External Integration and the Need for Manufacturing Competence

Licentiate thesis by

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Abstract

For a number of years, manufacturers have increasingly focused on their perceived core competencies and outsourced activities not seen as such. In doing so there are an increasing number of competencies that fall outside the ‘core’ domain but are nonetheless required for effective product and process development. The proposed solution to this problem has been external integration with an emphasis on collaborative product or process development and also the wider concept of supply chain management. It is, however, not always easy to substitute internal competencies with customers’ and suppliers’ capabilities. Many authors have focused on finding the prerequisites for effective external integration and particularly on areas such as trust and power.

This thesis contributes to the literature by extending the concept of absorptive capacity into the manufacturing domain and in the context of external integration. A conceptual framework is developed, where different streams of the literature have been merged into one coherent model. Integral parts of this framework are the concept of absorptive capacity as well as a model of competitive priorities. Competitive priorities have been taken into account as firms differ; what contributes to competitive advantage for one firm may be irrelevant for another.

Three papers are included in the thesis. The first one uses survey data, from a representative sample of the Swedish manufacturing industry, in order to validate the concept of absorptive capacity in the manufacturing sector. The second paper also uses survey data but aims to shed some light on competitive priorities’ impact on both the extent and the outcome of internal and external integration. The third paper describes a case study of a first-tier supplier and aims to illustrate how absorptive capacity in a manufacturing firm may look in practice.

The thesis concludes that the conceptual framework is indeed useful for understanding the challenges of effective external integration. Internal manufacturing competencies may allow a firm to integrate more effectively external sources, but the required competencies may vary from firm to firm. This implies a need for a fit between companies’ competitive priorities, external integration and absorptive capacity. It also implies that companies may struggle to achieve competitive advantage by utilising their customers and suppliers if they do not simultaneously develop appropriate competencies in-house.
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1. Introduction

For many years firms have focused on what they consider to be their core competencies (Prahalad and Hamel, 1990; Lonsdale and Cox, 2000). An increasing number of competencies fall outside the ‘core’ domain but are nonetheless required for effective product and process development. The proposed solution to this problem has been external integration with an emphasis on collaborative product development (e.g., Kamath and Liker, 1994) or process development (e.g., Sako, 2004) and also the wider concept of supply chain management (Christopher, 2005; Lambert et al., 1998). The supply chain management concept stipulates that it is not companies that compete with each other, but supply chains. The supply chain (usually led by its dominant firm) that can integrate externally most effectively will be the winner.

The subject of external integration has become increasingly important lately as the trend towards outsourcing has led to an increasing focus on external relations, particularly suppliers’ relations (e.g., Takeishi, 2001). When a company sources a larger share of its value added from external sources, it becomes more important to integrate these sources (Dyer and Nobeoka, 2000; Frohlich and Westbrook, 2001) so as to minimise the negative impact outsourcing may have. Many authors have indeed advocated integration or collaborative relationships as a way of combining the advantages of the integrated firm with the advantages of the disintegrated one. In fact, the literature has been fairly consistent in advocating integration as a way of improving firm performance (Hillebrand and Biemans, 2003).

Prerequisites for effective integration

In practice, the results from supply chain management as well as customer and supplier integration have not always been positive. (For an overview see Primo and Amundson, 2002 or Fawcett and Magnan, 2002.) There is thus a need to look more closely at the requirements for effective external integration.

Most empirical studies have nonetheless assumed either that integration is beneficial or less often that it is not beneficial. There is a shortage of research arguing that external integration is only beneficial under some specific circumstances. The few researchers that have taken such an approach have focused on aspects such as technological uncertainty (Ragatz et al., 2002; Stock and Tatikonda, 2004), or relational competence (Wagner and Boutellier, 2002).

Other authors have sought to explain the success, or lack thereof, of external integration through the concepts of trust and power. The more common theme among these is trust, where trust is seen as essential to building long-term relationships. One of the most widely quoted authors within this stream of the literature is Sako (1992). Another stream of literature is the one focusing on organisational power. Most prominent among these is Cox (1999; 2004), who maintains that the reason for firms’ very existence lies in their power to appropriate value for themselves.

