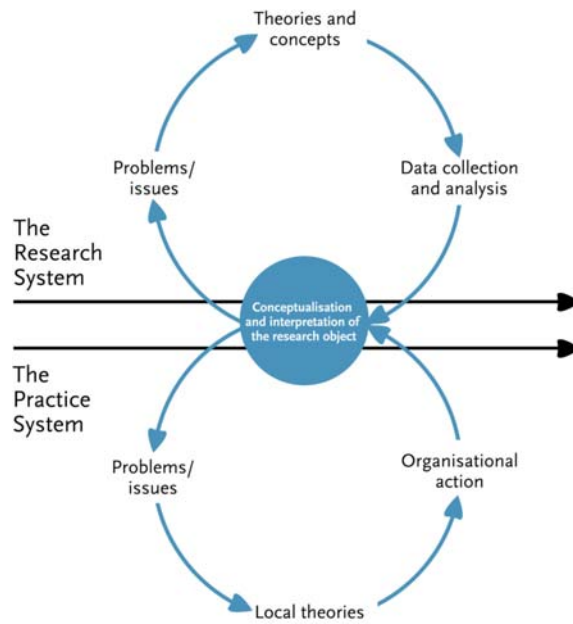


Figure 5. The knowledge creation model (Ellström, 2007).

The STRATEGO project had an interactive research approach. The interactive approach used in the STRATEGO project involved four steps: 1) survey and diagnosis, 2) feedback of results, 3) development activities and 4) follow up/evaluation (Winroth and Säfsten, 2013). These steps should be viewed as a cycle that needs to be iterated. The cycle was used and iterated many times during the STRATEGO project. New knowledge was created in close cooperation between the researchers and participating companies.

The research presented in this thesis is divided into three phases. Table 11 illustrates the phases, studies, case companies, papers and corresponding work in STRATEGO.

Table 11. Phases, studies, case companies, papers and corresponding work in STRATEGO

	Study (case)	Paper	Corresponding work in STRATEGO
Phase 1	Swedish (Aluminium, Automotive, Casting)	Paper 2	Survey and diagnosis
	Singaporean (Aerospace, Precision)		Survey
Phase 2	Swedish (Aluminium, Automotive, Casting)	Papers 2, 3, 4	Work with development activities together with the companies
Phase 3	Swedish (Aluminium, Automotive, Casting)	Papers 5, 6	Test of the STRATEGO tool
	Singaporean (Aerospace, Precision)	Paper 6	Test of the STRATEGO tool

The main method used in this research to collect empirical data is case studies. Case studies are useful when studying a phenomenon in its real-life environment, where interactions between the phenomenon and its context are to some extent unclear (Barnes, 2001; Dubois and Gadde, 2002; Yin, 2009). Case studies are also suitable when the research aims at theory testing and theory generating (Voss *et al.*, 2002). Further, case studies permit data to be collected from multiple sources of evidence, which can offer synergy effects and help to secure the validity of the data (Eisenhardt, 1989; Yin, 2009).

3.3.2 The Swedish study

Unit of analysis

The unit of analysis is related to the way the initial research questions are defined and to the fundamental problem of defining the case (Yin, 2009). The unit of analysis was the manufacturing strategy formulation in SMEs, and internal and external key factors were embedded units of analysis.

Case selection

Case selection and replication logic are crucial when doing case studies (Eisenhardt, 1989; Voss *et al.*, 2002; Yin, 2009). Each case should be selected to either (Yin, 2009):

- predict similar results (literal replication) or
- produce contrary results, but for predictable reasons (theoretical replication)

This research aimed at literal replication, i.e. to predict similar results. The cases in the Swedish study were selected through participation in the STRATEGO project. The companies were selected based on the following criteria:

- subcontractor
- between 11 and 249 employees at the unit
- independent or dependent but managed as an independent unit
- manufacturing and headquarters in Sweden
- willingness to participate in the research

Data collection

The data were collected during three phases (the phases are shown in Table 11 on the page above):

Phase 1. Initially, in 2010, a survey and a diagnosis were made in the Swedish study. Table 12 shows the number of respondents in each company. Semi-structured interviews were conducted to get a background of the companies, their work with manufacturing strategies and their requirements of tools (Table 12). The interview guide is included in Appendix C. All interviews were recorded and transcribed.

Table 12. Data for the initial semi-structured interviews in the Swedish study (Phase 1)

Company	Year	No of respondents	Respondents
Aluminium	2010	5	Owners (CEO and financial manager), human resource manager, sales manager, manufacturing manager
Automotive	2010	5	Division manager, manufacturing manager, engineering manager, sales manager, quality manager
Casting	2010	8	CEO, quality manager, production engineer, manufacturing manager, sales manager, warehouse representative, smelter.

Phase 2. Phase 2 focused on the formulation of manufacturing strategy in the Swedish study. This phase included the feedback of the results, identification of development activities and follow up/evaluation (see also Table 11 for information about this phase). In the STRATEGO project, development activities in each company were identified in collaboration with the company. The development activities were unique for each company depending on the companies' experience of formulating manufacturing strategy (identified in Phase 1). The research team was responsible for one development activity that was to develop a manufacturing strategy tool suitable for SMEs, i.e. the STRATEGO tool. The tool is presented in Säfsten *et al.* (2014b).

The OS matrix (described in Paper 3) was introduced in the companies as part of their development activities. The OS matrix (Slack and Lewis, 2011) was chosen as a potential facilitator for the manufacturing strategy formulation, as it was considered simple and easy to understand (see more in Paper 2). The OS matrix was found to be a good way to communicate the idea of competitive priorities and decision categories to the companies (see Paper 3 and Säfsten *et al.*, 2014a).

Phase 2 ended at different times in the study, depending on when the companies decided to implement the manufacturing strategy. Data were gathered differently in each company in Phase 2, illustrated in Table 13. At the project meetings in companies Aluminium and Automotive and at the two workshops, the author of this thesis took a more participative role, i.e. participating as observer according to Vinten (1994), see Figure 6.

Table 13. Data collection in the Swedish study in Phase 2

Techniques	Time period	No. of meetings	Types of data collected
Company Aluminium	January 2011- December 2012		
Project meetings		4	Written documents, recorded material
Workshops		2	Notes, recorded material
Company Automotive	January 2011- October 2011		
Project meetings		4	Written documents, recorded material
Workshops		1	Notes
Company Casting	January 2011- November 2012		
Project meetings		14	Notes, recorded material, written documents
Workshops		2	Notes, recorded material
<i>Interviews:</i>	September 2011	5	Notes, recorded material
<i>Respondents:</i>	CEO, production manager, quality manager, production planner		

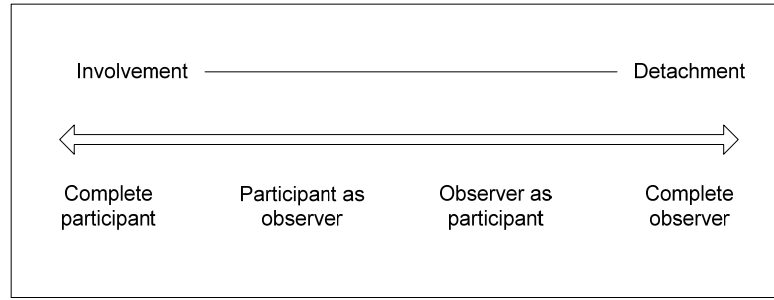


Figure 6. Observer roles based on Vinten (1994).

The project meetings aimed at discussing the companies’ work with the development activities. The author of this thesis was invited to observe company Casting’s manufacturing strategy formulation in Phase 2. At specific meetings in which they worked with development activities, the researcher was a complete observer (Vinten, 1994) in person or via Skype. These observations were conducted between August 2011 and February 2012. More in-depth interviews were also held with company Casting focusing on defining their manufacturing strategy formulation.

Phase 3. Phase 3 focused on tests of the STRATEGO tool in the Swedish companies. The development process of the STRATEGO tool is presented in Säfsten *et al.* (2014a), and the tool is described further in Säfsten *et al.* (2014b) and to some extent in Paper 6. Gradually, the development of the STRATEGO tool evolved and a number of different versions of a framework were developed and tested by the companies. The different versions of the framework and the STRATEGO tool were evaluated by the case companies after each test and thereafter refined by the researchers in the STRATEGO project (see Säfsten *et al.*, 2014a). The tests of the STRATEGO tool were important in order to understand what the case companies required in frameworks and tools. The first versions of the manufacturing strategy framework were not implemented but existed on paper (see Chapter 2.4 for definitions of frameworks and tools). After the framework had been implemented in Excel it was called the STRATEGO tool. However, the first tests of the STRATEGO tool were done on printed Excel sheets while the later tests were carried out directly in Excel (see Table 14). Table 14 presents when the Swedish companies tested different versions of the STRATEGO tool, what was included and in what format they tested the tool.

Table 14. Test of the STRATEGO tool, version, date, what was included and in what format the tool was tested

Company	Version of the STRATEGO tool	Date	What was included in the STRATEGO tool	In what format the STRATEGO tool was tested
Aluminium	Version 2.5	June 2012	Written instructions	On paper
Automotive	Version 1	January 2012	No written instructions	On paper
Automotive	Version 2	May 2012	Written instructions	In Excel
Casting	Version 3	August and November 2012	Written instructions	In Excel

3.3.3 The Singaporean study

Besides the Swedish study, a supplementary small-scale study was conducted in Singapore. The study had a multiple-case design (Yin, 2009), including two companies called company Aerospace and company Precision.

Unit of analysis

The unit of analysis was the manufacturing strategy formulation when using the STRATEGO tool.

Case selection

The case companies were selected from a database of companies that had participated in a programme at the Singapore Institute of Manufacturing Technology (SIMTech) aiming at developing business strategies. Criteria for the selection were the following:

- between 11 and 249 employees at the unit
- goods manufacturer or subcontractor
- manufacturing located in Singapore
- the companies should not be competitors
- willingness to participate in the study

Data collection

The Singaporean study included Phase 1 and Phase 3 (described in Table 11), because of the aim of the Singaporean research project (Appendix B).

Phase 1 included a survey. Here data were collected through semi-structured interviews. A guided tour in the manufacturing was included to get a deeper understanding of the manufacturing process. Before the interviews were carried out, an interview guide was developed, see Appendix D. The interview guide used in the licentiate thesis (Löfving, 2009) and the semi-structured interviews done in the Swedish study (Appendix C) influenced the interview guide. The aim of the interview was to get a background of the company and respondents as well as a description of the prevalence of strategies and manufacturing strategies. The respondents in the interviews were participants in the study or individuals recommended by the company as suited to answer the questions (see Table 15).

Table 15. Data collection in the Singaporean study (Phase 1 and Phase 3)

	Time period	No. of meetings	No. of interviews	No. of participants	Position of respondent
Company Precision	June - July 2012	3	6	4	Sales manager, production planner, quality manager, purchasing and account manager
Company Aerospace	February - March 2013	3	2	2	Vice president (VP), manufacturing manager

Phase 3. In Phase 3 data were gathered from meetings with the participating companies (see Table 15). The first meeting in each company aimed at introducing the researcher and the company. The next meeting focused on introducing the STRATEGO tool, and thereafter the researcher and participants decided how to manage the test of the STRATEGO tool. Table 16 presents which version of the STRATEGO tool the Singaporean companies tested as well as dates for the test, what was included and in what format the test was conducted. At the meetings, the researcher took the role of participant as observer (see Figure 6). At company Precision the author participated in the tests of the STRATEGO tool in order to be able to directly answer specific questions about the tool. Company Precision tested the STRATEGO tool on paper. Company Aerospace filled out the STRATEGO tool in Excel without the author's participation and had several meetings with the author to evaluate and discuss the use of the tool.

The two cases were written down after each meeting. If a company did not follow the instructions or if anything specific happened during the test and formulation, this was also noted in the case write-ups.

Phase 3 in the Singaporean study is addressed in Paper 6.

Table 16. Test of the STRATEGO tool, version, date, what was included and in what format the tool was tested

Company	Version of the STRATEGO tool	Date	What was included in the STRATEGO tool	In what format the STRATEGO tool was tested
Aerospace	Version 3	February - March 2013	Written instructions	In Excel
Precision	Version 2	June - July 2012	First version of written instructions	On paper

3.4 DATA ANALYSIS

Researchers have a pre-understanding of the research area, which affects the interpretation and analysis of the qualitative data (Alvesson and Sköldbberg, 2000). This means that the qualitative analysis is partly based on the researcher's interpretation and experiences of the research area. However, to be able to be objective and to validate the conclusions, the analysis should be done in a structured way that is easy for other researchers to follow. Yin (2009) proposes three general analysis strategies: relying on theoretical propositions, thinking about rival explanations and developing a case description. The analysis strategy chosen in this thesis was 'relying on theoretical propositions'. Before the research questions were developed, a theoretical proposition was developed, i.e. why the topic needed to be researched. Although the data analysis has been an ongoing and iterative process, five recurring steps can be distinguished:

- Literature review
- Within-case analysis
- Cross-case analysis
- Enfolding literature
- Conclusion drawing

The analysis began with a synthesis and categorisation of internal key factors from the eight identified publications that describe internal key factors for manufacturing strategy

formulation (see Chapter 3.2). The internal key factors were first summarised in Table 8. Platts's (1994) characteristics and 'guiding principles' as well as Lindström's (2008) characteristics and criteria were approached on the same level as shown in Table 8. Thereafter the internal key factors in Table 8 were entered on sticky notes and grouped and re-grouped several times to see different patterns. The process resembles the pattern matching described by Yin (2009). The groups were categorised using a descriptive label. Certain internal key factors could be attributed to more than one category and they were investigated further to understand the essential definition. One example is Papke-Shields *et al.*'s (2006) characteristic 'intensity', which describes both resource allocation and frequency of meetings, and who participated at the meetings, different categories. Some of the internal key factors were subordinated to other internal key factors, thus approached on different levels. For example the internal key factor 'participation' includes underlying internal key factors such as multi-functional participation.

After the internal key factors had been categorised, additional literature about manufacturing strategy formulation including different internal key factors was added to get a deeper understanding of each internal key factor.

To become more familiar with each case, collected data from each case study were read several times (Eisenhardt, 1989). The data were reduced to only include issues concerning manufacturing strategy formulation. The manufacturing strategy formulation in the Swedish case companies was visualised (described in Chapter 4). The visual displays were used to facilitate understanding and create an overview of the manufacturing strategy formulation in the Swedish case companies. The case studies and visual displays were mapped against the internal key factors and thus helped to understand whether and how internal key factors appeared in each case company's manufacturing strategy formulation. The case studies and displays in the Swedish study were compared with each other. This process resembles Yin's (2009) pattern matching. The comparison focused on differences and similarities in the reflection of internal key factors between the cases (Eisenhardt, 1989; Voss *et al.*, 2002). The results from the cross-case analysis were compared with previous empirical research studies on manufacturing strategy formulation in SMEs (e.g. Swamidass *et al.*, 2001; Barnes, 2002a; Kiridena, 2009).

When the case studies were analysed with the internal key factors, additional internal key factors derived from the findings. These were added to the list of internal key factors and compared with previous empirical studies on manufacturing strategy formulation in SMEs.

The empirical findings were analysed and related to specific SME characteristics. The aim of this analysis was to build explanations regarding whether SME characteristics were related to the internal key factors for manufacturing strategy formulation. This process resembles the explanation building described by Yin (2009). From this conclusions were drawn to answer the research questions.

The external key factors were identified in Papers 4 and 6. Thereafter, the case studies were analysed regarding whether or not the external key factors influenced the manufacturing strategy formulation with the same strategy as described above.

3.5 RELIABILITY AND VALIDITY AS QUALITY CRITERIA

All research is judged by the quality, or trustworthiness, of the conclusions (Miles and Huberman, 1994). According to Wigren (2007), there are different criteria when judging qualitative and quantitative research; credibility, trustworthiness or transferability, for example, can be more appropriate in qualitative research. However, 'traditional' criteria such as validity and reliability can be considered as criteria of good research in both

qualitative and quantitative research (Merriam, 1994; Miles and Huberman, 1994). Irrespective of quality criteria when judging qualitative research, the main question is still: to what extent can a researcher rely on the conclusions of the research (Merriam, 1994)? This thesis applies Yin’s (2009) tactics (Table 17) in order to evaluate the quality of the research. Both the Swedish study and the Singaporean study are included in this section.

Table 17. Reliability and validity as quality criteria (Yin, 2009, p. 34)

Tests	Case study tactics	Phase of research in which tactic occurs
Construct validity	Use multiple sources of evidence	Data collection
	Establish chain of evidence	Data collection
	Have key informants review draft case study report	Data collection
Internal validity	Do pattern matching	Data analysis
	Do explanation building	Data analysis
	Address rival explanations	Data analysis
	Use logic models	Data analysis
External validity	Use theory in single-case studies	Research design
	Use replication logic in multiple-case studies	Research design
Reliability	Use case study protocol	Data collection
	Develop case study database	Data collection

3.5.1 Construct validity

Construct validity is used to establish correct operational measures for the concepts being studied (Voss *et al.*, 2002). However, case study researchers often fail to establish correct operational measures as ‘subjective’ judgments are used to collect data (Yin, 2009). To overcome this, Yin (2009) proposes three tactics to increase construct validity when collecting data in case studies: using multiple sources of evidence, establishing a chain of evidence and having key informants review the case descriptions (see Table 17).

Triangulation through using multiple sources of evidence and multiple data collection methods can strengthen the validity (Yin, 2009). The literature search was made in different databases and multiple sources such as books, dissertations and articles to strengthen the validity. In the Swedish study, multiple sources of data were used like interviews, observations and project documents to strengthen the construct validity. Respondents with different job positions (Table 12) were interviewed to get their view of the company and this strengthen the construct validity. The interactive research approach increased validity, as the researchers in the STRATEGO project and the companies in the Swedish study worked closely together and met continuously. The researchers in the STRATEGO project discussed and interpreted the case studies. The Swedish companies together with the researchers initiated the development activities, and the companies evaluated the different versions of the STRAGEO tool. Further, informal follow-up questions were asked to participants when necessary to understand issues further. As this research was part of the STRATEGO project, the validity was also increased in this thesis.

In the Singaporean study, data were collected through interviews, observations and company documents to ensure the validity. In the Singaporean study, at least two respondents were interviewed at each company (Table 15). Most of the interviews were recorded and notes were taken during the interviews. When the interviews were not recorded, they were written down directly afterwards to reduce the risk of misinterpretation.

3.5.2 Internal validity

Internal validity refers to the identification of cause and effect and involves ascertaining how the results correspond to reality (Merriam, 1994; Croom, 2009; Voss *et al.*, 2002; Yin, 2009). Internal validity only concerns explanatory studies (Croom, 2009; Yin, 2009), which means it is applicable in this thesis. This thesis aims more at theory testing and refinement to understand theory in the light of what is observed. Internal validity is addressed in the data analysis and in the analysis techniques used. The analysis techniques used in this thesis resemble Yin's (2009) pattern matching in both the literature review and in the analysis of empirical data. Explanation building has also been used to some extent as SME characteristics were used to explain certain internal key factors. The use of these analysis techniques increases the internal validity.

3.5.3 External validity

External validity considers the whole research design and refers to the degree to which the findings can be generalised and replicated in other contexts (Miles and Huberman, 1994; Voss *et al.*, 2002; Yin, 2009). Yin (2009) distinguishes between two types of generalisation, statistical generalisation and analytical generalisation. Case studies rely on analytical generalisation (Yin, 2009) and strive at generalising the case studies to broader theory, i.e. develop theory (Eisenhardt, 1989; Meredith, 1998). Generalisability is problematic in case studies as the results are valid for that case's situation (Meredith, 1998). Therefore, Yin (2009) recommends that case studies should be compared and generalised with literature to increase external validity. External validity is to some extent achieved in this thesis, as the case studies were compared with previous empirical research studies.

To achieve external validity, replication logic in multiple-case studies is appropriate. External validity increases when the selection of cases is thoroughly reported and there is replication logic (Eisenhardt, 1989). The cases in the Swedish study as well as the Singapore study were selected considering literal replication logic aiming at similar results. This might also increase external validity.