Whereas both power and trust are doubtlessly required for most types of inter-organisational activities, they alone cannot explain the success of these activities. Trust
may facilitate effective communications between two organisations, but the substance as well as the exploitation of these efforts may not depend on trust. In other words, two firms may have ever so frequent and open communication, but it does not give them a competitive advantage unless it supports their strategy and not if they cannot do anything useful with the acquired knowledge. Similarly, power may be a useful tool in persuading external parties to engage in some type of integration, but these activities must also support the strategy and the organisations must have the competence to actually turn integration into competitive advantage.

Only a few authors have attempted to investigate the need for competencies in order effectively to communicate with the external environment. An example is Teece and Pisano’s (1994) theory of dynamic capability, where these capabilities are to a large extent embedded in the firm and will have consequences for how effectively it communicates with the external environment. This reasoning is quite similar to the arguments put forward by Prahalad and Hamel (1990), who define core competencies as difficult to imitate or transfer and embedded in the organisation, so they must be developed internally. An early observation made by Abernathy (1978) was that having experience in manufacturing helped firms identify and use product-relevant information. However, in the supply chain management literature the need for competence is not prominent, although Cousins and Spekman (2003) did point out the need to align competencies with the supply chain strategy.

**Purpose**

While acknowledging the previous finding of several streams of relevant literature, there seems to be a few factors that have not been taken into account. First, the role of manufacturing competence in facilitating successful integration has not been widely recognized; instead the focus has been on integrative competencies (see e.g., Wagner and Boutellier, 2002). Integrative competence is the actual abilities and mechanisms that are used in order to integrate outside constituents, not the competencies needed to assimilate and utilise the acquired knowledge.

Moreover, the previously mentioned factors of trust and power do not alone explain the success of external integration. This thesis will take a complementary approach and focus on the underlying competencies of the manufacturing firm that allow it to value, assimilate and use the competence it has extracted from external sources. A conceptual framework suitable for this task is the concept of absorptive capacity, originally introduced by Cohen and Levinthal (1989, 1990). This concept has been proven valid in many empirical studies, but has not been operationalised for the context of this thesis. In other words, absorptive capacity does exist, but this thesis will investigate whether it will have an impact when manufacturers seek to integrate their suppliers.

Different firms also have different needs for integration, what is an appropriate integration approach for one firm might not be very fruitful for another. Christensen (1997) presents a framework that provides an opportunity to understand the dynamics of products and markets as well as indicating some consequences for the effectiveness of integration, and this framework will contribute to the theory of this thesis. The firms can be analysed based on countless other factors, e.g., product life cycle (Hayes and
Wheelwright, 1979) or strategic positioning (Porter, 1980), but the chosen framework does to some extent also include many of these other factors.

As there seems to be a need to examine more systematically how competence relates to the effectiveness of external integration, this thesis will seize that opportunity. By further developing the concept of absorptive capacity, an attempt will be made to align the need for competencies with external integration and competitive priorities. The purpose is thus to analyse the need for manufacturing competence in order to turn external integration into competitive advantage, by further developing and utilising the concept of absorptive capacity. The study will investigating both how much and with whom to integrate, as well as provide some indication of the content of that integration.

**Research approach**

The theoretical underpinnings of this thesis are found within the wider resource-based view (Barney, 2001), as well as the closely related knowledge-based view (Kogut and Zander, 1992; Grant, 1996). According to the resource-based view, a company’s success is determined partly by the resources it possesses and partly by the way in configures these resources. The knowledge-based view stipulates that a firm’s key to competitive advantage depends on the knowledge they possess as well as how they use that knowledge. Grant (1996) claims that the latter is dependent on the ability to integrate various sources of knowledge.

Although many social scientists adopt a social constructionist approach, where the focus is on the perception of reality and not the ‘objective’ reality itself, a positivist approach is more prominent in natural science (Silverman, 2000). The positivist approach is more concerned with explaining social or other phenomena with the belief that there is an ultimate truth out there, whereas social constructionists want to understand complex social interactions. As the purpose of this study is explanatory and to a large extent based on survey data, the overall approach is inevitably tilted towards positivism. However, later parts of the study involve qualitative data and are concerned with refining the findings of the quantitative study. In order to keep coherence between the different parts of the study, it is appropriate to adopt the same approach in all parts. In fact a mismatch between different underlying assumptions of the world could produce highly dubious findings. Another justification for adopting a positivist approach is the desire, in the long run, to be able to generalise the findings to the whole population of similar firms. Managerial implications of the research are quite important in the field of operations management and related disciplines and in order to obtain those, confidence in the explaining power of the proposed model is useful. By contrast, understanding one particular firm is only helpful to another firm if the research can point to similarities and differences, and this may require that a serious amount of work be done to reinterpret the data.

**Limitations**

The focus of this thesis is on manufacturing and manufacturing-related integration, primarily with suppliers and to some extent also customers. Other types of external integration mechanisms (e.g., joint information technology platforms) as well as in
different functional areas (e.g., research or marketing) are certainly also feasible, but they may have different prerequisites and are not covered in this thesis. Moreover, while the impact of trust and power is acknowledged, it has been argued that the factors covered in this thesis are additional prerequisites. Although there may be interdependency between trust and power as well as the factors in this thesis, these are not explored.
2. Theoretical Framework

In this chapter, the relevant literature will be reviewed and a conceptual model will be proposed. The chapter is divided into five parts, where the first part defines the key concepts. The second part provides an introduction to supply chain management and the benefits of external integration. The third part reviews the concept of absorptive capacity, and the fourth part reviews some models of competitive priorities. The fifth and final part constitutes a synthesis, where an attempt at integrating these three streams of literature into one coherent conceptual framework will be made.

Definitions

Before embarking on the theoretical underpinnings of this thesis, some effort will be made at trying to define the terminology. As the title implies, the focus of the thesis is on manufacturing competence as well as external integration, but defining these two concepts is not straightforward.

Defining Manufacturing Competence

There is no coherence in the definition of manufacturing competence in the literature, where for example Cleveland et al (1989) define manufacturing competence as a capability that enables manufacturers to carry out a product- or market-specific business strategy. Some authors have not bothered to clearly define it at all, but assume that factors such as flexibility or lead time are competencies (e.g., Vickery et al., 1993), whereas others call these capabilities (e.g., Flynn and Flynn, 2004). In this thesis competencies will be defined as the underlying abilities, such as flow-oriented manufacturing, upon which capabilities, such as flexibility, are built. These capabilities can often also be enhanced by other abilities such as external integration. Most capabilities are transitory by nature, i.e., they only give a competitive advantage while a firm is ahead of the competition. When and if the competitors manage to emulate these capabilities, the competitive advantage is eroded. As competence is considered the sum of the underlying abilities that may produce capabilities, the ability to improve is paramount, and will be prominent in this thesis.

A term closely related to competence is knowledge, where competence is knowledge combined with an ability to act in order to produce an outcome (Docherty and Dilschmann, 1993). Knowledge can be seen from many different perspectives (see Hall, 1996, for a review) and one of the problems with managing knowledge is the problem of actually identifying it (Despres and Chauvel, 1999). However, most scholars do not even define knowledge, perhaps due to the divergence within the field of knowledge management or the tacit nature of knowledge itself. One of the few authors that has attempted to define knowledge offers a broad, yet accurate, definition: “the capacity for effective action” (Senge, 1999; cited in Call, 2005). This definition is adequate for the purpose of this thesis and knowledge will be treated as a resource, tacit or explicit, which is closely related to competence. The term knowledge is used instead of competence in instances where the knowledge is not directly related to manufacturing (as the word competence has been reserved for that purpose).
Defining External Integration

An early definition of external integration is “achieving unity of effort in various subsystems” (Lawrence and Lorch, 1969, quoted in Hardaker, 1998). This definition is sufficient for the purpose of this study, although it will be used in the context of external integration. The definition of external integration could thereby be phrased “Achieving a unity of effort throughout the supply chain”. It must, however, be pointed out that absolute unity of effort might be impossible to achieve, but the main point is striving towards that goal and not the goal itself.

Supply Chain Management

It is widely believed that it is no longer enough to be internally excellent, when the focal company is only a relatively small part of the supply chain (e.g., Lambert et al., 1998). The central premise of supply chain management is that it is increasingly supply chains that compete with each other, as opposed to individual firms (e.g., Christopher, 2005). Leading-edge companies have responded by allocating significant resources to utilising their supplier base more effectively as well as increasing their cooperation with their most important customers (ibid.). The most successful companies are usually those that have managed to integrate customers and suppliers with their internal processes (Frohlich and Westbrook, 2001). There is, however, often a wide gap between management literature and reality (Fawcett and Magnan, 2002), which means that most companies have failed to form these supposedly virtuous partnerships with customers and suppliers despite the proclaimed benefits.