3.5.4 Reliability

Reliability is related to the ability to repeat the case studies with the same result (Merriam, 1994; Yin, 2009). The tactics to ensure reliability include use of a case study protocol and development of a case study database (Yin, 2009). In the data collection, both case study documents and case study notes were included (Yin, 2009). The case study documents included transcribed interviews, development activities, case descriptions and evaluations of the test of the STRATEGO tool. The documents were collected in the research project and were saved in a project database. Case study notes were taken during interviews, meetings and observations. All case companies are described in Chapter 4, which is one kind of case study document. Further, the appended papers provide a description of the data collected.

The interviews were transcribed and the analysis followed a structured way described above. However, when doing case studies in a real-life context, the conditions may change, which might make the observations difficult to repeat. Moreover, even if the process is repeatable, it is not sure that the conclusions will be the same due to the qualitative aspects and the researcher's interpretation and experience. The interpretation is affected by the pre-understanding of the topic, which increases with the researcher's experience of the topic. In an interactive research process, reliability can be ensured through adaption and awareness of changes in both the phenomenon researched and in the research role and research practice (Lindhult, 2008). The researcher can, for example, adapt to new circumstances in the case studies. To make the research and the case study repeatable and possible to follow, the research steps should fit together and be described in a logical way (Karlsson, 2009). Reliability will increase if there is a chain of evidence (Yin, 2009). This thesis is structured in a logical way as outlined in Chapter 1.

CASE DESCRIPTIONS

In this chapter comprehensive/ descriptions of the companies and their manufacturing strategy formulation are presented. Case descriptions are given to illustrate the manufacturing strategy formulation in three different phases.

“[T]here appears to have been few attempts to undertake empirical investigations into the [manufacturing] strategy process.” Barnes (2001, p. 1078)

In this chapter, general descriptions of the companies and their manufacturing strategy formulation are presented. The empirical data were collected during three phases (see Table 11 in Chapter 3.3.1). This part further describes the manufacturing strategy formulation in the different phases in the companies studied. Phase 1 included both the Swedish study and the Singaporean study. Phase 2 focused on the manufacturing strategy formulation in the Swedish study and began with the development activities. The Singaporean study was not included in Phase 2. Phase 3 included a test of different versions of the STRATEGO tool in the Swedish study and the Singaporean study.

More case descriptions are provided in the appended papers. Table 11 in Chapter 3.3.1 illustrates which phases are described in the appended papers.

4.1 THE SWEDISH STUDY

The Swedish study was conducted at two SMEs, companies Aluminium and Casting, and one SME-like manufacturing company, company Automotive, in Sweden.

4.1.1 Company Aluminium

Phase 1

Company Aluminium was one of two companies in a small group. The company worked closely together with a major aluminium extruder that was also their supplier of raw material. Final customers were automotive (50 %), machining, furniture, telecom and electronics industries.

The company's core competencies were described as profile bending, CNC machining and welding, which were also parts of their business plans. Another competitive factor was the high degree of flexibility and the competence to perform all kinds of jobs on aluminium extrusions. The strategy was to not compete on very high volumes at low cost, but rather on flexibility and a good mix, which the major competitors were not very interested in.

Company Aluminium was privately owned and had 110 employees. The two owners were the CEO and the financial manager. They were aware of the possible conflict of interest in being both owners and operations managers and they tried to keep their two

roles apart.⁴ After they purchased the company in 2006, a gradual organisational change took place:

“A new company spirit must grow when the company grows. Maybe not in the familiar spirit, but as an employee you must feel that this is a company that invests in you and makes you feel happy at work. The employees must be in focus. It is a matter of maturity regarding the employees that they also feel the new company spirit.” (CEO and financial manager)

The company had a formal business plan.⁵ The CEO and the financial manager updated the business plan annually, reviewed it on a quarterly basis and discussed it in the management team. The business plan included the vision for the company, a competitor analysis and a target map. They used a SWOT (Strengths, Weaknesses, Opportunities and Threats) model to analyse their strengths and weaknesses, threats and possibilities. When analysing their competitors, they graded the competitors and used a chart where they mapped their own strategic position and that of their competitors. The target map included the quantitative objectives, i.e. it was a scorecard. The target map was divided into eleven processes, each with its own target. All targets should be measurable and relevant in order to ensure a degree of security; they included efficiency, quality, staff targets, sales, etc. In the business plan and target map, the objectives of manufacturing were included.

For a framework or tool to be useful, the company requested that it was simple and easy to understand. It must also be easy to visualise both the actual work and the results. Frameworks and tools were perceived as important to include various employees.

Phase 2

The CEO and the financial manager initiated the participation in the research project and led the manufacturing strategy formulation. The CEO and the financial manager involved the functional managers, i.e. manufacturing manager, HR manager and sales manager. The manufacturing strategy formulation process at company Aluminium is shown in Figure 7 and further described below.

One development activity was defined: review the business plan to include manufacturing in the long-term plans. It was decided that an analysis of the manufacturing should be done with the OS matrix. The CEO and the financial manager decided that the analysis of manufacturing and work with the OS matrix should be included in the annual assessment of the business plan. The CEO and the financial manager used the OS matrix to identify the competitive priorities and assess all processes. Since they were quite aware of the current competitive priorities, it was uncomplicated to identify current attributes. To do this, the decision categories, as originally suggested in the matrix, were replaced by the company's own processes. However, they found that it was difficult to include all information onto one sheet. Therefore, they set aside one sheet for each process. To get an overview of the matrices, they used a matrix that summed up the assessments at an aggregated level. A quantitative five-level scale was used to indicate to what degree each process contributed to the fulfilment of the competitive priority. The scale was also coloured to facilitate ranking the decision categories and competitive priorities. In this way, they highlighted what to improve in manufacturing and which improvement to begin

⁴ This thesis distinguishes between the different roles of owners, i.e. their job positions as CEO and financial manager.

⁵ The owners' label for the long-term plans and strategies.

with. During this first stage, the company had a problem ranking the decision categories and competitive priorities, due to trade-offs. They lacked a link to the actual requirements from the market. Gradually the work with the matrix evolved and focused on a few decision categories (not equivalent to the current processes), considered to be the most relevant for them. To indicate what to focus their activities on, the degree of fulfilment of each competitive priority was indicated by a coloured scale with percentages.

The CEO and the financial manager discussed the progress of the manufacturing strategy formulation with the functional managers at their regular meetings. According to the CEO and the financial manager, the functional managers discussed the progress and proposed further inputs, and “*the climate in the board of managers is dynamic*”, according to the CEO and the financial manager.

Phase 3

The CEO, the financial manager and the sales manager tested the STRATEGO tool, version 2.5, in June 2012 (as shown in Table 14 and in Paper 6). They followed the existing instructions. They filled out the tool on paper and their next step after testing the tool was to decide what to focus on to improve in manufacturing. The conclusions from the test show that the tool was useful but lacked written instructions and guidelines.

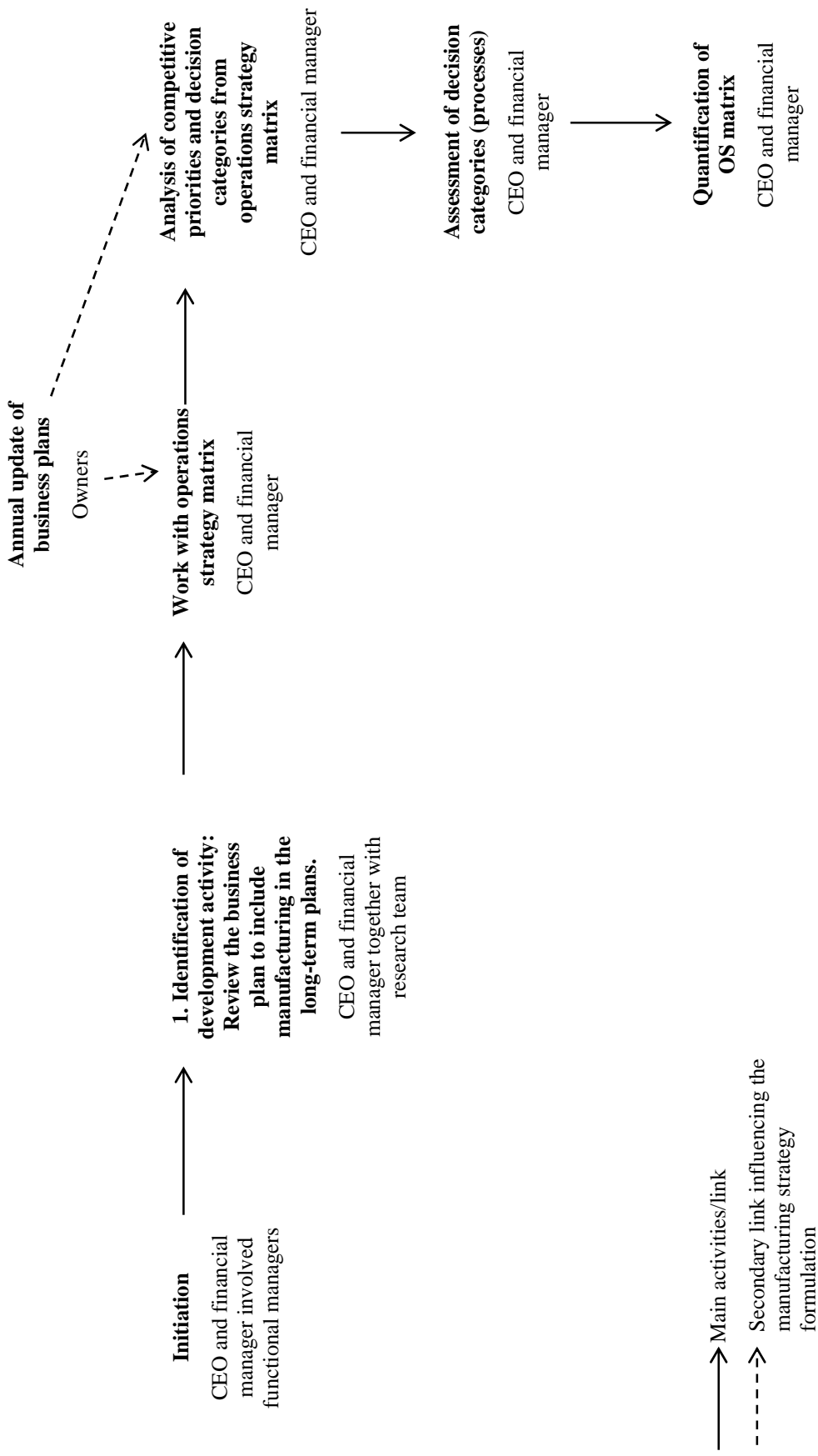


Figure 7. Manufacturing strategy formulation in company Aluminium, Phase 2.

4.1.2 Company Automotive

Phase 1

Company Automotive was a self-managing unit in a major company group. The company developed and manufactured automotive components for the automotive industry. It was a separate result unit and acted as a small company. They did not have much in common with the company group, apart from having some benefits from the sales resources. The company was required to grow by 10 % annually.

Marketing and product development were perceived to be in focus, with a minor interest in manufacturing. The product was not included in the customers' initial product specification but was requested when the final customers' products showed deficiencies. This made it hard to do market research in order to define customer demands. Company Automotive was, however, quite dominant on the market and had almost all major car manufacturers as customers, based on three patented product groups. Their major concern was in fact that the customer might manage to find its own, more cost-efficient, answer to its needs.

Their main competitive advantages were short lead times from order to delivery, including product development, prototyping and manufacturing; flexibility in their order handling; good technical product properties; high service level and the fact that their customers sometimes were depending on this particular supplier. The unit had a number of key performance indicators that were followed up monthly. Among other things they measured scrapping, but no real investigation of the root cause was made. Manufacturing was partly automated with batch production, and the unit had started to implement lean philosophies.

The current division manager founded the unit in 1997. In 2012 the unit had 90 employees.

On the company group level there were written corporate and business strategies that were updated annually and reviewed quarterly by the division manager and top management of the company group. The unit said that they followed informal strategies.⁶ The unit had an annual strategy meeting with the management team consisting of the functional managers (manufacturing manager, market manager, engineering manager) and the division manager. The functional managers were owners of various processes (market process, concept process, project process and manufacturing and delivery process). Even though they did not have any written manufacturing strategy, there existed a manufacturing strategy:

“No, we do not have that... We try to have a high level of automation and we do always have some overcapacity so we can (quickly) take in orders from customers. Despite that, we do not have any formal manufacturing strategies.” (Division manager)

The company group's time frame of strategies was three years, but the unit focused more on customer projects:

“... some of us talked about having a shorter horizon ..., perhaps develop a plan for the coming quarter of months and try to work more actively with that... to allot time to this competes with..., well, projects that we usually work with, it matters if we do it today or on Monday because on

⁶ Company Automotive talked about strategies on both overall and functional levels.

Monday it may be too late, while something that should be finished in five months has a tendency to..., well, if you do it today or on Monday does not matter and then it is delayed and not prioritised.” (Engineering manager)

The use of frameworks and tools was considered to be too time-consuming and a burden. For methods and tools to be useful, the respondents in company Automotive required that they were simple, easy to use and easy to understand, not time-consuming, and easy to communicate. The manufacturing manager said that it was important to involve people from the manufacturing department. Paper was perceived as a better medium than computer software. They would also like to have support for various decisions concerning manufacturing strategic choices, such as level of automation, material handling and cell layout.

Phase 2

The division manager and the manufacturing manager initiated the research project and the division manager led the manufacturing strategy formulation. He involved the manufacturing manager, the engineering manager, the sales manager and the quality responsible in the formulation. First the development activities for company Automotive were decided together with the research team:

- Work with the OS matrix
- Define strategy

The manufacturing strategy formulation process at company Automotive is shown in Figure 8 and further described below. The group began working with the OS matrix in May 2011. They began by identifying performance measurements and external and internal (from owners) requirements. Thereafter they decided on objectives. From then on the functional managers worked individually with their specific objectives. They tried to align the objectives with the decision categories. As they were unfamiliar and uncomfortable with the label ‘decision categories’, they chose to rename it as ‘processes’.

As part of development activity two (define strategy), the division manager wrote down the informal strategies (see above). He compared the informal strategies with the formal and written strategies from the top management. To set strategies for the unit followed, the division manager decided that the management team should have a two-day workshop. At the workshop, the controller also participated. Before the workshop, the management team individually wrote down their thoughts about strategies in the unit. At the workshop, they discussed these strategies. Surprisingly for them, the written strategies and the more informal strategies were congruent. At the workshop they decided on, defined and wrote down the strategies the unit should follow. The OS matrix was used at the workshop as a basis for understanding the competitive priorities as well as the decision categories (development activity one). However, a distinction between targets on company group level and unit level was made in the matrix. After the workshop, they worked individually with their own strategies and action plans. After a while, they met again in the group and discussed each others’ strategies. The outcome was both written strategies and written functional strategies. The strategies were divided into 12 weeks’ documented action plans. 12 weeks was determined as it was argued that shorter-term objectives should be more manageable. The strategic documents and action plans were collected in a file that should be easy to access and read for the subordinates. The file should also be updated when a document was updated. The 12 weeks’ plan should be updated every 12th week. As a final

activity in the formulation, the division manager presented the strategies and action plans for the subordinates in October 2011.

The OS matrix was perceived as unclear and difficult to use without further instructions. To support strategy formulation, it was essential that all parts of the OS matrix were clearly explained. The management team also perceived the traditional competitive priorities, to be too narrow. According to the division manager, for a small unit it was essential to consider requirements from both customers and owners, i.e. external and internal competitive priorities.

Phase 3

When the researchers had started to develop a manufacturing strategy framework and tool suitable for SMEs, one development activity was added for company Automotive:

- How can a manufacturing strategy tool support strategy and manufacturing strategy formulation, and what should be included in the tool?

Company Automotive tested the STRATEGO tool version 1 in January 2012 and version 2 in May 2012 (see Table 14 and Paper 6). The division manager, the manufacturing manager and the engineering manager participated in both tests. They followed the instructions and filled out the tool in Excel. After the test of the STRATEGO tool, the division manager evaluated the use of the tool. The competitor analysis was perceived as the most difficult part. The team did not analyse the relationships between competitive priorities (trade-offs) or between decision categories (links between the categories), but this relationship analysis was thought as appropriate to do when assessing those details. Conclusions from the test were that it was useful but lacked detailed instructions and guidelines.

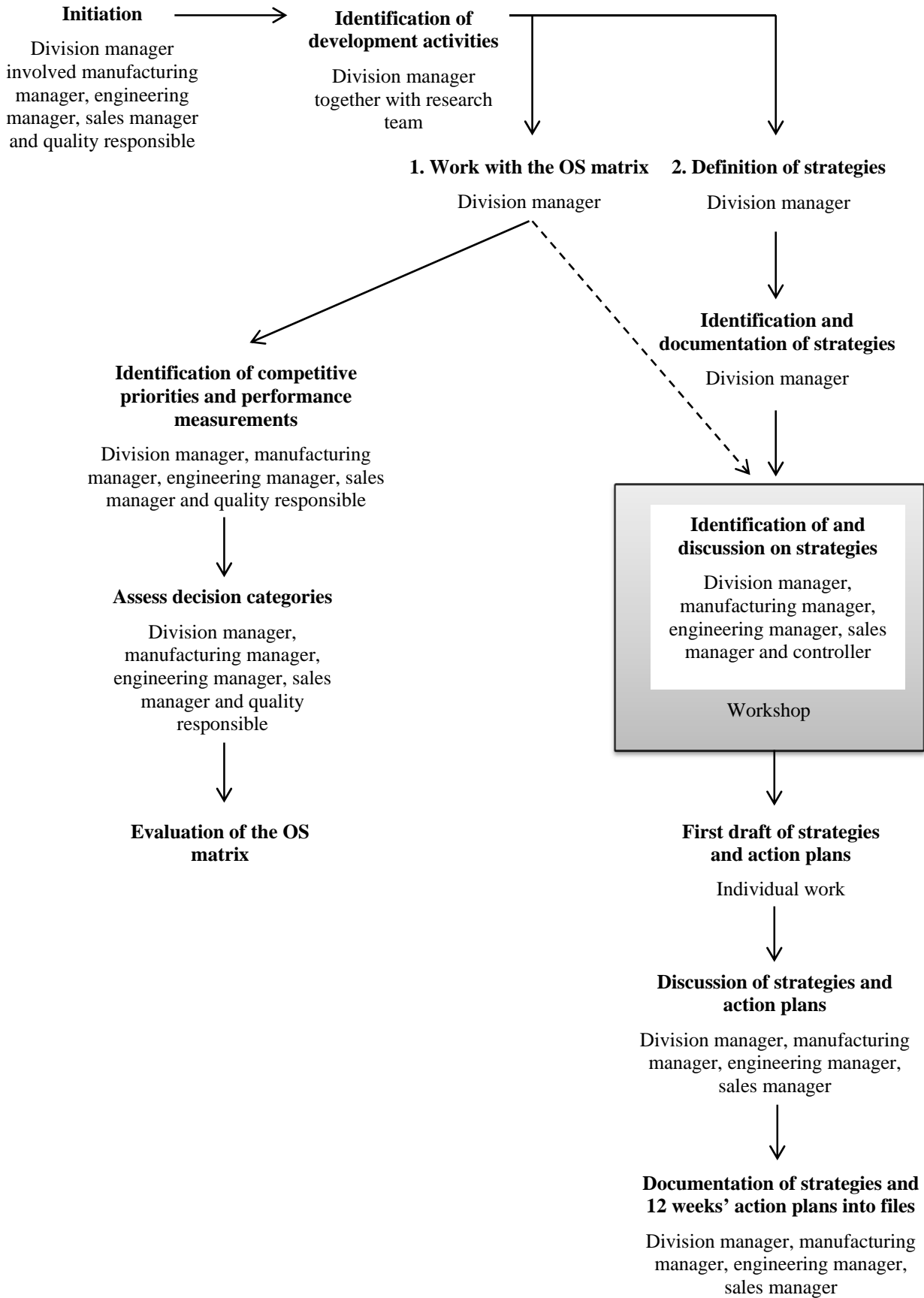


Figure 8. Manufacturing strategy formulation in company Automotive, Phase 2.