There is little consensus in the terminology of the supply chain management literature; what some refers to as involvement, cooperation, collaboration or partnering, others refer to as integration. Droge et al. (2004) for example call it “partnering” when a firm treats the supplier as a ‘strategic collaborator’ and involves them early in new product development, but they also call this process of achieving unity of efforts “integration”. Cousineau et al. (2004) even talk about supply source integration, and refer to the early involvement of suppliers in the product development process.

According to Frohlich and Westbrook (2001) there are two interrelated types of integration; forward and backward. Forward integration refers to coordinating and integrating the physical flow of materials from suppliers through manufacturers to customers, and it also refers to the effort aimed at joint product or process development. Backward integration refers to the flow of information that travels in the opposite direction to the physical flow of materials, i.e., from customers through the manufacturer to the suppliers. This thesis will be concerned mostly with forward integration.

In the remainder of the literature review the term external integration will be used to describe some of the key mechanisms inherent in effective supply chain management. These mechanisms are aimed at collaborative product as well as process development. The literature review of external integration will focus on the integration of customers and suppliers, ignoring issues like strategic alliances and the integration of the entire chain, as a sufficient amount of literature can be found in the two former categories. As most authors make the distinction between customer and supplier integration, it seems an appropriate way of arranging the review as well. It can, however, be argued that supplier
and customer integration are exactly the same phenomena but from different perspectives. While acknowledging that, the literature still highlights different problems and advantages depending on whether the integration is aimed upstream, i.e. towards suppliers, or downstream (towards customers).

Supplier integration

Many studies of the benefits of integrating suppliers in product development have focused on the Japanese automotive industry (e.g. Clark and Fujimoto, 1991; Kamath and Liker, 1994) and the evidence is usually compelling. Other authors have focused on Western firms; and many also found wide support for the advantages of supplier integration in terms of more effective new product development (e.g., Ragatz et al., 1997, 2002; Primo and Amundson, 2002). Some of the advantages proclaimed by increased integration concern access to knowledge, reduced complexity, easier coordination of information flow, broader scope, as well as better working relationships (Ragatz et al., 2002; Clark and Fujimoto, 1991). Better product quality has also been mentioned as a key outcome of integrating suppliers early in the design process (Takeichi, 2001). Moreover, supplier integration has been advocated as the natural extension of the lean manufacturing concept (Lamming, 1996). Lean manufacturing received massive attention in the 1990s following a book by Womack et al. (1990).

Petersen et al. (2005) focused on examining when suppliers should be involved as well as what level of responsibility they should have to ensure a new product development project’s success, and they found that it is crucial to be selective about whom to integrate. Rather surprisingly they also found that the effectiveness of supplier involvement in setting objectives was dependent on supplier responsibility, where very high responsibility had a negative impact on the effectiveness. Ragatz et al. (1997) list the success factors for effective supplier integration, and found that the most effective integration is supplier participation in new product development teams. The most important success factors were identified as trust, frequent communication, clear focus and structure, but also confidence in the supplier’s capabilities as well as a firm’s own competencies in areas such as technology, customer focus and cross-functional teams. Takeichi (2001) identifies knowledge of product architecture and components as particularly important for effective supplier integration, and concludes that firms need to develop competencies internally in order to benefit from the specialised expertise of suppliers. Das et al. (2006) suggest there is an optimal level of supplier integration and that integrating more when the overall level is low yields significant benefits, whereas negative outcomes are expected for those firms with an already inflated level of integration.

In a review of potential negative effects of supplier integration, Primo and Amundson (2002) highlighted factors like longer project development times, negative effects due to the amount of resources needed and supplier obstructionism, but proposed some explanation for the mixed results of previous research. First, different authors use different definitions of supplier integration and the results are therefore not comparable. Second, the results are often described in broad terms such as project success whereas more detailed metrics like increased speed or quality might give a more nuanced picture. Third, they propose using a contingency approach based on a firm’s technological capability. The first one is rather difficult to take into account - since there is no
consensus on what constitutes supplier integration it is rather difficult to follow the consensus. The latter two points, on the other hand, should be considered in any study aimed at furthering the understanding of factors contributing to the success of supplier integration.