4.1.3 Company Casting

Phase 1

Company Casting was an autonomous company in a family-owned company group. Company Casting had no strategic directions from the owners. Company Casting was a foundry, which manufactured casting components. Prime customers were European OEM companies. The company did not face any competition in Sweden:

“In some product segments we have competitors, but they are not many and I do not feel that we are disturbed by them directly... not in Sweden anyway. The competitiveness... it is rather that some (customers) purchase more cheaply from China than we can manufacture, others purchase from Poland, East Europe, in some cases it is a question of price, then one of our customers in Italy also purchases from Italian foundries, but then it is about cultural issues.” (Sales manager)

The company's competitive priorities were mainly linked to delivery precision, quality and customer relations. The company measured its performance in terms of volume.

The company was led by the CEO and had 58 employees in 2012. The CEO was recruited in 2003. According to the CEO, strategy was informal and unwritten.

The CEO had budgeted 50 million SEK for investments in manufacturing for the coming three years but had no manufacturing strategy or manufacturing plans. Manufacturing strategy was partly, and mostly implicitly, discussed by the CEO, the sales manager and the manufacturing manager. The respondents in the interview expressed different views of the manufacturing strategy. Not everyone felt that they knew what the strategy was, and a more explicit and clearly communicated manufacturing strategy was requested.

All respondents in company Casting agreed that, to be useful, frameworks and tools should be simple, easy to use and not time-consuming. The result had to be valuable, useful and ready for implementation. Visualisation was important and computer software was perceived to be a suitable form. The CEO said that he wanted to learn from the process, i.e. the use of a framework and tools should generate some learning.

Phase 2

The CEO initiated the manufacturing strategy formulation. The CEO involved the manufacturing manager, a production technician, the quality responsible and the production planner. They are defined further in this thesis as the manufacturing team. The CEO led the formulation even though he expressed that he actually wanted to delegate this to the manufacturing manager. The manufacturing strategy formulation and the development activities at company Casting are shown in Figures 9 and 10 and further described below.

The CEO, the manufacturing team and the research team determined the development activities. Each development activity had an owner who was responsible for the activity. The development activities were as follows:

- Identify competitive priorities and set performance measurements (owner: quality responsible)
- Elucidate business strategy (owner: CEO)
- Elucidate organisation and develop job descriptions for every position in manufacturing (owner: manufacturing manager)

- Carry out documentation, communication and implementation of visions and strategies in the organisation (owner: at first production technician and later manufacturing manager)

To start with, the group members had to identify their competitive priorities according to the development activities. The quality responsible talked to the sales manager and from this, they tried to analyse their competitive priorities. However, different customers had different requirements and the manufacturing team discussed how to rank the customers. Thereafter they wanted to identify and set relevant performance measurements. To identify the performance measurements, they assessed the present manufacturing situation (development activity one). Here, for example, they mapped the manufacturing flow and analysed lead times for different parts of the manufacturing. They also discussed how they should develop the enterprise resource planning and its content.

At the same time, the CEO began working on defining the visions and business strategy (development activity two), and the manufacturing manager began with the job descriptions (development activity three).

The group met every second week for six months to work with the development activities. They worked with development activity one to four in parallel and selected one owner of each development activity. As they worked with the development activities they divided each development activity into smaller activities and improvements. These activities and improvements were listed in a kind of to-do list at the meetings that included a given time plan and owner. The list contained, among other things, purchasing of whiteboards to facilitate communication with operators (development activity four). Some of the activities and improvements were implemented between the meetings and reviewed and improved during the next meeting. At the meetings, the participants had time to discuss issues they usually did not discuss, as they usually did not have any meeting concerning overall manufacturing improvements. According to the CEO, *“it was good to hear the different views of the people and to open up this discussion”*.

When the manufacturing team and the CEO had worked with the development activities for a couple of months and had got control of their performance measurements, a new development activity was defined by the STRATEGO research team and the CEO. The new development activity focused on working with the OS matrix. At the same time, the manufacturing team continued to work with the first four development activities. The team did not work explicitly with the OS matrix, but it was implicitly used when they worked with manufacturing issues. The CEO and the production planner tried to use the OS matrix but thought it was too difficult to use without a proper introduction.

At the beginning of 2012 the manufacturing team and the CEO focused mainly on operational issues. In the autumn of 2012, company Casting got a new chairman of the board. The new chairman and the management team (CEO, sales manager, manufacturing manager and financial manager) had a two-day workshop, at which they discussed strategic direction and formalised strategies; see Figure 10. Further, they also analysed the participants' involvement in the strategy and manufacturing strategy formulation. From this analysis it was decided that the management team should set the manufacturing objectives and the manufacturing team should work on realising the objectives, i.e. developing and implementing action plans and implement the plans. The manufacturing team led by a new manufacturing manager decided that they should continue to meet regularly.

Phase 3

Company Casting tested the STRATEGO tool version 3 in August 2012 and November 2012. The CEO, the manufacturing manager, the production planner and the quality responsible participated in both tests. The STRATEGO tool version 3 included the tool in Excel and refined written process instructions in Word.

The individuals in the team got a paper copy of the Excel sheet and written instructions in the first test (August 2012). The team discussed how different product segments should be separated. They followed the instructions of the STRATEGO tool, and the outcome verified the previous informal manufacturing plans.

In November 2012, after their workshop (presented in Figure 10), the manufacturing team used the STRATEGO tool again to align the newly written strategies with manufacturing strategy. However, the outcome verified the outcome of their first test of the STRATEGO tool.

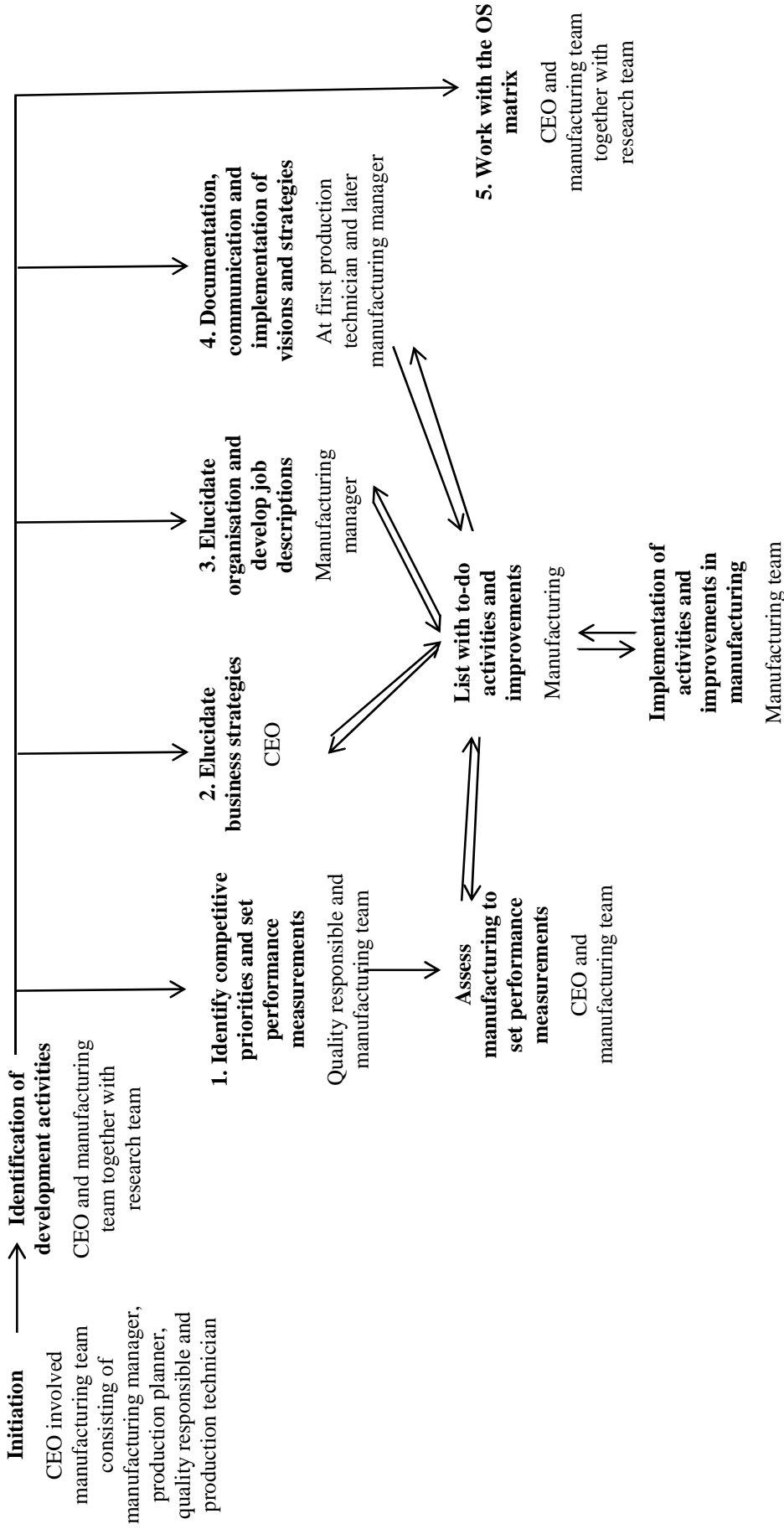


Figure 9. Manufacturing strategy formulation in company Casting, Phase 2, Part 1.

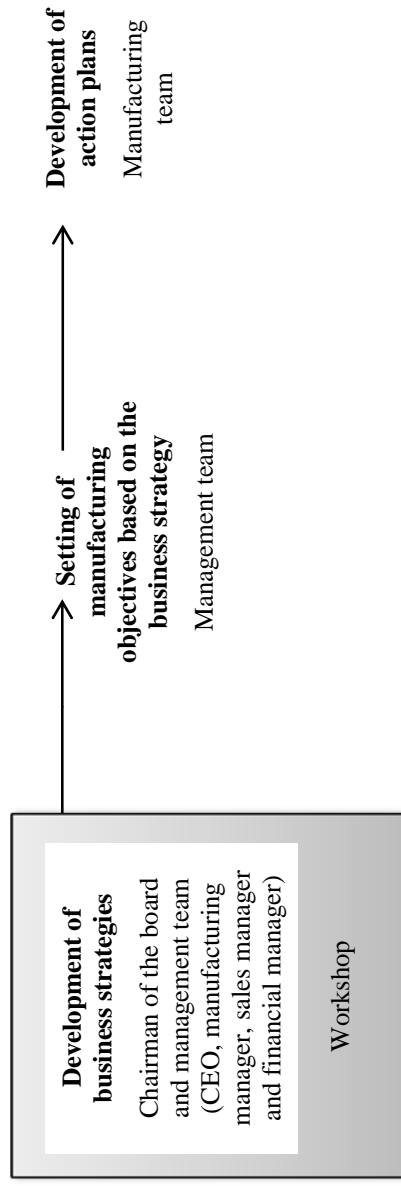


Figure 10. Manufacturing strategy formulation in company Casting, Phase 2, Part 2.

4.2 THE SINGAPOREAN STUDY

The Singaporean study is a supplementary study to the Swedish study and was conducted at two SMEs in Singapore, companies Precision and Aerospace.

4.2.1 Company Aerospace

Phase 1

Company Aerospace was a company in a privately owned company group. The group was established in 1990 to provide automation services for the electronics industry. Over the years, the company group has expanded to serve a wide range of industries including aerospace. Each company in the group acted as a small company and had not much in common with the others except the ownership.

Company Aerospace manufactured one component for aerospace industry in Singapore and the USA. Their competitive advantage was to provide complete solutions in-house, from in-house product development and manufacturing of tools to in-house manufacturing process. As they had all processes in-house, they could show a quality record of all processes and that is appreciated by the aerospace industry. Company Aerospace's core competence was their unique manufacturing process that provided greater flexibility and lower cost than their competitors.

Company Aerospace was founded in 2004 and began manufacturing in one of the other companies' facilities in the group. In 2008, company Aerospace moved its own manufacturing facility and had then 15 employees. The management comprised a Vice President (VP) who was responsible for sales, human resources, finance and operations and an operations manager who was responsible for manufacturing and engineering.

The company worked continuously with its strategic business plans and operational roadmaps.⁷ The owner formulated the business plans and assessed them on a yearly basis together with the VP. The VP was responsible for the operational roadmap and reviewed it once a year. The business plan and the roadmaps were closely aligned, as the core process in the company was a unique manufacturing process. The time horizon for the roadmaps was one year.

Phase 3

The VP tested the STRATEGO tool version 3 from February to March 2013 (see Table 16 and Paper 6). The VP initiated the participation in the study and involved the operations manager. At first manufacturing strategies and the STRATEGO tool were introduced to the two participants. Then a date was decided when the participants should test the STRATEGO tool. This date was set to a week after the introduction of the STRATEGO tool meeting. On the date decided, the operations manager could not participate, and therefore the VP tested the STRATEGO tool himself. First he thought about which product segment or customer to choose in the analysis. The choices were whether to continue analysing a successful product case or analysing what was satisfactory to the customers. There were also different competitive priorities for new customers and old customers and this was discussed during the whole manufacturing strategy formulation. The VP decided however to analyse old customers in this particular test of the STRATEGO tool. As the development of product included both engineering and manufacturing, it was decided that the analysis of the product segment should include both engineering and manufacturing, i.e. the operations. Even though the VP tested the STRATEGO tool himself, he discussed issues concerning the content in the STRATEGO tool informally with the manufacturing manager when they met at the office. The VP had also

⁷ The roadmaps correspond to manufacturing strategies but are labelled roadmaps in the company.

several meetings with the researcher when he described the test of the tool and evaluated the tool. The manufacturing strategy formulation took approximately one month for company Aerospace.

The result from the STRATEGO tool was written down and confirmed the roadmaps for the manufacturing. The VP's earlier thoughts about the company and operations were also confirmed and written down during the test of the STRATEGO tool. It was decided that the result from the STRATEGO tool should be further discussed with the owner.

4.2.2 Company Precision

Phase 1

Company Precision was a family-owned company that provided precision machining services for local and regional industries. The final customers belonged to oilrig, oil refinery, military, electrical and aerospace industries. Company Precision's competitors were other precision engineering SMEs in Singapore. However, company Precision relied on personal acquaintance with their customers and, according to the sales manager, "*Some customers have been with us the last 30 years. They have had different M&As [mergers and acquisitions] but they still come back to us*". The products were customised precision metal replacement components. The volumes ranged between one and five pieces. According to the sales manager, the industry was stable and "*there are not many products that change over time*".

The core competencies in manufacturing were CNC milling, CNC turning and different processes of grinding. The competitive advantages were delivery time and flexibility. The company also focused on achieving customer satisfaction through service such as supporting the customers during their research and product development.

Company Precision was founded by the family in 1946 and had 38 employees in 2012. A majority of the family worked at the office in the company.

The company had written business plans but had not reviewed the plans. The business plans focused on growth of the company and manufacturing issues. The written business plans were part of a programme at SIMTech in which company Precision had participated. There were unwritten plans for the manufacturing. The CEO and the sales manager discussed informally both long-term and short-term plans for the business and for manufacturing. However, obstacles to implementing the business plans were lack of time and lack of professionals in the company.

Phase 3

The sales manager, the production planner, the account managers and the purchasing manager tested the STRATEGO tool version 2 in June and July 2012 (see Table 16 and Paper 6). The sales manager initiated the participation in the study and led the test of the STRATEGO tool. The sales manager invited the production planner, the quality responsible, the account and purchasing managers (two persons sharing these responsibilities) to participate in the test of the STRATEGO tool. The quality responsible could not participate due to lack of time but the other people involved accepted to participate in the test. The STRATEGO tool was introduced to the participants individually and was filled out individually on paper. Each test took approximately one hour. When the sales manager had filled out the STRATEGO tool, he discussed it informally with the production planner. The result from the production planner's test of the STRATEGO tool largely confirmed the sales manager's results. The result included a list of manufacturing strategies and action plans, but they were not written down. The sales manager did not discuss the result with the other participants.

4.3 SUMMARY OF DATA

In this section, parts of the collected data during the studies, which were used in the analysis for this thesis, are briefly summarised. The general characteristics of the five companies studied are shown in Table 18.

Further, the manufacturing strategy formulation in the three phases was of interest. Table 19 shows the manufacturing strategy formulation in each phase in each company. In Phase 1 the existence of strategies, manufacturing strategies and formulation was identified in the companies studied (see Table 19). In Phase 2 for the Swedish companies the activities and participation (shown in Figures 7-10) are briefly summarised. Phase 3 consists of the test of the STRATEGO tool in all five companies and describes the participants and which version of the tool was tested at each company.

Table 18. General characteristics of the companies studied

	No. of employees	Final customers' industry	Markets	Market conditions	Competitive rivalry
Company Aluminium	110	50 % automotive	Local	Unstable	High
Company Automotive	90	Automotive	International	Unstable	High
Company Casting	58	Construction	International (Europe)	Stable	Low
Company Precision	38	Oil rig, oil refinery, military, electrical, aerospace	International	Unstable	High
Company Aerospace	15	Aerospace	International	Unstable	Medium

Table 19. Characteristics of the manufacturing strategy formulation in the companies studied

	Manufacturing strategy formulation in Phase 1	Manufacturing strategy formulation in Phase 2	Manufacturing strategy formulation in Phase 3
Company Aluminium	Written business plans, reviewed twice a year by the owners.	CEO and financial manager developed a proposal that was discussed with the functional managers at regular meetings	CEO, financial manager and sales manager STRATEGO tool version 2.5
Company Automotive	Written strategies from top management. Unit followed unwritten strategies. No formalised formulation.	Individual and group work to formulate strategies, functional strategies. 2-day workshop	Division manager, manufacturing manager, engineering manager STRATEGO tool version 2
Company Casting	Unwritten strategies and manufacturing plans. No formalised formulation.	CEO and manufacturing team worked with development activities. 2-day workshop.	CEO and manufacturing team STRATEGO tool version 3
Company Precision	Written strategies. No formalised formulation	NA	Individual work. Sales manager, production planner, account and purchasing managers STRATEGO tool version 2
Company Aerospace	Written business strategies and manufacturing roadmaps. Formalised formulation.	NA	Vice president STRATEGO tool version 3

CHAPTER 5

RESULTS

The aim of this chapter is to answer the research questions. This chapter analyses the empirical findings and reviews the literature.

“It is the process of strategic planning, not the plan itself, that appears to be the key component of business performance.” Beaver and Jennings (2000, p. 400)

5.1 INTERNAL KEY FACTORS FOR MANUFACTURING STRATEGY FORMULATION IN SMES

In Paper 2, assessment criteria for manufacturing strategy formulation frameworks were derived from literature and the case studies. These criteria were used to assess manufacturing strategy formulation frameworks to investigate the most suitable framework for SMEs. The assessment criteria in Paper 2 were the first step towards the internal key factors presented in this frame. A new literature review was conducted after Paper 2 was written, and more internal key factors were sought after and found. The previous research studies, including internal key factors for manufacturing strategy formulation, are presented in Chapter 2.4, and the internal key factors from literature are summed up in Table 8. Thereafter, the internal key factors in Table 8 were synthesised and categorised into four categories: *procedure* (what should be done), *alignment* (consistency between strategies, manufacturing strategies and manufacturing decisions), *management* (how the formulation is managed), and *realisation* (how the formulation is executed). The main categories include a number of internal key factors and are described further below. Some internal key factors were derived from the empirical findings, and they are also included in the categories. Some of the internal key factors were subordinate to other internal key factors, thus appearing on different levels. The internal key factor ‘participation’, for example, includes underlying internal key factors like multi-functional participation. Another example is ‘initiation’, which includes underlying internal key factors such as resource allocation, i.e. internal key factors that should be considered when initiating manufacturing strategy formulation.

This section will describe each category and underlying internal key factors. The case descriptions and previous studies on manufacturing strategy formulation in SMEs (Swamidass *et al.*, 2001; Barnes, 2002a, 2002b; Kiridena, 2009) are also applied. Empirical findings in this section are derived from the case descriptions in Chapter 4 and from Papers 2, 3 and 5.

5.1.1 Procedure

The first category, procedure, includes internal key factors such as initiation, gathering and analysing information, and identifying improvements. The definition of the category ‘procedure’ in this thesis is similar to Platts’s (1994) definition of his desirable characteristic procedure, which consists of the actual steps or activities that are needed to formulate a manufacturing strategy. The internal key factors included in procedure are described in detail below, starting with initiation.

Initiation

Initiation is an internal key factor for formulating manufacturing strategies and “*is necessary to provide a mechanism for introducing the strategy formulation process into an organization*” (Platts, 1994, p. 98). Initiation includes underlying internal factors that should be considered when initiating the formulation such as strategic initiative, adequate resource allocation, identification of working groups, commitment and clearly defined expectations (presented in Table 8). They are further described below.