Some authors have measured the extent of supplier integration by looking at how much technology and information sharing are occurring between the focal firm and its suppliers (Ragatz et al., 2002). Das et al. (2006) have rather comprehensive measures of supplier integration, spanning 24 different factors from joint training to new product development to purchasing to cost information sharing. In this thesis only a few general measures of integration will be employed and they concern product and process development (see papers 1 and 2).

**Customer integration**

Customer integration can mean different things to different people, and the main distinction can be made by defining who the customers are. The customers can be both internal, e.g., the next person on an assembly line, or external. The customer can also be either the next process or the end user. Traditionally, in the marketing literature (see Griffin and Hauser, 1996 for a review), the end users have been in focus and the need to integrate them in new product development has mainly been advocated as a means of assuring compliance with their needs. Authors like von Hippel (2005) have taken the argument one step further and describe how the lead user should be identified and integrated, since that customer possesses the knowledge to drive the innovative process forward and thereby assure the long-term survival of the company. Other authors (e.g., Prahalad and Ramaswamy, 1999) have described the difficulties and challenges in doing that.

A supplier’s attractiveness in the eyes of their customers can be enhanced through developing innovation capabilities (Petroni and Panciroli, 2002). According to these authors, customers assign different roles to their suppliers depending on their innovation capabilities (see also Kamath and Liker, 1994). Swink and Mabert (2000) agree that competence is a key to increasing the attractiveness of suppliers.

Campbell and Cooper (1999) are critical of the universal belief that it is always beneficial to be close to the customer, and reported that firms who involved customers in their product development project were no more successful than firms with in-house projects. They believe the main culprit was an asymmetric power structure, where the customer is usually larger and able to appropriate most of the value. Seungwha and Gyeong (2003) investigated benefits gained by the supplier in new product development partnerships and found that suppliers do benefit, but the results were mixed. Firms with extensive partnering with their customer were no better in innovation or quality, but had significantly better financial performance.

The success of customer integration in new product development can also depend on at what stage they are being involved, according to Gruner and Homburg (2000). Interestingly, they found that early involvement and late involvement increase the likelihood of success, whereas involvement at medium stages had no impact on product success. Enkel et al. (2005), acknowledges the risks associated with customer integration,
such as knowledge leaks or increased dependence, but focus mainly on how to mitigate these risks. They suggest choosing trustworthy customers without too much power and drawing up formal contracts.

In an article about strategic technology alliances, Hagedoorn and Schakenraad (1994) found no performance impact from these alliances. However, they did not distinguish between vertical alliances, termed customer-supplier integration, and horizontal alliances between firms, or other types of relationships. Stock and Tatikonda (2004) found that a high level of external integration is most effective when technological uncertainty is high.

In sum, the literature suggests that the desirability of customer integration is at best mixed. Some empirical evidence suggests that benefits will outweigh costs under certain conditions, whereas other studies see no evidence of success at all. The focus of this thesis will not be on the end user but rather the customer firm in dyadic customer-supplier relationships. Customer integration in this respect is the mirror image of supplier integration, and typically firms that sell to other businesses are to some extent engaged in both. Although customer integration as described here can be seen as the same as supplier integration, just seen from the perspective of the supplier (see also Stjernström and Bengtsson, 2004), there are some differences which will become clearer in the next few paragraphs.

Customer or supplier Integration, or perhaps both?

As all companies have limited resources, it is not feasible to integrate all external sources. Although the advantages seem to be more consistently positive for supplier integration than for customer integration, they are both just different sides of the same coin. The inconsistency in proclaimed benefits implies that customers may gain more from the integration than the suppliers do. The marketing literature is, on the other hand, fairly consistently positive about being close to the customer, but usually refers to end users (see Griffin and Hauser, 1996). The discrepancy between the marketing and the supply chain management literature can be explained by the difference in power structure. Whereas end users are usually small, e.g., the individual consumer, in business-to-business relationships the customer is often much larger and larger customers are in a better position to appropriate value (Cox 1999, 2004). Benefits of customer integration may also be more implicit, as it may turn the customer into a loyal buyer, but that is more difficult to measure. Indeed, Lambert and Burduroglu (2000) acknowledge that although customer satisfaction is the most commonly used measure of success, only rarely can it be proven to lead to increased sales or higher prices. An intangible effect of customer integration can also be to take advantage of learning from the ‘best’ customer and apply that knowledge when dealing with other customers (Liker and Wu, 2000). Once again, the benefits may be extensive but very difficult to measure.

A number of authors have seized upon the dilemma of which side to integrate, often focusing on whether it is more fruitful to integrate customers or suppliers. Morash (2000) propose that supplier integration is more effective for companies that aim for cost leadership and customer integration for those aiming for differentiation (see also the review of competitive priorities). Frohlich and Westbrook (2001) propose a more inclusive framework by introducing ‘the arc of integration’ (see Figure 1). They find that the wider the arc is, the more benefits accrue to the focal firm, but they do not take into
account that firms have limited resources or any contingency factors. As it is not feasible to integrate all customers or suppliers, the firms should focus on those with the highest potential payoff (Swink and Mabert, 2000), while also taking into account the needs of the external partner.

The focus of Droge et al. (2002) is on whether it is beneficial to integrate externally, i.e. both customer and suppliers, as well as internally, i.e. engineering design and manufacturing. They found that both internal and external integration had a positive effect on many performance indicators. They also noticed some interaction effects between internal and external integration, and recommend this area for further research. Hillebrand and Biemans (2004) develop this premise further in an exploratory study and suggest three explanations for why internal integration facilitates external integration. First, internal integration mechanisms are used to coordinate external integration. Second, the norms of external and internal integration are similar, and finally external cooperation may stimulate internal cooperation.

Manufacturing competence as a prerequisite for effective integration

As mentioned in the previous paragraphs, there have been many attempts at explaining the success, or lack thereof, of external integration. This thesis will contribute to the body of literature but will take a more unusual approach. While acknowledging the previous findings of other relevant literature, this thesis aims to consider a few factors that have not been taken into account previously. First, the role of manufacturing competence in facilitating successful integration has not been widely recognized; instead the focus has been on integrative competencies (see e.g., Wagner and Boutellier, 2002). Integrative competence is the set of actual abilities and mechanisms that are used in order to integrate outside constituents, not the competencies needed to assimilate and utilise the acquired knowledge.

The second weakness of most literature in the field is that it assumes that ‘one size fits all’. Except for case study-based research, most empirical studies show either that integration is beneficial or, less often, that it is not beneficial. There is a shortage of research arguing
that external integration is beneficial under some circumstances, but not under others. The few researchers that have taken such an approach have usually focused on aspects such as technological uncertainty (Ragatz et al., 2002; Stock and Tatikonda, 2004) or relational competence (Wagner and Boutellier, 2002).

This thesis takes a complementary approach and focuses on the underlying competencies of the manufacturing department that allow it to value, assimilate and use the competence it has extracted from external sources. One conceptual framework suitable for this task is the concept of absorptive capacity, originally introduced by Cohen and Levinthal (1989). This model is, however, also incomplete as it does not take into account that the differing needs of different firms, which can be explained by the term competitive priorities. The next few paragraphs will review the absorptive capacity framework as well as different models explaining competitive priorities.

**Absorptive Capacity**

Cohen and Levinthal (1989) introduced the concept of absorptive capacity in a widely cited article, where they showed that firms gain two benefits from investing in research and development. The first one is obviously technical knowledge and the other is the ability to ‘absorb’ knowledge from the external environment. The benefits would, according to the authors, outweigh disadvantages such as direct cost but also the risk of knowledge leakage. The message in this article is fairly simple; the combined benefits should be taken into account when making investment decisions. The first article from Cohen and Levinthal (1989) does not provide any clues as to where this absorptive capacity comes from, or what it really is. The second article on absorptive capacity from Cohen and Levinthal (1990) goes further in explaining the concept. In their paper a clear emphasis is put both on the ability to value and assimilate knowledge as well as on the ability to commercialise it. These form two distinct dimensions, the structure of internal and external communication as well as the nature of know-how.

According to Cohen and Levinthal (1990), the basis of absorptive capacity is previous knowledge in a particular area, and lies mostly within individuals. However, they also point out that organisational absorptive capacity is not simply the sum of each individual’s absorptive capacity, as organisational structures and mechanisms also play a part. This thesis will follow Cohen and Levinthal’s line of reasoning and accepts that a large part of the absorptive capacity resides within individuals, but will attempt to measure it at an organisational level.