An internal key factor that should be considered when initiating manufacturing strategy formulation is strategic initiatives. Several researchers have pointed out that manufacturing strategy formulation is driven by different strategic initiatives (Lee, 2002; Kiridena, 2009). Kiridena (2009) identifies three modes of initiation: forced, opportunistic and evolutionary, see Table 7 in Chapter 2.4. The forced initiatives are often launched by top management and are forced by reactions to external factors like competitor moves, regulatory requirements or directives from the parent company (Lee, 2002; Kiridena, 2009). Examples of forced initiatives, e.g. acquisition of other businesses and restructuring the organisation, are given by Swamidass *et al.* (2001) and Kiridena (2009); they are derived from the top management. On the other hand, opportunistic initiatives are initiated by management on a lower level than top management and are driven by new technology developments, changes in market or customer requirements, or entrepreneurial insights. Initiatives can also be triggered by internal or external events, such as a research study. Kiridena (2009) presents examples of this in a case study. In both the Swedish and the Singaporean studies (Phase 2), initiation was triggered by an external event, i.e. the invitation to participate in the research project.

To have a more successful manufacturing strategy formulation, it is important that initiation sets the stage for the formulation by having the management discuss and define the expectations for the formulation as well as the expected outcome (Platts, 1990, 1994; Kiridena, 2009). Therefore ‘clearly defined expectations’ is an underlying internal key factor for initiation. Kiridena’s (2009) case companies Tronsico, Technico and Ventico A discussed strategic initiatives in a management group, in the board of managers or with a manufacturing team. This is in accordance with the findings in the Swedish case companies. In company Aluminium, the CEO and the financial manager decided together to participate in the study. The initiative in the Singaporean studies was mostly taken by one manager (e.g. vice president, sales manager) when he/she agreed to participate in the research project.

Another internal key factor that should be considered when initiating the formulation is resource allocation (Platts 1990; Anderson *et al.*, 1991; Papke-Shields *et al.*, 2002). Resource allocation aims at identifying adequate resources such as financial, time as well as human resources. None of the previous studies on manufacturing strategy formulation in SMEs address resource allocation (e.g. Swamidass *et al.*, 2001; Barnes, 2000, 2002a, 2002b; Kiridena, 2009). The manager(s) in the case companies, together with the researchers, discussed what to be expected, the expected outcome, and allocated the resources needed, i.e. time and participants.

Platts (1994) states that identification of working groups is an important characteristic when initiating the manufacturing strategy formulation and it is an internal key factor underlying initiation. According to Platts (1990), three groups should be identified: managing, supporting and operating group. Each group has different objectives and work tasks in the manufacturing strategy formulation. The Swedish study in Phase 1 stressed the importance of involving people in the formulation. All companies in the Swedish study involved employees in the formulation in one working group (Phase 2). This group worked with all issues in the formulation from gathering and analysing information to identification of improvements. In the Singaporean companies, the initiating manager also involved employees in the formulation (Phase 3).

Another internal key factor, included in initiation, is commitment. Commitment is emphasised as important by Platts (1994) and Kiridena (2009). Even though Kiridena (2009) emphasises the importance of commitment when formulating manufacturing strategies, there is little evidence of commitment in his case study descriptions. Swamidass *et al.* (2001) and Barnes (2002a, 2002b) also do not take into account the importance of commitment. Commitment in the case companies in this research is closely related to the internal key factor participation in the category realisation that will be described in Section 5.1.4.

Gathering and analysing information

An internal key factor for manufacturing strategy formulation in the category procedure is gathering and analysing information (Platts, 1994). This internal key factor aims at making decisions in different areas and supporting the identification of competitive priorities. As presented in Paper 2, information about competitive priorities and decision categories is gathered and analysed in most of the frameworks in order to be able to identify improvements (Skinner, 1969; Platts and Gregory, 1990; Miltenburg, 2005; Hill and Hill, 2009; Slack and Lewis, 2011). Therefore it is interpreted that gathering and analysing information consists of the underlying internal key factors that aim at identification of competitive priorities and decision categories. The internal key factor competitive priorities comprises Adam and Swamidass's (1989) order winners. Hill and Hill (2009) present order winners together with order qualifiers and delighters, and these are also included in this internal key factor. The internal key factor decision categories involves infrastructural and structural decisions (see Paper 1) and includes Marucheck *et al.*'s (1990) issue elements of strategy as well as Adam and Swamidass's (1989) process variable infrastructure.

The previous empirical research studies about manufacturing strategy formulation in SMEs (Swamidass *et al.*, 2001; Barnes, 2002a; Kiridena, 2009) also do not explicitly mention competitive priorities and decision categories nor any activity of gathering and analysing information. In Phase 2, the companies in the Swedish study started with different activities depending on the development activities decided (see Figures 7, 8 and 9 in chapter 4). The first development activity in companies Aluminium and Automotive (see Figures 7 and 8) was to use the OS matrix. The use of the OS matrix in the Swedish case companies is described in Paper 3. Both companies Aluminium and Automotive began their work with the OS matrix by identifying their competitive priorities and thereafter they analysed decision categories. Company Casting began work by identifying their performance indicators as well as their corresponding competitive priorities (see Figure 9). As company Casting did not use performance measurements to any great extent, they first needed to identify the most important performance measurements. They began analysing the manufacturing and which issues should be measured. When the STRATEGO tool was developed later in Phase 2, companies Aluminium and Automotive requested that identification and analysis of competitive priorities should precede the analysis of decision categories.

Furthermore, company Aluminium (Phase 1) did an annual competitor analysis when they reviewed their business plans. Company Automotive (Phase 1) also knew their competitors. In Phase 2, these two companies requested that an analysis of competitors should be included in the STRATEGO tool. Some of the manufacturing strategy frameworks that were identified in Paper 2 include an analysis of competitors (e.g. Skinner, 1969; Platts and Gregory, 1990; Miltenburg, 2005). Considering this, information about competitors should also be gathered and analysed to be able to identify the competitive priorities and thereafter to analyse decision categories. Therefore, competitor analysis is interpreted as an internal key factor underlying gathering and analysing information.

Identifying improvements

The last internal key factor in the category procedure is identification of improvements (Platts, 1994), which is part of the actual manufacturing strategy. This internal key factor addresses how long time the strategy will last and whether all strategic alternatives are analysed. Considering this, identifying improvements includes the underlying internal key factors horizon of improvements and manufacturing strategy as well as comprehensiveness.

Swamidass *et al.* (2001) and Barnes (2002a) also do not explicitly mention identification of improvements. Company Casting identified improvements along the way in Phase 2. These improvements were thereafter implemented directly in manufacturing. Contrary to this, company Automotive developed quarterly action plans for improvements in manufacturing. The action plans are translated as the manufacturing strategies in company Automotive.

An underlying internal key factor that should be considered when identifying improvements is the time horizon of improvements and manufacturing strategy. Papke-Shields *et al.*'s (2002, 2006) planning characteristic 'horizon' is defined as, how long time the strategy is intended to run, and this definition is also used in this research. Platts (1990) highlights the time horizon of improvements as he divides improvements into operational and strategic improvements. Platts's suggestions of improvements show both a short and a long perspective, where the long-term strategic improvements can be interpreted as the manufacturing strategy. The studied companies' horizons for improvements, manufacturing strategies and strategies varied; company Casting had a five-year horizon for the informal strategies while company Automotive had a 12-week horizon for action plans in manufacturing and a one-year horizon for the strategies. Kiridena's (2009, p. 134) case company Technico stated that "*the longest time frame that we're working on is twelve months, no five-year plans, and really the working time frame is three to six months*". This is similar to company Automotive (Phase 2) "*as the world changes so much [in a year]...one year did not work for us, and it is better for us to take smaller pieces and therefore we decided what to do in the next quarter*" (division manager at company Automotive).

When identifying improvements, all strategic alternatives should be analysed and considered to be able to choose the most appropriate improvements and manufacturing strategies (Papke-Shields *et al.*, 2006). However, no evidence about considerations of all strategic alternatives was identified in the case companies or in previous empirical research studies about manufacturing strategy formulation in SMEs (Swamidass *et al.*, 2001; Barnes, 2002a, Kiridena, 2009).

5.1.2 Alignment

The second category, alignment, includes internal key factors related to the alignment of strategies on different levels as well as to objectives. The internal key factors in this category are consistency between strategies, functional strategies and manufacturing strategies, as well as consistency between strategies and manufacturing. This category also includes the company's definition of manufacturing strategy and manufacturing objectives as internal key factors.

Adam and Swamidass (1989) stress that consistency between strategies and manufacturing is an important process variable, which is considered as an internal key factor in this thesis. All case companies had informal or formal strategies (in Phase 1). In Phase 1, most of the case companies also had informal plans or visions for manufacturing that can be translated into manufacturing strategy. The case companies' informal or formal strategies mainly focused on growth linked to the informal plans for manufacturing, indicating a close relation between strategies and manufacturing. Considering this, the strategies were implemented directly into manufacturing. This is similar to Kiridena's (2009, p. 174) smaller case companies that state: "*We don't really have an individual acceptable manufacturing strategy.*"

We have an overall scope of strategy”, which indicates the close relation between strategies and manufacturing.

Several research studies about internal key factors (Adam and Swamidass, 1989; Marucheck *et al.*, 1990; Anderson *et al.*, 1991; Lindström, 2008) highlight the relations between strategies, functional strategies and manufacturing strategies. Anderson *et al.* (1991) and Papke-Shields *et al.* (2006) emphasise the necessity of strategic anchors, i.e. the alignments between budgets, strategies and manufacturing strategies. This is in line with Barnes (2002a), who identifies a close relation between strategies, marketing strategies, manufacturing objectives and manufacturing strategies in his studies about SMEs. In Phase 2, strategies were closely aligned with manufacturing strategies in two of the Swedish companies. Company Aluminium decided to include the formulation of manufacturing strategies into their annual business plan review process. Before company Automotive formulated functional strategies that included manufacturing strategies, they identified and formulated strategies. In these two case companies, this seems to be done naturally as the manufacturing strategy originated from the set directions (strategies). However, company Automotive was the only company where functional strategies could be distinguished.

An internal key factor is a company’s definition of manufacturing strategy as it is important that a company speaks the same language (Marucheck *et al.*, 1990). The previous empirical research studies about manufacturing strategy formulation in SMEs (Swamidass *et al.*, 2001; Barnes, 2002a; Kiridena, 2009) do not mention the companies’ definition of manufacturing strategy. In Phase 1, all case companies mentioned some kinds of strategies, plans, objectives or vision, even though all case companies did not speak about strategies or manufacturing strategies explicitly.

The category alignment also includes the internal key factor ‘objectives of manufacturing’ as identified by Marucheck *et al.* (1990). Barnes (2002a) highlights the manufacturing objectives in SMEs in his study and reports that most of his case companies seemed to have manufacturing objectives. In Phase 1, only company Aluminium had written manufacturing objectives that were measurable. These manufacturing objectives were included in company Aluminium’s target map.

5.1.3 Management

The third category, management, concerns how formulation is managed and includes internal key factors such as who is responsible for formulation, the role of the manufacturing manager and owner’s influence. Management is described in most of the previous research studies about internal key factors for manufacturing strategy formulation (Adam and Swamidass, 1989; Marucheck *et al.*, 1990; Anderson *et al.*, 1991; Lee, 2002; Papke-Shields *et al.*, 2006; Kiridena, 2009) (see also Table 8 in Chapter 2.4). Adam and Swamidass (1989) focus on the role of manufacturing managers in the manufacturing strategy formulation. Anderson *et al.* (1991) address managerial leadership, which they define as to what extent the top management takes a determined and active role in the manufacturing strategy formulation. Papke-Shields *et al.* (2006) identify flow as the locus of authority for strategic planning, which is here seen as a management issue. Platts (1990, 1994) includes project management as a desirable characteristic to ensure that the formulation is adequately resourced and runs to a well-defined plan. In this thesis, project management is interpreted as a management issue and included in this category.

Both Barnes (2002a) and Kiridena (2009) highlight who is responsible for the formulation in terms of CEO, managing director or manufacturing manager. In the companies studied (in Phase 2 in the Swedish study and Phase 3 in the Singaporean study), the initiator (i.e. CEO, managing director, etc.) was also responsible for the manufacturing strategy formulation. The manufacturing managers participated in the formulation in the companies studied but were not

responsible for the manufacturing strategy formulation. Thus the manufacturing managers in both company Casting (late in Phase 2) and in company Automotive (Phase 2) were responsible for developing action plans for manufacturing.

The owners' influence on manufacturing strategy formulation is described in Paper 4. It is considered as an internal key factor for manufacturing strategy formulation, as the owners in the end are responsible for strategies and manufacturing strategies. Few of the previous empirical research studies about manufacturing strategy formulation in SMEs focus on owners' influence on manufacturing strategy formulation. Barnes (2002a) states that attitudes of the owners are likely to impact a company's strategy and their attitudes towards manufacturing may directly affect manufacturing decisions and actions. For example, in company Electro (Barnes, 2002a, 2002b), the manufacturing manager's freedom of actions had been constrained by operational requirements from the owners to conform the operations in the different subsidiaries. The owners of company Casting did not participate in the manufacturing strategy formulation in Phases 2 and 3. In company Automotive, the owners gave the company some strategic directions, but they were not used to any great extent in the unit (Phase 1). The owners of company Automotive were not involved in the manufacturing strategy formulation in Phases 2 or 3. However, the two owners of company Aluminium were CEO and financial director respectively, and they formulated business plans (Phase 1), thus they were very active in the formulation. As they tried to separate their owner roles and professional roles, it is unclear how much the owners influenced the manufacturing strategy formulation (Phase 2 and 3). This is consistent with the findings from the Singaporean study. The owners of company Precision worked in the organisation, but it was unclear how much they influenced the manufacturing strategy formulation (Phase 3). The owner of company Aerospace formulated the business strategies and discussed the roadmap with the VP (Phase 1) but was not involved in the test of the STRATEGO tool (see Phase 3).

5.1.4 Realisation

The category realisation addresses how the formulation is executed and how organisational issues are managed. This category includes internal key factors concerning participation, communication, structured meetings, time duration, formalisation and manufacturing strategy frameworks.

Participation

The realisation category includes participation as an internal key factor. In this internal key factor, there are underlying internal key factors related to participation, such as individual or group participation and multi-functional participation.

Previous studies about internal key factors argue for the importance of participation of employees in manufacturing strategy formulation (Adam and Swamidass, 1989; Anderson *et al.*, 1991; Maruchek *et al.*, 1990; Platts, 1990; Papke-Shields *et al.*, 2002). When participation of employees in manufacturing is mentioned in previous empirical research studies, it is often in terms of the manufacturing manager (Adam and Swamidass, 1989; Swamidass *et al.*, 2001). Barnes (2002a) describes the participation of top management and manufacturing manager in the manufacturing strategy formulation in SMEs, but he does not say if other employees participated.

Platts (1994) advocates both individual and group participation, which in this research is considered as a significant internal key factor for participation. In Phase 2, all companies in the Swedish study worked in groups. Moreover, company Automotive also worked individually with the development of action plans for each function. Teamwork and individual work in company Automotive were combined: first participants worked in a team, then individually and then they met again in the team to discuss the progress. According to

company Automotive, “we helped each other, it was good, we were open-minded in the discussions, we usually are. Then we identified many things and people were self-critical of themselves and their function”. Conversely, the Singaporean companies (Phase 3) mainly formulated the manufacturing strategy individually, and informally discussed strategic issues considering the STRATEGO tool outside the planned meetings, for example when they met at the office.

Platts (1994) advocates participation in order to achieve enthusiasm, understanding and commitment. If the participants are committed when formulating manufacturing strategies, successful implementation is more likely. None of the previous studies on manufacturing strategy formulation in SMEs (Barnes, 2002a; Kiridena, 2009) explicitly mention whether group participation led to commitment. The Swedish companies were satisfied with formulating manufacturing strategy in groups that enabled discussions. The Swedish companies also stated that it was good to have something to rally around and to discuss about. In the discussions in the groups, it was possible for the researchers both to get a good overview of the company and manufacturing and to get people involved.

Anderson *et al.* (1991) included organisational involvement in their process attributes specifying it as the different functions’ involvement in the formulation. Participation from different functions is in this research interpreted as an important internal key factor that should guide the choice of participants. Kiridena (2009) mentions multi-functional participation in the manufacturing strategy formulation in SMEs but does not develop it further. In Phase 2, the Swedish companies stressed the importance of participation from different functions as well as from within the manufacturing function. During Phases 2 and 3, companies Aluminium and Automotive involved the management teams consisting of individuals from different functions. Company Casting and the companies in the Singaporean study did not have different functions but involved employees that worked with, for example, sales, purchasing, manufacturing and quality. According to the CEO of company Casting, this was positive for the group as “it was good to see the different views of the people and to open up this discussion”.

Communication

The realisation category includes communication as an internal key factor. Communication deals with to what extent the manufacturing strategy is communicated throughout the organisation (Anderson *et al.*, 1991). There seems to be a distinction that communication is of major concern when implementing manufacturing strategy but it is not so significant in the manufacturing strategy formulation (Maruchek *et al.*, 1990). None of the previous studies on manufacturing strategy formulation in SMEs describe communication explicitly (e.g. Barnes, 2002a; Kiridena, 2009). Company Automotive explicitly communicated the outcome of the formulation, i.e. strategies and manufacturing strategies, to all the employees. This presentation was viewed as the end of the formulation and the beginning of the implementation.

Structured meetings

Another internal key factor in the realisation category is structured meetings including the underlying internal key factor workshop-style meeting. Decision-making forums are emphasised in Platts (1990, 1994) as desirable characteristics when formulating manufacturing strategies. Decision-making forums are in this thesis interpreted as a kind of structured meetings. Papke-Shields *et al.* (2002) also include frequency and richness of meetings in their planning characteristic ‘intensity’. None of the previous empirical studies on manufacturing strategy formulation in SMEs describe any structured meetings explicitly (e.g. Barnes, 2000, 2002a; Kiridena, 2009). Considering the empirical findings in Phase 1, neither

the Swedish nor the Singaporean companies were used to working with structured strategic formulation in any setting. Companies Aerospace and Aluminium reviewed their business plans annually but did not have any particular strategy meetings for strategy formulation. In company Aluminium, the CEO and the financial manager first discussed business plans together and thereafter the proposal was discussed in the regular meetings with the management team. Companies Casting and Precision had no structured meetings for either strategy or manufacturing strategy formulation in Phase 1. A difference concerning meetings in the Swedish companies can be discerned between the different phases. In Phase 2, company Aluminium discussed the manufacturing strategy issues at their regular management team meetings. In contrast, company Casting had specific project meetings in the manufacturing team every second week (Phase 2). In Phase 3, when the companies in both the Swedish and the Singaporean studies tested the STRATEGO tool, all three companies decided to have separate planned meetings aimed at testing the tool.

The internal key factor structured meeting includes workshop-style meetings as an underlying internal key factor as emphasised by both Platts (1994) and two of the case companies in this research. Platts (1994) emphasises workshop-style meetings as a way to gather people together and collectively agree on objectives, identify problems and develop improvements. Workshop-style meetings have rarely been discussed in prior empirical studies on manufacturing strategy formulation in SMEs (e.g. Barnes, 2002a; Kiridena, 2009). To gather people, Platts' (1990) case companies suggest a two-day workshop as an alternative to separate meetings. In line with Platts (1990), in Phase 2 companies Automotive and Casting, each had a two-day workshop outside the company, where they discussed both strategies and manufacturing strategies. The companies decided the workshops at these two companies spontaneously. Platts's case companies were satisfied with the workshops, but Platts (1990) identifies several possible problems with a workshop. Platts's possible problems include lack of time to collect data before the workshop and less time to reflect on strategic issues. Neither of the companies Automotive or Casting seemed to have any problems with the workshops or after the workshops. For example, company Automotive collected data before the workshop and had follow-up meetings after the workshop to reflect individually on strategies. Companies Automotive and Casting stressed that they were satisfied with the outcome from their workshops and this kind of structured meeting.

Time duration

When time duration is discussed in previous research, it is often related to the suitable time to formulate a manufacturing strategy using a manufacturing strategy framework (see Paper 2). In this research, time duration is viewed as the actual time to formulate a manufacturing strategy and is considered as an internal key factor. The time for formulating a manufacturing strategy includes the time to use a manufacturing strategy framework; in previous research studies the time needed varies considerably (see Paper 2). For example, Lindström (2008) states that 2-3 days are an appropriate time to formulate a manufacturing strategy, while Riis and Johansen (2003) propose that the development of a manufacturing vision would normally take three to five months (described in Paper 2). None of the previous empirical research studies on manufacturing strategy formulation in SMEs define the time it takes to formulate a manufacturing strategy (Swamidass *et al.*, 2001; Barnes, 2002a; Kiridena, 2009). The Swedish companies (reported in Paper 2) agreed that the formulation and use of a framework should not be too time-consuming but did not say how long time is preferable for formulation.

Platts (1994) suggests that an agreed timescale is desirable when formulating a manufacturing strategy, as there are always some reasons to postpone activities. Therefore an agreed timescale is interpreted as an internal key factor underlying time duration. None of the previous empirical studies on manufacturing strategy formulation in SMEs specify any agreed

timescales (Swamidass *et al.*, 2001; Barnes, 2002a; Kiridena, 2009). However, Platts (1990) investigates manufacturing strategy formulation in two studies about larger companies. The first study did not have an agreed timescale. The time to formulate manufacturing strategies varied between Platts's case companies and in some of them, the formulation was delayed for various reasons. In accordance with Platts's (1990) studies, the time for formulating manufacturing strategy in Phase 2 varied in the Swedish companies, for several reasons. One example of this is the work with implementing a second shift at company Casting. In Platts's (1990) second study, he constrained the time for formulating a manufacturing strategy in the case companies to 6-7 weeks, with which his companies were satisfied. This has similarities with the Singaporean study (Phase 3) as the time for testing the STRATEGO tool was discussed and decided at the first meeting. The time to formulate a manufacturing strategy and test the tool was decided to take approximately 4 weeks for the Singaporean companies as the participants needed time to reflect between the meetings. The Singaporean companies seemed satisfied with these constraints.

Formalisation

Formalisation is an internal key factor, described by previous research studies on internal key factors (Anderson *et al.*, 1991; Lee, 2002; Papke-Shields *et al.*, 2002). Papke-Shields *et al.* (2002) define formality as the extent to which the planning process is structured through written procedures and the extent of documentation resulting from the formulation. Formalisation is here defined according to Walsh and Dewar (1987) (presented in Chapter 2.2.2). Previous empirical studies about manufacturing strategy formulation in SMEs indicate the lack of formalisation when formulating manufacturing strategy (Barnes, 2000, 2002a, 2002b; Kiridena, 2009). Barnes (2002a, 2002b) concludes that none of his case companies had a formalised manufacturing strategy formulation while three of six companies had a more formalised strategy planning. In Phase 1, none of the case companies in this research had a formalised manufacturing strategy formulation. Companies Aerospace, Aluminium and Automotive had written strategies but did not document the actual formulation procedure. Therefore, formalisation is considered as an internal key factor.

Manufacturing strategy frameworks

The last internal key factor in the realisation category concerns manufacturing strategy frameworks. This internal key factor includes the underlying internal key factors decision aid (Anderson *et al.*, 1991) and simple tools and techniques (Platts, 1994). These two underlying internal key factors can be viewed as internal key factors that guide the use of manufacturing strategy frameworks. Previous research studies on manufacturing strategy formulation in SMEs (see e.g. Swamidass *et al.*, 2001; Barnes, 2002a, 2002b; Kiridena, 2009) do not mention any manufacturing strategy frameworks. In the two studies in this research, the use of strategy frameworks in general was sparse in the case companies (Phase 1). Company Aluminium mentioned that they used a strategic analysis tool, SWOT, to analyse their situation in the annual review of their business plans (Phase 1). Besides that, none of the case companies used any strategy frameworks or tools (Phase 1).

Platts (1990) emphasises strategy and manufacturing strategy frameworks that are simple to use and understand. In Phase 1 (reported in Paper 2), the Swedish companies requested a manufacturing strategy framework that was easy to use and understand. Therefore 'simple and easy to use tools' are considered as a significant internal key factor when choosing manufacturing strategy frameworks and tools. In Paper 2, the operations strategy matrix (OS matrix) (Slack and Lewis, 2011) was identified as the simplest manufacturing strategy framework. The OS matrix comprises the matrix shown in Figure 11 and captures the alignment of competitive priorities (performance objectives) and decision categories (decision

areas). The OS matrix does not include any written instructions and predefined steps. The OS matrix is presented in Paper 3.

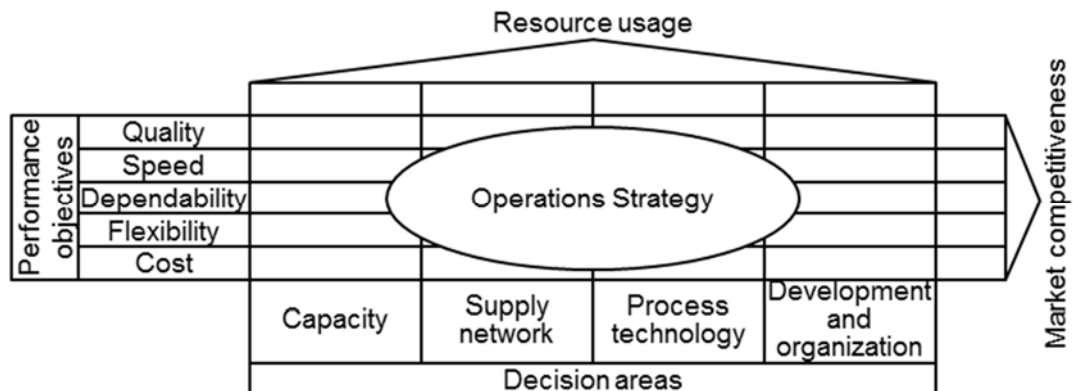


Figure 11. The Operations Strategy matrix (Slack and Lewis, 2011).

In Phase 2, the OS matrix was introduced to the Swedish companies as described in Paper 3. During the work with the OS matrix, the companies in the Swedish study requested more defined steps. Company Automotive perceived that the OS matrix was difficult to use without further instructions and that all parts in the tool should be clearly explained. Based on the Swedish companies' experience from using the OS matrix and their requirements on manufacturing strategy frameworks (described in Paper 2 and in Säfsten *et al.*, 2012), the STRATEGO tool was developed. The Swedish companies and company Precision tested version 2 of the STRATEGO tool (Phase 3). During the evaluation of that version of the tool, the companies asked for a higher degree of formalisation in the form of more thoroughly written descriptions and guidelines for decision categories. This led to the development of the STRATEGO tool version 3, which included descriptions that are more extensive (see Säfsten *et al.*, 2014b).

Another internal key factor underlying a manufacturing strategy framework as described above is decision aid. According to Anderson *et al.* (1991), manufacturing strategy frameworks can be a decision aid in the manufacturing strategy formulation. The companies studied thought the STRATEGO tool was a good support to achieve a structured manufacturing strategy formulation and therefore it is considered that using tools and frameworks as decision aids is appropriate. This is further developed in Paper 6.

5.2 RELATING INTERNAL KEY FACTORS FOR MANUFACTURING STRATEGY FORMULATION TO SME CHARACTERISTICS

The categories of internal key factors for manufacturing strategy formulation, derived from literature and empirical findings, are presented above. Table 20 presents the categories with underlying internal key factors on different levels as described in Chapter 5.1. The internal factors are approached on two different levels as the underlying internal key factors can be viewed as important or guiding internal key factors when considering the overlying internal key factors, see Table 20. One example is the internal key factor participation with the underlying internal key factors individual and group participation and multi-functional participation. The underlying internal key factors, i.e. individual and group participation and multi-functional participation in this example, imply that these internal key factors should be regarded when a company considers who should participate.

In Table 20, a majority of the internal key factors are derived from literature about larger companies, and two internal key factors are derived from the empirical findings, competitor analysis and owner’s influence.

Table 20 also shows the appearance of the internal key factors derived from literature in the empirical studies in this research and in previous empirical research studies on SMEs (Barnes, 2000, 2002a, 2002b; Swamidass *et al.*, 2001; Kiridena, 2009). As can be seen in Table 20, most of the internal key factors are reflected or required by the case companies. However, as shown in Table 20, less key factors are reflected in the previous empirical research studies about manufacturing strategy formulation in SMEs (Swamidass *et al.*, 2001; Barnes 2000, 2002a, 2002b; Kiridena, 2009).

Table 20. List of categories of internal key factors for manufacturing strategy formulation and their appearance in the empirical studies in this thesis and in previous empirical research studies

Internal key factors	Empirical studies presented in this thesis	Previous empirical research studies
Procedure		
<i>Initiation:</i>	X	X
Strategic initiatives	X	X
Clearly defined expectations	X	
Adequate resource allocation	X	
Identification of working groups	X	
Commitment		
<i>Gathering and analysing information:</i>	X	
Competitor analysis	X	
Competitive priorities	X	
Decision categories		
<i>Identification of improvements:</i>	X	X
Horizon of improvements and manufacturing strategies	X	X
Comprehensiveness		
Alignment		
<i>Consistency between strategies and manufacturing</i>	X	X
<i>Consistency between strategies, functional strategies and manufacturing strategies</i>	X	X
<i>Company's definition of manufacturing strategy</i>	X	
<i>Objectives of manufacturing</i>	X	X
Management		
<i>Responsibility of formulation</i>	X	X
<i>Role of manufacturing manager</i>	X	X
<i>Owner's influence</i>	X	
Realisation		
<i>Participation</i>	X	X
Individual and group participation	X	
Multi-functional participation	X	X
<i>Communication</i>		X (lack of communication)
<i>Structured meetings</i>	X	
Workshop-style meetings	X	
<i>Time duration</i>	X	
An agreed timescale	X	
<i>Formalisation</i>	X	X (lack of formalisation)
<i>Manufacturing strategy frameworks</i>		
Decision aid	X	
Simple and easy to understand and use	X	

5.2.1 Internal key factors derived from literature, and empirical data

When comparing the internal key factors derived from literature in Table 20 with the empirical data in this thesis and previous empirical research studies about manufacturing strategy formulation in SMEs (Barnes, 2000, 2002a, 2002b; Swamidass *et al.*, 2001; Kiridena, 2009), it was found that not all internal key factors appeared in the empirical data or in previous literature about SMEs. Table 21 presents the internal key factors derived from literature about larger companies that did not appear in the manufacturing strategy formulation in the empirical data presented in this thesis and the literature about SMEs. These are commitment (underlying initiation) and comprehensiveness (underlying identification of improvements) in the category procedure, communication (underlying participation) and use of manufacturing strategy frameworks in the category realisation, see Table 21. Even though most of the internal key factors appeared in the case companies, it is important to investigate why certain internal key factors did not appear either in the empirical studies or in previous research studies carried out in SMEs. One explanation of this might be the characteristics that SMEs share. Therefore it is of interest to further analyse the relationship between SME characteristics and the internal key factors that are not reflected either by practice or previous research studies. The characteristics shared by SMEs are presented in Papers 1 and 2 and described further in Section 2.1.2 in this frame. In Chapter 2.1.2, four main SME characteristics are presented: management practices, operational environment, limited resources and operational focus. Table 21 shows which main characteristics of SMEs influence the internal key factors that are not reflected in the empirical studies. The influence of the SME characteristics is shown further in Table 21 below. Two of the internal key factors, commitment and comprehensiveness, seem not to be influenced by SME characteristics and are not further mentioned in this section but discussed in Chapter 6.1.

Table 21. The internal key factors that did not appear in the empirical data presented in this thesis or in the previous research studies about SMEs, and their relation to SME characteristics

Internal key factors not reflected in the empirical data or in previous empirical research studies in SMEs	SME characteristics
Procedure	
Commitment	
Comprehensiveness	
Realisation	
<i>Communication</i>	Operational focus, Management practices
<i>Manufacturing strategy frameworks</i>	Organisational environment Management practices

Communication was not reflected in the empirical findings in this research or in previous empirical research studies about manufacturing strategy formulation in SMEs (see Table 21). Kiridena (2009) reports the lack of communication in his small or medium-sized case companies. One example of the lack of communication in SMEs is shown in one of Ates *et al.*'s (2013, p. 45) case companies where one manager said “... *the main challenge we have is providing channels of communication to prevent technical decisions and the progress of our projects to be interpreted personally. We don't have any visual display of performance in the factory and the general consensus is that it doesn't lead to higher motivation among the workers. Our workers are used to being told to have a job completed within a set period of time and for the most part this is achieved.*” As mentioned in Section 5.1.4, the communication of strategies and formulation in the case companies in this research was unclear. The only visible proof of communication of strategy was when company Automotive presented the strategy to the employees at the end of Phase 2. Furthermore, even though the

communication of strategy was unclear in the case companies, there were hints that the participants in the formulation informally communicated and discussed decisions with employees in, for example, company Casting. In the Singaporean companies the participants also discussed the result informally. The unclear and invisible communication may be related to the flat organisation, where communication is more informal and information may be discussed outside formal meetings. The communication can also depend on the manager and the informal and centralised decision making (shown in Table 21). The operational focus may be an explanation for the invisible communication in both empirical studies and previous research studies as described in the section about organisational environment. The operational focus is said to lead to an absence of communication (Tallon *et al.*, 2000; Ates *et al.*, 2013).

As shown in Table 21, neither the case companies (in Phase 1) nor previous studies about manufacturing strategy formulation in SMEs (Swamidass *et al.*, 2001; Barnes, 2002a, 2002b; Kiridena, 2009) mention the use of any manufacturing strategy framework. Previous research studies on strategy frameworks in SMEs also mention the poor use of strategy frameworks in SMEs (Stonehouse and Pemberton, 2002; Woods and Joyce, 2003; Ates, 2008). This can be related to the management practices in SMEs. The empirical findings in this research found evidence of the influence of management practices on the use of manufacturing strategy frameworks and tools. In the case companies, the use of manufacturing strategy frameworks depends on the managing director and the manufacturing manager and their knowledge and experience of manufacturing strategy frameworks and tools. Also, the introduction of manufacturing strategy frameworks may be easier in SMEs than in larger companies due to the centralised decision making. The financial manager in company Aluminium claims, “[A large company] *does not have the freedom to work with the STRATEGO tool. And the question is, if it [the STRATEGO tool] derived from the side, what acceptance does it get from the board of directors, as you answer to them?*”.

5.2.2 Relating other internal key factors to SME characteristics

In Chapter 5.1, some internal key factors in Table 20 appeared in similar ways in the manufacturing strategy formulation in the case companies and in the previous empirical research studies about SMEs (Barnes, 2000, 2002a, 2002b; Swamidass *et al.*, 2001; Kiridena, 2009). For example ‘who is responsible for the formulation’ and ‘alignment between strategies and manufacturing strategies’ appeared in similar ways in the case companies and in previous research studies about SMEs. One explanation for the similarities in the appearance of internal key factors is that they are among the characteristics that SMEs share.

When analysing how the internal key factors appeared in the manufacturing strategy formulation in the case companies and in previous research studies about SMEs (Barnes, 2000, 2002a, 2002b; Swamidass *et al.*, 2001; Kiridena, 2009), different patterns in the appearance were also found (see descriptions in Chapter 5.1) in, for example, participation and formalisation. This can be explained by the unique manufacturing strategy formulation in the case companies, shown in Figures 7, 8, 9 and 10 and presented in Paper 3. The unique manufacturing strategy formulation in the case companies and the different patterns in the appearance of the internal key factors in the case companies and in previous studies carried out on SMEs may also be related to the SME characteristics. Therefore it is of interest to further investigate the appearance of internal key factors derived from literature and presented in Table 20 in the case companies and in previous research studies carried out in SMEs. The internal key factors listed in Table 21 are excluded in this section as they were investigated in Chapter 5.2.1. When no consistence was found in the appearance of internal key factors in the manufacturing strategy formulation in the case companies and in the previous research about SMEs, the internal key factor was not investigated further with the SME characteristics. One example is the internal key factor time duration where no consistence in the appearance of the

internal key factors in the case companies or in previous studies about SMEs was found. Another example of an internal key factor not included in Table 22 is strategic initiative. As there seems to be no consistence between strategic initiatives in the previous research studies about SMEs (Barnes, 2002a, 200b; Kiridena, 2009) and the strategic initiatives were derived from the research project in all case companies, no relation between SME characteristics and strategic initiatives were found. Nor were ‘workshop-style meetings’ and ‘simple and easy to use’ investigated further as both Platts’s (1990) larger case companies and the companies Automotive and Casting presented in this research proposed workshop-style meetings and required simple and easy to use frameworks and tools. Due to this, workshop-style meetings and simple and easy to use frameworks and tools seem to be desirable internal key factors for both larger companies and SMEs. No relation between SME characteristics and the internal key factors ‘gathering and analysing information’ and ‘identification of improvements’ was found and therefore these are not included in Table 22.

Table 22 presents which of the internal key factors are related to SME characteristics (management practice, operational environment, limited resources and operational focus). The relation between SME characteristics and internal key factors is described below the table and distributed in accordance with the four main SME categories.

Table 22. Internal key factors’ relation to SME characteristics and the appearance of the internal key factors in the empirical studies presented in this thesis and in previous empirical studies

Internal key factors	Empirical studies presented in this thesis	Previous empirical studies	SME characteristics
Procedure			
<i>Initiation:</i>	X	X	
Adequate resource allocation	X		Limited resources
Identification of working groups	X		Limited human resources
Alignment			
<i>Consistency between strategies and manufacturing</i>	X	X	Organisational environment
<i>Consistency between strategies, functional strategies and manufacturing strategies</i>	X	X	Organisational environment
Management			
<i>Responsibility of formulation</i>	X	X	Management practices
<i>Role of manufacturing manager</i>	X	X	Management practices
Realisation			
<i>Participation</i>	X	X	Limited human resources, Management practices
Multi-functional participation	X	X	Organisational environment
<i>Formalisation</i>	X	X (lack of formalisation)	Management practices Operational focus

Management practices

One of the most distinguishing characteristics of SMEs is management practices, including leadership style, manager’s personality and informal and centralised decision making (e.g. Ghobadian and Gallear, 1997; Beaver and Jennings, 2000; Daily *et al.*, 2002; Cagliano and Spina, 2002; Hudson Smith and Smith, 2007; Ates, 2008). Management practices seem to be related to internal key factors in the category management and some internal key factors in the category realisation like participation and formalisation (see Table 22). All case companies in this research relied heavily on the managing director and his/her decisions (described in Paper 5). The Swedish case companies’ leadership styles and corresponding organisational culture

are presented further in Paper 5 and shown in Figure 12. As shown in Figure 12, the leadership style differs in the Swedish case companies.

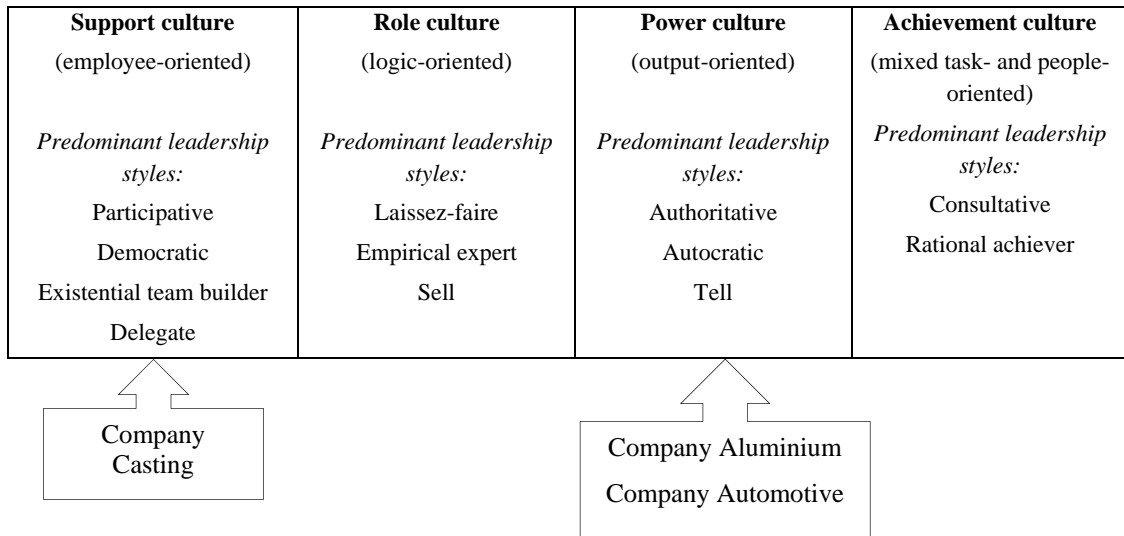


Figure 12. Position of the companies in the Swedish study in Pheysey's (1993) model.