Cohen and Levinthal (1990) argue that the necessary absorptive capacity for product and process innovation is often firm-specific and difficult to acquire, and hence must be developed internally. There is a striking similarity with core competence as described by Prahalad and Hamel (1990), as those competencies are also firm-specific and difficult to imitate. Absorptive capacity is furthermore path dependent, so the accumulated absorptive capacity is only effective when acquiring, utilising and commercialising related knowledge (Cohen and Levinthal, 1990). In other words there must be a fit between the particular type of absorptive capacity and the integration effort as well as the knowledge the firm wish to integrate.
Empirical studies with a straightforward interpretation of absorptive capacity

Many authors have used the arguments of Cohen and Levinthal (1990) to explain the role of existing knowledge for the effectiveness of knowledge transfer. Szulanski (1996) showed that a lack of absorptive capacity is the largest barrier to intra-firm sharing of best practices, bigger than all motivational or social factors. The absorptive capacity was seen as a function of the existing stock of knowledge, and manifested by an ability to identify, value and apply new knowledge.

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Veugelers (1997) found that external cooperation in R&D has no effect on innovation unless firms have their own R&D infrastructure, and cooperation stimulates R&D expenditures. She also reported that firms with higher R&D spending are more likely to be engaged in external R&D cooperation. These results are interpreted as supporting the absorptive capacity argument, and it is indeed in line with Cohen and Levinthal (1990). Veugelers (1997) does not provide any evidence for which specific factors contribute to absorptive capacity, and recommends this area for further research.

Shenkar and Li (1999) found that firms will not seek knowledge in an area where they already have some knowledge, but that they seek complementary (as opposed to specific) knowledge. The firms’ predisposition to complementary knowledge is interpreted as a sign that the absorptive capacity, which is a function of previous knowledge, determines which type of knowledge it will seek. This is in line with Levinthal and March (1993), who by extending the argument of path dependence warn of the dangers of being too narrowly focused, as it can make the firm blind to knowledge outside its centre of attention.

Stock et al. (2001) have a rather simple approach to measuring absorptive capacity by measuring the level of R&D as a percentage of sales. They find that higher levels of absorptive capacity spending increase the performance of a firm’s products up to a certain point. That is hardly surprising as they in fact have shown that higher R&D spending contributes to product performance without any need to cite absorptive capacity. Petroni and Panciroli (2002) have a similar approach, considering absorptive capacity along two dimensions: R&D expenditure as a percentage of sales as well as investment in personnel training.

A paper by Mowery et al. (1996) shows that being R&D intensive does not help firms absorb capabilities from alliance partners. But when measuring absorptive capacities as experience in related capabilities, they do, however, find significant support for the notion. This implies that it is not enough to just measure the investment in monetary terms, but more insight is required into what particular competencies have been developed.

Further development of absorptive capacity

There are some weaknesses in Cohen and Levinthal’s (1990) framework. First of all, they are rather vague on what actually constitutes absorptive capacity, and mostly describe a tacit asset that somehow appears as a result of investments in knowledge. Moreover, on the one hand they state that the absorptive capacity is the firm’s existing knowledge base, but on the other hand it is partly found in the way it structures its communication with its external environment. If the communication with the external environment is absorptive capacity it could be interpreted as stating the obvious; you need to acquire knowledge (if
acquisition is deemed part of a firm’s absorptive capacity) in order to benefit from it. The question arises whether external communications is indeed an absorptive capacity or a mechanism for which absorptive capacity is required in order to be successful. Furthermore, although Cohen and Levinthal (1990) acknowledge the multidimensional nature of the absorptive capacity, they only operationalised it as R&D spending. A few authors have seized upon the vagueness of Cohen and Levinthal (1990) and propose some reconceptualisations.

Lane and Lubatkin (1998) introduced the concept of relative absorptive capacity, arguing that it is not enough to look at a firm in isolation. Instead, the potential for inter-organisational learning is dependent on the relative levels of absorptive capacity of the two firms engaged in the knowledge transfer. They investigated the relative absorptive capacity along three dimensions: related knowledge, similarity in structure and similarity in business logic. This is partly in line with Cohen and Levinthal (1990), who write about the structure of communications as well as the character and distribution of knowledge, but nothing comparable to Lane and Lubatkin’s (1998) business logic. Moreover, Cohen and Levinthal (1990) looked at individual firms and not dyadic relationships.