There seems to be different patterns regarding how participation reflected in the case companies can be related to different leadership styles and organisational cultures in the Swedish companies. For example, companies Aluminium and Automotive with a power culture (see Figure 12) involved functional managers while company Casting with a support culture involved the manufacturing team. The managing director of Company Casting said that it was natural to invite the manufacturing team as, after all, the formulation concerned manufacturing issues.

There are similarities in the appearance of the internal key factors in the case companies and in previous studies about SMEs in the category management that can be related to the centralised decision making. Those responsible for the formulation are influenced by the centralised decision making. In the companies studied in this research, the managing director (CEO, division manager, etc.) initiated and led both the strategy formulation and the manufacturing strategy formulation. None of the manufacturing managers initiated or were responsible for the manufacturing strategy formulation but they were all part of the team. The manufacturing managers in company Casting (late in Phase 2) was, however, responsible for developing more short term action plans for manufacturing. Who is responsible for manufacturing strategy formulation in SMEs is contrary to findings from previous studies on manufacturing strategy formulation in larger companies (Marucke *et al.*, 1990; Kiridena, 2009), where manufacturing strategy formulation was initiated and lead by the manufacturing manager while the CEO and/or the managing director formulated the overall strategies. Therefore, one of the major differences between SMEs and larger companies regarding manufacturing strategy formulation seems to be who initiated and was responsible for the manufacturing strategy formulation.

The empirical findings related to the internal key factor formalisation differ in the case companies in the different phases. The differences can be related to the varying leadership styles, the personalised management and the managers' different experiences of manufacturing strategy formulation. In Phase 1, companies Aluminium and Aerospace had a more formalised strategy formulation. Company Automotive had a formal strategy formulation on the overall strategy level but less formalised strategy formulation in the unit. Companies Casting and Precision had less formalised formulation in Phase 1. During the

development of the STRATEGO tool, the Swedish case companies requested a more formalised formulation. Findings from previous research about strategy formulation or manufacturing strategy formulation in SMEs (e.g. Robinson and Pearce, 1984; Harris *et al.*, 2000; Barnes, 2002a, 2002b; Cagliano and Spina, 2002; Verreynne, 2005; Ates, 2008; Kiridena, 2009) are consistent concerning the lack of formalisation in SMEs. These previous research studies relate the lack of formalisation to the centralised decision making in SMEs. The informal and centralised decision making can also be related to the degree of formalisation in the case companies as the decision making is centralised to a few people in SMEs.

Organisational environment

Another SME characteristic is the organisational environment that contains organisational culture (Hudson Smith and Smith, 2007). SMEs often have a flat organisation with few hierarchical levels (Ghobadian and Gallea, 1997). In Paper 5 it is concluded that leadership style seems to be more significant in the manufacturing strategy formulation in SMEs than organisational culture due to the managers' visibility and centralised decision making in the formulation. Therefore this section does not focus on organisational culture but on the influence of the flat organisation on internal key factors. The analysis shows that organisational environment is related to internal key factors in the category alignment and to some internal key factors in the category realisation (see Table 22).

The empirical findings show consistency among the case companies in terms of alignment between strategies and manufacturing, which can be related to the flat organisation with few hierarchical levels. Companies Casting and Precision, for example, discussed strategies including both growth and manufacturing and implemented these strategies directly in the manufacturing.

The alignment between functional strategies is related to the size of the organisation in the case companies. In the smaller case companies as well as the smaller companies in Kiridena's (2009) study, there existed an overall strategy that included all functions. In the medium-sized companies Aluminium and Automotive the functions could be discerned and company Automotive was the only company that formulated plans for all functions. This is different from larger companies where it is assumed that there are functional strategies (Skinner, 1969; Hill and Hill, 2009; Slack and Lewis, 2011).

Multi-functional participation in the Swedish case companies can be related to the organisational size. A flat organisation is related to the smaller case companies, Casting, Precision and Aerospace, since a function in these companies could consist of one person, or one person could be the manager of several functions like, for example, the engineering and manufacturing manager in company Aerospace. Company Automotive, on the other hand, had a larger organisation than the smaller companies due to its size.

Limited resources

One of the most distinguishing characteristics of SMEs is their limited resources like limited time and limited human resources (Hudson Smith and Smith, 2007, Bridge *et al.*, 2009, Ates *et al.*, 2013). Limited time seems to be related to internal key factors in the category procedure such as resource allocation and identification of working groups, and in the category realisation such as manufacturing strategy frameworks. One example of this was that all the Swedish companies in Phase 1 requested not too time-consuming manufacturing strategy frameworks. The limited resources can have consequences for resource allocation, as there are a limited number of people and limited time. None of the case companies or previous research studies on manufacturing strategy formulation in SMEs (Barnes, 2002a; Kiridena, 2009) explicitly mention identification of working groups. In this research, all case

companies identified one working group due to the recommendations from the researchers in the STRATEGO project. However, the managers at the case companies decided who should participate. This is also related to limited human resources as the case companies consisted of a limited number of individuals who could participate. However, the idea of working in different groups with different aims should be applicable to SMEs just as well as people could participate in different groups and have different roles.

Operational focus

It is stated that SMEs often have an operational focus and often focus on daily problem solving (Cagliano and Spina, 2002; Wiesner and Millett, 2012; Ates *et al.*, 2013). The operational focus is related to the appearance of internal key factors like formalisation and workshop-style meetings presented in Chapter 5.1. Formalisation is described in the section about management practices above. Surprisingly, in Phase 2, the Swedish companies requested a more formalised formulation. The formalised formulation enabled the companies studied to focus on discussions about strategic issues, which they usually did not have time to discuss as they mostly prioritised operational activities.

5.2.3 Internal key factors for manufacturing strategy formulation in SMEs

As mentioned above and presented in Table 20, a majority of the internal key factors appeared in the case companies' manufacturing strategy formulation. It was also indicated in Chapter 5.2.1 that some internal key factors that appeared in the case companies are related to SME characteristics. Figure 13 presents the internal key factors that appeared in the case companies' manufacturing strategy formulation and in previous studies about manufacturing strategy formulation in SMEs; their relation to SME characteristics is also shown in Figure 13. However, some of these internal key factors seem not to be related to SME characteristics. Figure 13 also shows the internal key factors derived from literature about larger companies that did not appear in the case companies. The internal key factors that did not appear in the case companies or in previous studies about manufacturing strategy formulation in SMEs (Barnes, 2000, 2002a, 2002b; Swamidass *et al.*, 2001; Kiridena, 2009) are shown in red in Figure 13.

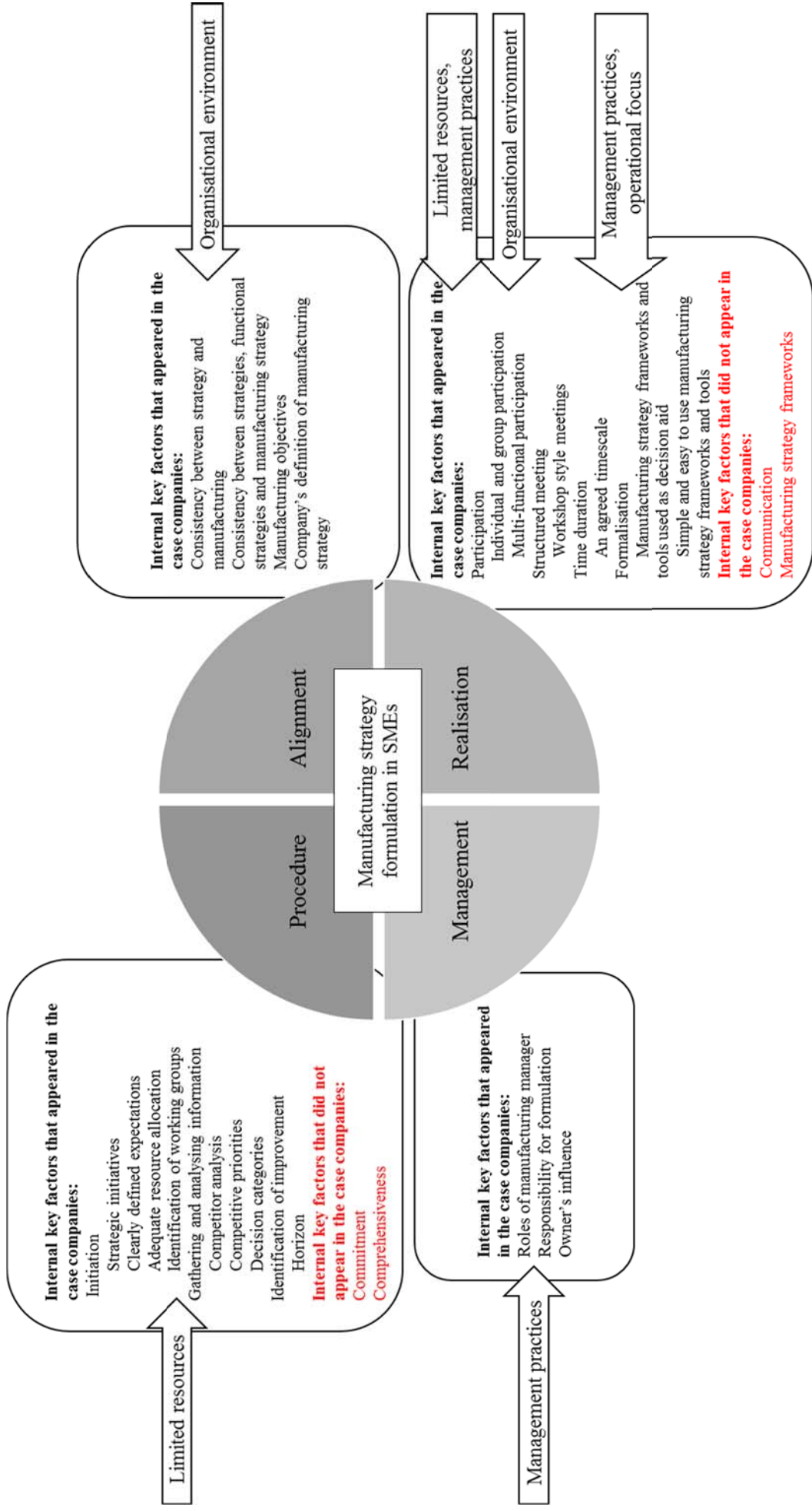


Figure 13. Model of internal key factors in manufacturing strategy formulation in SMEs and their relation to SME characteristics.

5.3 INFLUENCE FROM EXTERNAL KEY FACTORS ON MANUFACTURING STRATEGY FORMULATION IN SME

In Papers 4 and 6, the external key factors were identified in literature. The external key factors derived from literature consisted of macro environment, industry, competitive environment, suppliers, and national culture. National culture is described in Paper 6, and the other external key factors are presented in Paper 4. Thereafter the found external key factors were assessed if they influenced the manufacturing strategy formulation in the case companies.

Two of the external key factors, macro environment and industry, were not investigated further due to several reasons. The macro environment affects more or less all organisations (Johnson *et al.*, 2012), and it was assumed that the macro environment affects the other external key factors. Therefore, it was not investigated further. All case companies in both the Swedish and Singaporean studies belonged to different industries that makes it difficult to identify any patterns of the influence of industry in the manufacturing strategy formulation. Moreover, the empirical findings presented in Paper 1 reveal that industry seems not to be a significant external key factor when making manufacturing choices.

Suppliers were found to have little influence on the manufacturing strategy formulation in the Swedish companies as described in Paper 4 and are therefore not investigated further in this frame.

Two of the external key factors were found to influence manufacturing strategy formulation in SMEs; competitive environment and national culture (see also Papers 4 and 6). These are described more in detail in this chapter.

5.3.1 Competitive environment

The competitive environment described in this frame is a development and extension of competitors and markets, presented in Papers 1 and 4. Competitive environment is emphasised in amongst other Slack and Lewis (2011) and Barnes (2002a) and described as influential for manufacturing strategy in general and competitive priorities in particular. Kiridena (2009) divides competitive environment into market condition and competitive rivalry and this research follows this division. Kiridena (2009) find little evidence of any pattern considering these market condition and competitive rivalry in his case companies. Swamidass *et al.* (2001) and Barnes (2002a; 200b) do not describe the influence of competitive environment further. Companies Automotive and Aluminium (Phase 1) competed on volatile markets, and were aware of their competitors or substitute products. The engineering manager at company Automotive stated that “*we say that we have one competitor in each country*”, but the real threat was from their own customers’ substitute products. Both companies Aluminium and Automotive had several competitors and substitute products that is in this thesis interpreted as moderate competitive rivalry. Company Casting competed on a niche market, with stable market conditions. Previously they faced very low competitive rivalry as stated by the sales manager “*In some product segments we have competitors, but it is not many and I do not feel that we are disturbed by them directly....*” In this regard, as they still got customers, company Casting was not forced to further identify their competitive priorities (Phases 1 and 2). They had neither been forced to improve manufacturing according to the production technician: “*We have not had any competitors and we have always had a good margin and I think...off course it is good, but there are not the same requirements to become better all the time*”. However, during the last three years, extensive investments had been made and the possibilities to expand to new markets were discussed. Recently company Casting however faced more

threats from competitors in other markets and saw the need to identify competitors and different markets deeper. Company Aerospace had volatile market condition with several competitors and substitute products, here interpreted as moderate competitive rivalry. The sales manager in company Precision said that “*every precision engineering company is our competitor*” and therefore it is interpreted that their market condition was volatile and competitive rivalry high.

As understanding of the environment is one of the primary issues to develop strategies, it is of relevance for both strategy and manufacturing strategy formulation (see e.g. Ates, 2008). Company Automotive emphasised shorter planning horizon due to unexpected market changes (Phase 1) that is similar to Kiridena’s (2009) case company *Technico*, who reviews new manufacturing plans as responses to changes in markets or growth of company. This implies that market conditions influence manufacturing strategy formulation when market conditions or business strategies change, i.e. the need for a new initiative to (re)formulate manufacturing strategy. The Swedish companies also stressed the importance of having a competitor analysis in the STRATEGO tool (described in Phase 2). Based on the results presented in Paper 4, competitive environment seems to be related to specific activities as initiation, competitor analysis and competitive priorities in the manufacturing strategy formulation and part of the manufacturing strategy.

5.3.2 National culture

The national cultural dimension’s influence on manufacturing strategy formulation in Sweden and Singapore is presented in Paper 6. In Paper 6, the case companies were analysed according to an analysis model including the national cultural dimensions (Hofstede and Hofstede, 2005) and underlying variables derived from literature (e.g. Newman and Nollen, 1996). The empirical findings presented in Paper 6 show that single variables in the dimensions power distance, long-term orientation, and masculinity influence participation and decision-making when using a manufacturing strategy tool.

Limited teamwork is closely linked to countries with high power distance index (Cagliano *et al.*, 2011) like Singapore (see Figure 3). The Singaporean companies’ managers initiated teamwork for testing the STRATEGO tool, but they ended up formulating the manufacturing strategy individually. Even though the sales manager in company Precision spoke to the production planner about the result of the test, the sales manager made the final decisions. On the contrary, Sweden had a low power distance and the Swedish companies worked in groups in more formal settings as workshops that correspond to Cagliano *et al.*’s (2011) descriptions of low power distance countries. High score in masculinity tends to reduce teamwork as masculine countries have a more competitive approach than more feminine countries (Cagliano *et al.*, 2011). That is valid in this study, since Singapore has higher masculinity score than Sweden. In the Swedish companies, the decisions were made in consensus in the teams.

In high power distance cultures like Singapore (see Figure 3), fewer employees participate in decision-making (Newman and Nollen, 1996). The empirical findings presented in Paper 6, indicate that power distance influence decision-making. In the Singaporean companies, decision-making was centralised and the individual with highest position made the final decisions, i.e. consistent with the high power distance index for Singapore. The sales manager in company Precision did e.g. informally discuss the result from the STRATEGO tool with the production planner, but it was the sales manager who made the final decisions about the results and what should be done. Sweden, on the other hand, has a low power distance according to Hofstede (2013) (see Figure 3), meaning that the decision-making is more decentralised. At the Swedish company, the decisions when

using the STRATEGO tool were made either in consensus or by the participant with most knowledge regarding one specific issue. However, the participants in companies Aluminium and Automotive consisted of the management team, thus making the decision-making somewhat more centralized.

DISCUSSION AND CONCLUSIONS

This chapter discusses the main findings of the research. Thereafter the quality of the research result are presented followed by theoretical and practical contribution. The conclusions are then presented. Recommendations for future research conclude the chapter.

“At the end of a doctoral thesis, there are often more questions than at the beginning. New knowledge generates new questions...” (Ates, 2008, p. 198)

6.1 DISCUSSION

The purpose of this thesis is to increase the understanding of manufacturing strategy formulation in SMEs. Two research questions were formulated from the purpose. To answer the research questions the author conducted the research in two parts:

- Literature reviews to identify internal and external key factors for manufacturing strategy formulation in general and in SMEs in particular, as well as SME characteristics.
- Empirical research in three medium-sized companies in Sweden and two small companies in Singapore.

The literature reviews aimed at an overview of current knowledge to be able to better understand practice. The empirical research aimed to achieve a better understanding of manufacturing strategy formulation in SMEs. To understand the manufacturing strategy formulation further, internal and external key factors were investigated in both theory and practice.

RQ1: What are the internal key factors for manufacturing strategy formulation in SMEs?

In this thesis, an internal key factor is defined as something that can be considered significant for manufacturing strategy formulation. The first version of internal key factors is presented in Paper 2 as assessment criteria for manufacturing strategy formulation frameworks. This was the starting point for the final results presented in this thesis. The assessment criteria were further developed for several reasons. After the development of the assessment criteria that focused on manufacturing strategy frameworks, new literature addressing internal key factors for manufacturing strategy formulation was explored to investigate if there existed more research studies about internal key factors for manufacturing strategy formulation. The internal key factors are identified from prior research about manufacturing strategy formulation (e.g. Marucheck *et al.* 1990; Platts, 1990; Anderson *et al.*, 1991; Papke-Shields *et al.*, 2006; Lindström, 2008; Kiridena, 2009) as well as from empirical findings. The internal key factors identified are divided into four categories, *procedure* (what should be done), *alignment* (consistency between strategies, manufacturing strategies and manufacturing decisions), *management* (how the formulation

is managed), and *realisation* (how the formulation is executed). A summary of the internal key factors is presented in Table 23.

Table 23. Categories and internal key factors for manufacturing strategy formulation in SMEs

Procedure	Alignment	Management	Realisation
Initiation <i>Strategic initiative</i> <i>Adequate resource allocation</i> <i>Commitment</i> <i>Identification of working groups</i> <i>Clearly defined expectations</i>	Consistency between strategy, functional strategies and manufacturing strategy	Roles of manufacturing manager	Participation <i>Individual and group participation</i> <i>Multi-functional participation</i>
Gathering and analysing information <i>Competitor analysis</i> <i>Competitive priorities</i> <i>Decision categories</i>	Consistency between strategy and manufacturing	Responsibility for formulation	Structured meetings <i>Workshops-style meetings</i>
Identification of improvements <i>Horizon of improvements and manufacturing strategy</i> <i>Comprehensiveness</i>	Manufacturing objective	Owner's influence	Time duration <i>An agreed timescale</i>
	Company's definition of manufacturing strategy		Communication Formalisation Manufacturing strategy frameworks <i>Decision aid</i> <i>Simple and easy to use and understand</i>

The empirical findings indicate that the case companies emphasised internal key factors in the categories realisation and management, rather than internal key factors in the category procedure. The result (i.e. the actual manufacturing strategy) was not perceived as the most rewarding outcome of the formulation for the companies studied, but the very formulation itself, i.e. the realisation and interaction of participants. This is also discussed in Papers 2, 3, 4 and 5. The importance of realisation and participation in manufacturing strategy formulation is supported by more recent research studies (e.g. Nielsen-Englyst, 2003; Riis and Johansen, 2003; Papke-Shields *et al.*, 2006; Riis *et al.*, 2006; Rytter *et al.*, 2007; Paiva *et al.*, 2008, 2012) and research studies about strategy in SMEs (Robinson and Pearce, 1984; Beaver and Jennings, 2000). Further, the most frequently mentioned internal key factors in prior research about internal key factors (see e.g. Platts, 1990; Anderson *et al.*, 1991; Lee, 2002; Kiridena, 2009) are initiation, participation, adequate resource allocation and formalisation. These internal key factors belong to the categories realisation and procedure (see Table 20). This is in contrast to prior research about manufacturing strategy frameworks as the focus often is on procedure (in Paper 2). This can to some extent be related to the influence of the traditional strategic planning approach (see Chapter 2.2) to manufacturing strategy formulation and frameworks, where the focus has

been on procedure. As all internal key factors presented in Table 20 are considered as significant for manufacturing strategy formulation, not considering one or several categories and internal key factors can affect the outcome of the formulation. It is important to realise that if one internal key factor is not considered, it might have consequences for other factors as well. This is in accordance with the ideas of Papke-Shields *et al.* (2006) regarding best practice for manufacturing strategy formulation. Papke-Shields *et al.* (2006) suggest that best practice when formulating manufacturing strategies can be achieved when companies work with both rational and adaptive characteristics (see Chapter 2.4), i.e. planned activities and steps and interaction of participants.

Most of the internal key factors are not described in previous research studies about manufacturing strategy formulation in SMEs (Barnes, 2000, 2002a, 2002b; Swamidass *et al.*, 2001; Kiridena, 2009). This makes these descriptions somewhat incomplete. There might be many explanations for this. One is that SMEs may not have a structured manufacturing strategy formulation. Both Barnes (2002a) and Kiridena (2009) describe the lack of structured manufacturing strategy formulation in SMEs. If SMEs do not have an actual manufacturing strategy formulation, it cannot be found in prior research studies. Considering this, the formulation of manufacturing strategy in SMEs is still not well known.

Contrary to previous research studies about manufacturing strategy formulation in SMEs, a majority of the internal key factors appeared in the case companies' manufacturing strategy formulation in Phases 2 and 3 or were requested by the Swedish companies in Phase 1 (also described in Paper 2). Overall, the empirical findings considering internal key factors correspond quite well to Platts's (1990) desirable characteristics as well as his empirical findings from larger companies. One example is workshop-style meetings that were decided by two of the Swedish case companies as well as Platts's (1990) case companies. These companies were satisfied with this way of working. Another example is the descriptions of time duration and agreed timescales. Platts's (1990) first study had no agreed timescales and the formulation was sometimes delayed, as in the Swedish study. In Platts's (1990) second study, there were agreed timescales like in the Singaporean study. Therefore, the categories and internal key factors for manufacturing strategy formulation seem to be applicable in both SMEs and larger companies.

Some of the internal key factors that are identified from prior research (e.g. Marucheck *et al.*, 1990; Platts, 1990; Anderson *et al.*, 1991; Papke-Shields *et al.*, 2006; Lindström, 2008; Kiridena, 2009) were not reflected in the manufacturing strategy formulation in the case companies or in the previous empirical research studies (Barnes, 2000, 2002a, 2002b; Swamidass *et al.*, 2001; Kiridena, 2009). To understand why these internal key factors were not reflected in the empirical studies and in previous empirical research, they were related to the characteristics shared by SMEs. The SME characteristics were introduced in Paper 1, and the main characteristics like management practices, organisational environment, limited time and operational focus were further investigated in this frame. SME characteristics like organisational environment are related to the identified gaps (see Table 21). Some of the gaps seemed not to have any relation to the SMEs characteristics, such as commitment and comprehensiveness (see Table 21). This can have several causes. This result may be a consequence of the data collection, as the researcher only participated at certain meetings. Commitment and enthusiasm may be complex to study. Hints of commitment and enthusiasm are indicated in the teamwork in the Swedish companies. The Swedish case companies stated that it was good to have a manufacturing strategy

framework to gather around and to discuss about. During the group discussions, it was possible for the Swedish case companies to get a good overview of the company and manufacturing and to get people involved.

Another general internal key factor, not fully reflected in the manufacturing strategy formulation in the case companies, is communication. Previous studies on manufacturing strategy formulation in SMEs mention the lack of communication. Unclear communication may be a consequence of the data collection, as people might not consider this important to discuss or it is done more informally outside the meetings in which the author participated. The communication with employees not involved in the formulation in the companies was difficult to investigate, as the researcher only took part in meetings where the participants discussed manufacturing strategies. This might be related to the informal decision making and flat organisation where individuals discuss issues informally at, for example, coffee breaks.

Similarities in how the internal key factors appeared in the manufacturing strategy formulation in the case companies can be related to the SME characteristics, in particular operational focus, limited resources, flat organisation and centralised decision making.

The difference in how internal key factors were reflected in the case companies can be related to differences in the case companies' manufacturing strategy formulation as displayed in the figures in Chapter 4. This can be related to the case companies' different experiences of formulation strategies and manufacturing strategies as well as their strategic maturity. Another explanation might be the leadership styles and organisational cultures in the Swedish case companies (described in Paper 5). In Papers 4 and 5, management practices such as leadership style are identified as the characteristics that influence manufacturing strategy formulation in SMEs most and were found to be related to the manager's personality, experience and knowledge about strategies and manufacturing strategies. The importance of management practices is in line with other research studies on SMEs (e.g. Ghobadian and O'Regan, 2000; Barnes, 2002a). In Paper 5, leadership style and organisational culture are investigated, but due to the centralised decision making, leadership style seems to be more influential in the manufacturing strategy formulation in the Swedish case companies than organisational culture. Even though SMEs are assumed to share SME characteristics described in Chapter 2.1.2 and in Paper 1, there might still be differences in these characteristics due to, for example, leadership style as shown in this research (see Paper 5). This can also be related to Paper 1, in which it was concluded that SMEs are a heterogeneous group. This is also consistent with other research studies about SMEs (Ghobadian and O'Regan, 2000; Cagliano and Spina, 2002; Löfving, 2009; Assarlind, 2014). Therefore, each individual organisation's characteristics might influence how a company formulates its manufacturing strategy.

Manufacturing strategy formulation is often described in the form of manufacturing strategy frameworks (see Paper 2). Previous research studies on manufacturing strategy formulation in SMEs (see e.g. Swamidass *et al.*, 2001; Barnes, 2002a, 2002b; Kiridena, 2009) do not mention the use of either strategy or manufacturing strategy frameworks in their case companies. There is also little evidence of the use of any strategy frameworks in SMEs in previous research studies addressing SMEs (Stonehouse and Pemberton, 2002; Woods and Joyce, 2003; Ates, 2008; Kraus *et al.*, 2006). Before the case companies were introduced to the OS matrix and the STRATEGO tool, they did not use strategy frameworks or tools except a SWOT analysis. When the companies had used the STRATEGO tool they emphasised that it was good to have a tool to meet and discuss about. The case companies in this research also thought the STRATEGO tool was a good support to achieve a structured manufacturing strategy formulation. This is related to the

suggested internal key factor ‘decision aid’ (Anderson *et al.*, 1991). Anderson *et al.* (1991) propose that strategy and manufacturing strategy frameworks should be used as decision aid in the formulation, which is in accordance with the findings in this research. To get more SMEs to work with manufacturing strategy frameworks, it may be appropriate to market manufacturing strategy frameworks as decision aid instead of addressing the actual procedure (see discussion about categories above).

The use of strategy and manufacturing strategy frameworks and tools is also related to the formalisation of manufacturing strategy formulation in SMEs as the use of frameworks may enable a more structured formulation. Various research studies assume that SMEs have a less formalised formulation (e.g. Cagliano and Spina, 2002; Ates, 2008). It is also advocated that the strategy formulation in SMEs should be informal (Robinson and Pearce, 1984) (discussed in Paper 2). This is consistent with empirical findings from Phase 1 as none of the case companies had a structured and formalised manufacturing strategy formulation. Surprisingly, the Swedish companies requested a more formalised formulation in Phase 2. This is in contrast to Robinson and Pearce’s (1984) recommendation for informal formulation in SMEs. The formalised formulation and the use of the STRATEGO tool enabled the Swedish companies to discuss strategic issues that they usually did not have time to discuss. Key findings from this is that benefits reaped from using a more formalised manufacturing strategy formulation are a closer dialogue between the participants, a shared view in the organisation of what to improve in manufacturing and knowledge about their competitive priorities.

The strategy language in SMEs is discussed in a couple of research studies (Woods and Joyce, 2003; Ates, 2008). Both these studies stress that one of the obstacles when doing research in SMEs is the different strategy language used in practice and theory. This is relevant to discuss in this research as well. None of the case companies explicitly talked about manufacturing strategies, competitive priorities and decision categories. Furthermore, all case companies had some informal visions, objectives, plans or ideas for the company and manufacturing. The companies also described processes that were translated into decision categories. One of Ates’s (2008, p. 203) key conclusions was that “[m]ain stream strategy process theory is relevant in manufacturing SMEs, however the language that SME managers are using is different than theory. Academic researchers need to understand SME managers’ language in strategy”.

RQ2: What external key factors influence manufacturing strategy formulation in SMEs?

In this thesis, an external key factor is an external factor that is considered significant for the manufacturing strategy formulation in SMEs. The external key factors were identified from literature reviews in Papers 4 and 6 and included macro environment, industry, supplier, competitive environment and national culture. When the influence of these external key factors on the manufacturing strategy formulation was further investigated, it was suggested that two external key factors, competitive environment and national culture, were more influential than the other external key factors. Due to this, these two external key factors were investigated further in this frame.

Based on the results in Paper 4, it is indicated that a competitive environment influences initiation, competitor analysis and competitive priorities. As these internal key factors are part of the category procedure, it is assumed that a competitive environment mostly influences internal key factors in this category. When the competitive environment changes, there is a need to initiate a review or to (re)formulate manufacturing strategies.

However, after the initiation of formulating manufacturing strategies, the market condition is closely related to the result.

Paper 4 separates the different factors to understand each factor's influence on manufacturing strategy formulation. However, several interesting relationships between different factors in Paper 4 were found. Paper 4 also states that many factors seem to be inseparable. Investigating external key factors and other factors like, for example, SME characteristics may be complex as invisible relations may be difficult to analyse.

Paper 5 describes a possible relationship between competitive environment and organisational culture in the Swedish companies. Competitive environment and organisational culture can also be related to the market-based and resource-based approaches presented in Chapter 2.2.3. The companies Automotive and Aluminium were competing on more competitively exposed markets and their respective organisational culture, power culture, was externally oriented (see Figure 12). Company Automotive had a market-based approach while company Aluminium had both a market-based and a resource-based approach. Company Casting had a more resource-based approach and had been quite free from competitors; it is only during the last couple of years that they have got more competitors. Therefore, it had not been perceived as important by company Casting to focus on external issues. This is reflected in their support culture, which focused on the employees (see Figure 12). When competing on a more competitive market, it seems more important to know the requirements of the markets, which seems to be related to which organisational culture a company has. Thus, Ates (2008, p. 175) states that “[t]his may imply that SMEs which manage to survive in a challenging environment for manufacturing companies are externally oriented and they have strategic awareness because they strongly do strategic planning and develop goals to direct the operations”. Actually, the findings in this research show that the externally focused case companies in this thesis were more aware of the need to work with strategies. One of the conclusions from Papers 4 and 5 is that SMEs might not see the need to formulate strategies when they have few competitors and compete in a stable market. This is also one explanation for why the manufacturing strategy formulation looks different in the case companies. In addition, changes in the competitive environment can be an incentive to begin formulating manufacturing strategies.

Barnes (2002a, 2002b) investigate the possible impact of external key factors like customers and competitors on the manufacturing strategy process in SMEs but found little evidence of the impact of external factors on the process. This contradicts recent research studies on SMEs that stress the importance of a competitive environment (e.g. Ates, 2008; Gunasekaran *et al.*, 2011; Assarlind, 2014). Paper 1 also highlights the importance of a competitive environment for certain manufacturing choices like, for example, choice of suppliers. The findings in this research also indicate that the competitive environment influences certain internal key factors such as initiation. Therefore, Barnes's (2002b) findings are surprising. Most of the case companies in this research were well aware of the competitive environment if they competed on more volatile markets. One explanation may be differences in the competitive environment between Barnes's (2002b) study and this study. In the turbulent environment in which most of the case companies in this research compete, they need to be able to adapt and react quickly to environmental or other external changes or possibilities. This implies that manufacturing strategy formulation should be an ongoing activity that is updated when needed and that emergent strategies (Mintzberg and Waters, 1985) must be considered. This is in accordance with previous empirical studies on manufacturing strategy formulation in SMEs (e.g. Swamidass *et al.*, 2001; Barnes,

2000, 2002a; Kiridena, 2009), but somewhat contrasting with traditional manufacturing strategy formulation (e.g. Skinner, 1969).

The other external key factor assumed to influence manufacturing strategy formulation was national culture (described in Paper 6). Hofstede's studies (Hofstede, 1984; Hofstede and Hofstede, 2005) show that Sweden and Singapore have different national cultures. When designing the Singaporean study, it was expected that the STRATEGO tool needed to be refined further to be applicable in Singaporean companies. Surprisingly, there were more similarities than differences when using the tool in the studies in the different countries. The main differences that were identified in Paper 6 were related to participation and decision making. These differences can be explained by the differences in the power distance and masculinity dimensions in Sweden and Singapore. Long-term orientation was also found to influence the time perspective of the outcome of the use of the tool, the actual manufacturing strategy. However, the analysis done in Paper 6 shows little evidence of the influence of factors in the individualism and uncertainty avoidance dimensions when using a manufacturing strategy tool. Considering the similarities in the use of the STRATEGO tool in the Swedish and Singaporean companies, it may be assumed that SME characteristics like management practices such as personalised management and centralised decision making, limited resources and a flat and flexible organisation may be more influential on the use of manufacturing strategy frameworks and tools than national culture. For example, one finding was that the number of employees and the organisation structure seem to influence the decision making as the decision making in the small or medium-sized case companies in both countries was centralised.

Many of the existing manufacturing strategy frameworks have been developed and tested in the UK and the USA (see Paper 2). According to Hofstede and Hofstede (2005), UK and US national cultures are more similar than those in Sweden and Singapore. Cagliano *et al.* (2011) found in their study of new forms of work organisations in different countries that there was no cultural profile that was dominant in promoting adoption of general new forms of work organisations and that each type of cultural profile determines a different way of adopting the model. Considering the findings in Paper 6 and Cagliano *et al.*'s (2011) conclusions, it can be assumed that frameworks might be of universal use, but how companies work with a framework might differ somewhat in, for example, participation and decision making.

Industry was identified as an external key factor in Paper 4 but was not further investigated in this research as a possible external key factor. The findings in Paper 1 indicate that industry is not very significant when making choices in manufacturing decision categories in SMEs. Industry may not be significant when making more operational decisions, but whether or not industry influences strategic decisions in SMEs was not further investigated. As the case companies belonged to different industries, no conclusions could be drawn on the significance of industry or the influence of industry on manufacturing strategy formulation.

6.2 METHOD DISCUSSION

This discussion will focus on the consequences that the methodological choices may have on the result. The research design and method chosen in this thesis are closely related to the research approach in the STRATEGO project. The interactive research approach has improved the construct validity in this thesis as the interactive approach aims at creating knowledge with practice rather than for practice (Ellström, 2007).

The findings in this thesis are based on two studies. The Swedish study contains three main cases and the Singaporean study contains two supplementary cases. As with most

case studies, the case selection and data collection may have affected the results. The two studies were not exactly identical as there was no Phase 2 in the Singaporean study, but the two studies rather fulfilled different purposes. The two studies together aimed at building a deeper understanding of the phenomena in different contexts, which strengthens the construct validity of the results. When it comes to the number of case companies there is always a trade-off between the possibility to cover a great variety of organisations and to achieve depth. The aim of this research has never been to generalise statistically across a variety of organisations. Löfving (2009) aimed at studying a variety of SMEs including 20 subcontractor SMEs. In the research towards this thesis, it was of interest to study fewer SMEs more deeply. The three companies in the Swedish study made it possible for the author to study manufacturing strategy formulation in more depth. A survey might also have been appropriate as a complement to the case studies to further test and verify the relevance of the internal and external key factors for manufacturing strategy formulation in SMEs.

One limitation that may have affected the results is that the author could not follow the manufacturing strategy formulation closely in the Swedish study, because she spent most of her time in Singapore between October 2011 and December 2013. This means that she spent less time at the Swedish companies, even though the researcher had contact with them, for example via Skype. If the author had followed the Swedish companies more closely, this might have led to other findings as well. On the other hand, there were also advantages of working at a distance as the author could focus on searching and analysing literature and studying Singaporean SMEs.

Leong *et al.* (1990) highlight the problem of comparing studies with different units of analysis. They state that particular care must be taken when choosing the unit of analysis in studies of manufacturing strategy. The author of this thesis has considered the differences in units of analysis, in both the two studies in this research and in previous research studies. The author was aware of the units of analysis in previous research studies (e.g. Platts, 1990; Barnes, 2002a; Kiridena, 2009).

The selection of companies was affected by the willingness of SMEs to participate. Generally, the participating companies were very generous and willing to share experiences and information. Hence, at the beginning of the research towards this thesis, there were five case companies in the STRATEGO project, as described in Appendix A. One company participated until the end of 2011 (two of the planned three years) and another did not fulfil the selection criteria for this research since it was a large company. More case companies might have led to other results. Including the larger company in this study may also have led to other results. For the Singapore project, the author visited or was in contact with eight SMEs. The Singaporean study ended up with two case companies. One of the main reasons not to participate was lack of time. The lack of time for SMEs and their operational focus are highlighted in research studies on SMEs (Hudson Smith and Smith, 2007; Ates *et al.*, 2013). To engage SMEs in research projects might be a great challenge due to their limited time and operational focus.

6.3 CONCLUDING THE RESEARCH

There is a potential for SMEs to work with manufacturing strategies to improve competitiveness. However, the work with manufacturing strategies in SMEs is not well known either in theory or in practice. A first step for SMEs to work with manufacturing strategies is to formulate manufacturing strategies. Therefore, the focus of the research in this thesis is on manufacturing strategy formulation in SMEs. The purpose of this research is to increase the understanding of manufacturing strategy formulation in SMEs. The

manufacturing strategy formulation can be captured by internal and external key factors that are further investigated in this research. The conclusions are given in relation to the research questions posed: what are the internal key factors for manufacturing strategy formulation in SMEs and what external key factors influence manufacturing strategy formulation in SMEs?

The first research question aimed at identifying the internal key factors for manufacturing strategy formulation in SMEs. The findings are synthesised in a model in Figure 13 and in Table 23. Internal key factors from manufacturing strategy formulation were synthesised into four categories: *procedure*, *alignment*, *management* and *realisation*. Two internal key factors were derived during the analysis of the case studies while the others were found in literature.

It can be concluded that, even if most of the internal key factors were derived from literature about larger companies, a majority of them were found valid in the case companies' manufacturing strategy formulation. The internal key factors seem to be relevant for all kinds of companies, but how they appeared in each individual company's manufacturing strategy formulation might differ. Overall, the categories and internal key factors shown in Table 20 should be of general value for the manufacturing strategy formulation in any company. The internal key factors for manufacturing strategy formulation should be considered as guidelines for all kinds of manufacturing companies.

Some internal key factors did not appear in the case companies and one explanation is the limited strategic maturity of the SMEs. Another explanation is that these factors are related to the characteristics SMEs share, such as operational focus, limited resources, management practices and organisational environment. The organisational environment could explain why there was no consistency between functional strategies and manufacturing strategies in the small case companies. The SME characteristics could also explain how some internal key factors are reflected in certain ways in the case companies. Even though some internal key factors were not reflected in the case companies or were reflected differently, this does not mean that they are less important for manufacturing strategy formulation in SMEs. For successful manufacturing strategy formulation, all internal key factors in Figure 13 and Table 23 should be considered.

Another conclusion is that the formulation itself, in particular participation, was perceived as more important than the result (i.e. the actual manufacturing strategy) as the formulation enabled a dialogue between the participants. In this way companies need to examine their businesses and operations and define competitive priorities and how they deal with them. In this process it is possible both to get a good overview of the company and to get people involved. It is also a good opportunity to challenge and to question the way the company is working and to rethink or even reengineer some processes that have remained for too long and need to be changed. The use of manufacturing strategy frameworks was viewed as a decision aid in the discussion as it helped the companies to focus on strategic issues included in the manufacturing strategy content that they usually did not discuss.

Further, it can be concluded that the case companies developed from not having any manufacturing strategy formulation to requesting a more formalised manufacturing strategy formulation. Previous research studies on SMEs (e.g. Robinson and Pearce, 1984; Harris *et al.*, 2000; Cagliano and Spina, 2002; Ates, 2008) assume that SMEs have a less formalised strategy and manufacturing strategy formulation. This is consistent with the findings in Phase 1 in the case companies but different from what the companies

requested. Even though SMEs may have a less formalised manufacturing strategy formulation, they are open to a more formalised manufacturing strategy formulation.

Several interesting relationships regarding why some internal key factors are reflected in certain ways were found between the SME characteristics organisational environment, management practices, operational focus and limited resources. Considering this, this research verifies the importance of the unique characteristics that SMEs exhibit.

It can be concluded that SMEs may have strategies on an overall level including objectives for both growth and manufacturing, and they may realise strategies directly into manufacturing. This can be derived from the flat organisation with few hierarchical levels. Here a distinction between small and medium-sized enterprises is appropriate, as small companies do not always have separate functions or a function can include one person, while medium-sized enterprises may have different functions. It may not be correct to discuss functional strategies in small companies. Therefore it can be more appropriate to expand or refine the definitions about strategies and manufacturing strategies in small companies towards operations strategy, which includes a wider perspective of operations.

The second research question aimed at investigating the influence of external key factors in manufacturing strategy formulation in SMEs. To answer this question, external key factors that might influence manufacturing strategy formulation in SMEs were identified in literature reviews in Papers 4 and 6. The external key factors identified were macro environment, industry, supplier, competitive environment and national culture. Two of these external key factors, competitive environment and national culture, were found to influence manufacturing strategy formulation.

Most of the case companies as well as SMEs in other studies (e.g. Ates, 2008) knew their markets and competitors well, in particular if they competed on a volatile market with many competitors. The competitive environment influenced the category procedure (see Table 20), in particular initiation, competitive analysis and competitive priorities. It can be concluded that changes in the competitive environment is an incentive for (re)formulation of manufacturing strategy in SMEs.

Further, it can be concluded that single variables in the dimensions power distance and masculinity influence participation and decision making when using a manufacturing strategy tool. The dimension long-term orientation was found to influence the actual manufacturing strategy. More similarities than differences in the use of the STRATEGO tool between the case companies in Sweden and Singapore were found and it is assumed that SME characteristics like management practices, limited resources and organisational environment are more significant for manufacturing strategy formulation than national culture.

Paper 4 concludes that many of the factors investigated in the paper like, for example, competitive environment, organisational culture and leadership style are intertwined.

6.4 THEORETICAL CONTRIBUTION

The contribution in this thesis is mainly theoretical, bringing increased knowledge to the topic of manufacturing strategy formulation in SMEs.

A lack of research about manufacturing strategy formulation in SMEs was acknowledged (Barnes, 2001; Dangayach and Deshmukh, 2001; Rytter *et al.*, 2007; Brown *et al.*, 2010), and from that perspective, the empirical descriptions in Chapter 4 are contributions.

One contribution is the synthesis of the internal key factors (see Table 20) and external key factors for manufacturing strategy formulation in SMEs. This research has adopted a

more holistic perspective of internal and external key factors for manufacturing strategy formulation than what has been done before.

By addressing new institutionalism, SME characteristics and decision categories in the same study, new insights into the categories of manufacturing decisions were provided in Paper 1. The theoretical contribution in Paper 2 includes the synthesis and assessment of manufacturing strategy frameworks that have not been made before. The result in Paper 6 increases the knowledge about the applicability in different countries when using a manufacturing strategy framework that has rarely been addressed in prior research.

6.5 PRACTICAL CONTRIBUTION

The main contribution to practice is the model with internal key factors for manufacturing strategy formulation in SMEs and the identification of external key factors and their influence on manufacturing strategy formulation in SMEs. This research encourages an increased focus on work with manufacturing strategies in SMEs. Both SMEs and larger companies thinking of formulating or reformulating their manufacturing strategy can use the model (Figure 13 and Table 20) for internal key factors for manufacturing strategy formulation as guidelines to help them in their process and to ensure that they adequately address the internal key factors. The model is also a complement to the STRATEGO tool. The companies in the Swedish study emphasised that the STRATEGO tool was a good support in discussions. The STRATEGO tool was used as a decision aid helping the companies to focus on particular issues. A structured way of working can help SMEs in their discussions. Here the internal key factors and the STRATEGO tool can be used as a support when formulating manufacturing strategy and facilitate learning in the company.

6.6 FUTURE RESEARCH

Even though manufacturing strategies are extensively researched, there is still a question of the usability of the theories in practice and to what degree companies, especially SMEs, use manufacturing strategies in practice. Future research issues have been identified from limitations of this research and from identified theory gaps.

This thesis comprises manufacturing strategy formulation, but not manufacturing strategy implementation. The study of company Automotive ended when the strategies and manufacturing strategies were communicated to the employees. The next step in research could be to investigate the implementation phase in general and internal and external key factors for manufacturing strategy implementation in particular. Here the research on SMEs is also limited.

Considering the focus of this thesis, SMEs, it would be of interest to empirically study manufacturing strategy formulation in larger companies to be able to compare the results.

Although the review of literature about internal and external key factors for manufacturing strategy formulation is quite extensive, there is a possibility that there exist other internal and external key factors. It is also of interest to further study the relationship between internal key factors as well as between external key factors. More research needs to be done considering both internal key factors and external key factors. A next step in this research should be to test and verify the relevance of the internal and external key factors for manufacturing strategy formulation in SMEs by doing a survey.

The internal key factors were identified from the manufacturing strategy area. Thus, for example, Anderson *et al.* (1991) and Papke-Shields *et al.* (2006) are inspired by internal key factors derived from the business strategy area. Internal key factors for strategy formulation have been more extensively researched than internal key factors for manufacturing strategy formulation, but a different terminology exists in this area as well.

Strategy formulation and manufacturing strategy formulation in SMEs are closely related and sometimes even intertwined as the smaller companies in this research (companies Casting, Aerospace and Precision) include manufacturing in their strategies. Therefore, the study can be extended to also reviewing internal key factors considered in strategy formulation for SMEs like, for example, Robinson and Pearce's (1984) criteria for strategic planning in SMEs, O'Regan and Ghobadian's (2004) key factors for strategy formulation in SMEs as well as Acur and Englyst's (2006) success criteria when assessing strategy formulation.

When the Swedish companies began working with their development activities, they started slightly differently depending on the prerequisites. This can partly be explained by the case companies' strategic maturity, which has not been included in this research. Previous research studies on strategies (see e.g. Berry, 1998; Papke-Shields *et al.*, 2006) point towards a significant influence of strategic maturity on manufacturing strategy formulation. To be able to further understand how SMEs formulate manufacturing strategies, strategic maturity should be investigated further.

One impression from this research is that individual SMEs are different from each other in certain ways but similar in other ways. It was found in this research that the similarities that SMEs share often concern specific SME characteristics. Although the heterogeneity has been described in Paper 1 and other research studies about SMEs (Cagliano and Spina, 2002; O'Regan and Ghobadian, 2004; Assarlind, 2014), they are often defined and treated as a homogeneous group. According to Assarlind (2014, p. 52), "*...it is difficult to always motivate a single approach to defining all SMEs in research. However, this heterogeneity does not mean that less research effort should be spent on SMEs; instead, it implies a considerable need for further research.*" Considering this, there is a need for further structuring and categorising the SME group. Small and medium-sized companies might be separated in research to further understand similarities and differences between companies with different numbers of employees. Additionally, another suggestion is to divide SMEs into subcontractors and original manufacturers as done in Paper 1 and in Cagliano and Spina (2002). Considering this, it is important for future research on SMEs to describe and eventually separate different categories and groups of SMEs.

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APPENDICES

APPENDIX A THE STRATEGO PROJECT

The STRATEGO project was financially supported by the Swedish Governmental Agency for Innovation Systems (VINNOVA) in its programme 'Production Strategies and Models for Product Realisation'. The STRATEGO project started formally in December 2009 and was concluded in April 2014. The STRATEGO project aimed at increasing the possibility for SMEs to use manufacturing strategies in a manner that clearly contributes to sustainable competitiveness on an international market. The research questions for the project were:

- How mature are SMEs regarding manufacturing strategies?
- What are the prerequisites for SMEs to use manufacturing strategies to support competitiveness in SMEs?
- How can the current manufacturing strategy framework be adapted and further developed to be applicable for SMEs?

Five companies participated in the STRATEGO project (Automotive, Aluminium, Casting, Outdoor and Plastics), and three of them were included in this thesis (Automotive, Aluminium and Casting). Company Outdoor was excluded in this thesis as the participating unit was part of a larger company group and not managed independently. Company Plastics appointed a new managing director in 2011, who decided that the company should not participate further in the project.

In the project a strategic tool, the STRATEGO tool, supporting the formulation of manufacturing strategies, was developed in close collaboration with the participating companies. The STRATEGO tool, version 3, is presented in Säfsten *et al.* (2014).

The author's role in the STRATEGO project

The project team consisted of four team members, the author of this thesis, Professor Mats Winroth, Associate Professor Kristina Säfsten and PhD student Nina Edh. Associate Professor Säfsten had the role of project leader. Edh's research focused on the dimension of the individual in manufacturing strategy in SMEs (Edh, 2013). Edh participated in the research at company Aluminium.

The author was not involved in Phase 1, as she was on parental leave. In Phases 2 and 3 of the project, she had the role of participant observer and observer, and focused specifically on manufacturing strategy formulation.

Publications

There is a publication list for the STRATEGO project. Some of the publications were initiated by the senior researchers in the project and aimed at answering the research questions in the project. For example, Paper 2 in this thesis, which assess manufacturing strategy frameworks, partly answers the project's research question 3. Papers 2 to 6 in this thesis describe the participating companies in the STRATEGO project. With the exception of the appended papers in this thesis, papers published are presented below.

Edh, N., Winroth, M. and Säfsten, K. (2012a), "Organizational Comprehension of Manufacturing Strategy – A Case Study of a SMME", / *Procedia CIRP, Vol. 3, Proceedings of 45th CIRP Conference on Manufacturing Systems Technology*, 16-18 May 2012, Athens, Greece.

Edh, N., Winroth, M. and Säfsten, K. (2012b), "Production-related Staff's Perception of Manufacturing Strategy at a SMME", *Procedia CIRP, Vol. 3, Proceedings of 45th CIRP Conference on Manufacturing Systems Technology*, 16-18 May 2012, Athens, Greece, pp. 340-345.

- Edh, N. (2013), *The People Dimension in Manufacturing Strategy: Operators and Managers*, Licentiate thesis, Department of Technology Management and Economics, Chalmers University of Technology, Gothenburg, Sweden.
- Säfsten, K. and Winroth, M. (2011), "Manufacturing strategies supporting competitiveness in SMME, *Proceedings of the 18th International Annual EurOMA conference*, 3-6 July 2011, Cambridge, UK.
- Säfsten, K., Winroth, M. and Löfving, M. (2012), "Requirements on manufacturing strategy frameworks for SMME" *Proceedings of the 5th Swedish Production Symposium*, 6-8 November 2012, Linköping, Sweden
- Säfsten, K., Winroth, M. and Löfving, M. (2014a), "Development of a manufacturing strategy framework for SMEs", Paper accepted for the 21st EurOMA Conference, 20-25 June 2014, Palermo, Italy.
- Säfsten, K., Winroth, M. and Löfving, M. (2014b), STRATEGO Produktionsstrategier som stöd för konkurrenskraft i små och medelstora tillverkande företag – en handbok, *JTH Research Report, 2014/002*, ISSN 1404-0018, Jönköping, Sweden.
- Winroth, M. and Säfsten, K. (2013), "Development of a manufacturing strategy tool useful to SMEs – An interactive approach" /, *Proceedings of the 22nd International Conference on Production Research (ICRP22)*, 28 July-1 August 2013, Iguassu Falls, Brazil.
- Winroth, M., Säfsten, K., Löfving, M. and Edh, N. (2012), "A tentative comprehensive manufacturing strategy framework adapted to the requirements in SME", *Proceedings of POMS 23rd Annual Conference "Socially Responsible Operations"*, 20-23 April 2012, Chicago, IL.

APPENDIX B THE SINGAPOREAN COLLABORATION RESEARCH PROJECT

The Singaporean collaboration research project was financially supported by the Agency for Science, Technology and Research (A*STAR) in the programme “A*STAR Research Attachment Programme” (ARAP) in Singapore. The project was called “Manufacturing Strategies Supporting Competitiveness in SMEs – Current Situation and Potential in Singapore” and was a collaboration research project between the School of Engineering in Jönköping and Singapore Institute of Manufacturing Technology (SIMTech). The Singapore project was conducted between December 2011 and September 2013. The collaboration research project aimed at investigating the potential of manufacturing strategies to support competitiveness of SMEs in Singapore as well as testing and adapting an existing manufacturing strategy framework, developed on the basis of experiences from SMEs in Sweden, to be applicable to SMEs in Singapore. Hence the specific research questions in this project were:

- How mature are SMEs regarding manufacturing strategies?
- What are the prerequisites for SMEs to use manufacturing strategies to support competitiveness in SMEs?
- How can the current manufacturing strategy framework be adapted and further developed to be applicable to SMEs in Singapore?

This project builds on the STRATEGO project, and the STRATEGO tool was tested and refined. Six companies participated in the Singapore project, but only two of them are included in this thesis. The survey (Phase 1) was conducted and the STRATEGO tool was introduced in three companies. Due to many reasons such as lack of time, etc., these companies decided not to participate any further in the study. Company Marine, described in Paper 6, is not included in this thesis due to company secrecy and because the test of the STRATEGO tool and the survey were done late in the research process.

The author’s role in the Singapore project

The project leader, Dr Roland Lim, recommended companies based on the case selection criteria (see Section 3.3.3 in the frame). Dr Lim initially contacted two of the participating companies, and the author initially contacted four companies. The author collected and analysed the data herself and led the test of the STRATEGO tool.

Publications

The Singapore project is included in Paper 6.

APPENDIX C INTERVIEW GUIDE STRATEGO RESEARCH PROJECT

STRATEGO: Inledande kartläggning

Presentation med namn. Denna intervjustudie ingår i ett forskningsprojekt kallat STRATEGO – Produktionsstrategi som stöd för konkurrenskraft i SME.

Vi kommer att intervjua ett antal personer som på olika sätt berörs av produktionsstrategi i varje företag. De personer vi intervjuar har olika roller som t ex operatörer, chefer, produktionstekniker, etc. Intervjuerna spelas in för att få ett gemensamt underlag. Det är bara vi i forskningsteamet som kommer att ha tillgång till intervjuutskriften. Återkopplingen till företagen sker enbart på gruppnivå, och det kommer inte att framgå hur enskilda personer har svarat. Intervjun kommer att ta ca 1 tim och innehåller ett antal olika frågeområden.

Här är ett informationsblad om projektet och vilka vi är. Har du några frågor innan vi börjar?

På band vid intervjuens början: företag, person och datum

Frågor till VD/chef

1. Antalet anställda, fördelning olika befattningar.
2. Organisation.
3. Hur arbetar ni mot er ägare? Hur ser koncernledningen ut? Vilka kompetenser är det som finns i koncernledningen? Är ni styrda av dem eller fristående? Hur ses produktionen på koncernnivå?

Bakgrundsfrågor

4. Vilken är din nuvarande befattning?
5. Vilken avdelning, grupp tillhör du (organisatorisk hemvist)?
6. Hur länge har du varit anställd i företaget?
7. Utbildning?
8. Tidigare yrkeserfarenhet (inom företaget/utanför företaget)?

Företagsbeskrivning

9. Kan du börja med att beskriva Bruzaholms bruk. Vad är det för företag? Vad gör ni och varför?
10. Hur ser ni på produktionen i företaget?
11. Vilken kontakt har ni med övriga företag i koncernen (beror av ägandeförhållande)?
12. Vilka delar av produktframtagningsprocessen arbetar ni med i företaget?
13. Hur arbetar ni med produktframtagning? T ex produktutvecklingsmodell, projektstyrningsmetodik, etc.

Produkter

14. Företagets produkter: vilka, viktigast, hur bestäms vilka, volymer?

Produktion

15. Hur ser produktionsverksamheten ut?
16. Hur bestäms produktionsupplägget? Av vem?
17. Anpassas nya produkter efter befintligt produktionsupplägg eller tas nya produktionsupplägg fram för nya produkter?
18. Hur ofta görs större förändringar i produktionen? På vems/vilket initiativ görs förändringar i produktionen?
19. Vilka mätetal används i produktionen? Varför dessa/varför inga?

Konkurrensfördelar

20. Vilka är företagets främsta konkurrensfördelar?
21. Hur arbetar ni för att stödja dessa?

Användning av metoder och verktyg i allmänhet

Ge några exempel på möjliga verktyg tex FMEA, DfA.

22. Vilka metoder och verktyg använder du/ni idag för ert arbete med att utveckla produktion? I andra sammanhang?
23. Vad är det som gör att ni använder dessa metoder och verktyg?
24. Vad tycker du fungerar bra/dåligt med respektive verktyg? Varför?
25. Om inga verktyg används, varför?
26. Vilka krav ställer du på metoder och verktyg som du ska använda för att arbeta med att utveckla produktion? Vilken tidsåtgång är rimlig?

Produktionsstrategier

Resource based, market based, top-down, bottom-up...

Nuläge/Mognadsgrad

27. Vem arbetar med produktionsfrågor i företaget?
28. Hur arbetar man med produktionsfrågor i företaget?
29. När ni arbetar med produktionsfrågor, hur långt fram i tiden tänker ni då?
30. Har ni någon uttalad produktionsstrategi idag?
31. Om så, hur ser den ut? Vem har tagit fram den? Hur används den? Hur uppdateras den? Fungerar den bra? Vad är bra/dåligt med den?
32. Tycker du att beslut som tas rörande produktionen stödjer/stämmer överens med produktionsstrategin?
33. Använder ni eller har ni använt några speciella verktyg eller metoder för att ta fram er produktionsstrategi/när ni beslutade hur ni skulle producera?

Önskat läge

34. Hur skulle du vilja att ni arbetade med produktionsstrategier?

Avslutande frågor

Runda av intervjun.

35. Är som det något mer som du vill ta upp rörande detta, utöver det som vi har pratat om?
 36. Vilka personer tycker du är relevanta att prata med för att skapa oss en god bild av ert arbete med produktionsstrategier?

APPENDIX D INTERVIEW GUIDE THE SINGAPOREAN RESEARCH PROJECT

Questions for owner/manager

Describe your company and ownership?

- a. Industry
 - b. Customers
 - c. Markets
 - d. Ownership
 - e. No of employees
2. Describe the organization structure?

Background questions

3. What is your current position?
4. Can you describe your role in the company and your background?
5. Responsibilities in the company?
6. How long have you been employed at the company?
7. Former working experience? (inside outside the company)

Description of the company

8. Why do the customers choose you? What are your competitive advantages? Approach to new customers?
9. What is your relationship with your customers?
10. What areas is your company currently doing well in?
11. Do you have business objectives/goals/strategies?
 - a. Short term and/or long term

Manufacturing

12. Can you describe your manufacturing?
 - a. Layouts
 - b. Machines
 - c. Employees
13. Do you have any goals/objectives/plans for manufacturing? What are those objectives/goals/plans?
14. Are the manufacturing plans/objectives connected to the business strategy/plan?
15. What type of contribution does the business expects from manufacturing? And vice versa.
16. How do you measure manufacturing performance?
17. What are the difficulties you currently face in achieving manufacturing goals/objectives?
18. What are the most important aspects and the issues concerning manufacturing? *Example: implementing lean production,*
19. How often do you make bigger changes in the manufacturing? On who's initiative