Zahra and George (2002) distinguish between potential and realised absorptive capacity, where the former refers to valuing, acquiring and assimilating external knowledge, whereas the latter refer to transforming and applying it commercially. In order to improve firm performance both potential and realised absorptive capacity are required and when these two are fairly equal the firm reaches optimum performance. This argument is very similar to the concepts of exploration and exploitation (March, 1991), and both Zahra and George (2002) as well as March (1991) emphasise the necessity in combining the two dimensions. March (1991) also acknowledged the path dependence of competencies, as do Cohen and Levinthal (1990), and suggest increasing returns by sticking to the firm’s core field of expertise, although there is a risk the field is a suboptimal one (see also Levinthal and March, 1993). The problem of too much exploration and too little exploitation could also be described as an increased level of potential absorptive capacity without the realised absorptive capacity needed to commercialise it (Zahra and George, 2002). In fact, it is difficult to see any definite difference between the concept of potential vs. realised absorptive capacity and exploration vs. exploitation, although the former seems to be a broader concept. This thesis will adopt Zahra and George’s (2002) terminology, as it fits better within the overall concept of absorptive capacity.

Within the two types of absorptive capacity, Zahra and George identify four dimensions, two for potential and two for realised absorptive capacity. These dimensions are acquisition and assimilation, which are both classified as potential absorptive capacity, as well as transformation and exploitation, which are realised absorptive capacity. When compared to Cohen and Levinthal’s (1990) original paper, Zahra and George (2002) have added the dimensions transformation which Cohen and Levinthal does not mention; the other three are to some extent covered. Transformation refers to the internal mechanisms that allow the firm to combine existing knowledge with newly acquired.

**Empirical studies with an enhanced view of absorptive capacity**

A number of authors have taken a more enhanced view of absorptive capacity when operationalising the concept, and looked at different mechanism and contributing factors.
Jones (2004) was influenced by Zahra and George’s (2002) concept of potential and realised absorptive capacity and suggests that the potential of small service firms is dependent on their ability to respond by acquiring and exploiting external information. Lin et al. (2004) link the effectiveness of technology transfer with absorptive capacity. In absorptive capacity they include factors such as technology diffusion channels, interaction mechanisms and R&D resources. They conclude that absorptive capacity is critical for the effectiveness of technology transfer. Caloghirou et al. (2004) selected a set of variables representing what they considered “an enhanced notion of absorptive capacity”, such as R&D spending, human resource training and mechanisms for internal and external knowledge flow, and found that they do indeed contribute to innovation. Nieto and Quevedo (2005) operationalised absorptive capacity along four dimensions: communication with external environment, level of know-how and experience, diversity and overlap in the knowledge structure, as well as strategic positioning. They found that absorptive capacity has a high explanatory power of the success of innovation. Another interesting finding is that firms’ innovative efforts in an environment of technological change and opportunity are aided by a critical mass of know-how and certain absorptive capacity. This means that firms that have sufficient internal absorptive capacity are better suited both to innovate as well as to adapt to changes in external conditions.

Concluding remarks on absorptive capacity

There seems to have been a clear development in the concept of absorptive capacity. Although Cohen and Levinthal (1989, 1990) clearly state that absorptive capacity is both a resource as well as the structure of communications, they still operationalised it only as a resource that is a by-product of R&D spending. Other early empirical studies have followed their example and regard absorptive capacity only as a resource. In later papers, in particular Zahra and George (2002), the concept has evolved into representing both a resource as well as the mechanisms through which that resource is utilised. In the first paper of this thesis the former approach was adopted, whereas in the third paper the more comprehensive view of Zahra and George (2002) is embraced. In the first paper the term ‘manufacturing absorptive capacity’ is used as a way of distinguishing it from the (R&D) absorptive capacity of Cohen and Levinthal (1990) and others, and it refers to the fact that it originates from an investment in manufacturing competence. ‘Manufacturing absorptive capacity’ is thus an extension of Cohen and Levinthal (1990) and other early empirical studies which consider this capacity a resource.

Alternative frameworks

The theory of dynamic capability (Teece and Pisano, 1994) is rather similar to absorptive capacity and both are in the realm of the resource-based view (see Barney, 2001). A dynamic capability refers to the ability to adapt to a changing environment through appropriating, adapting and integrating both internal as well as external competencies and resources, and it is largely embedded in the firm. The similarity with the absorptive capacity concept is striking and Zahra and George (2002) do indeed define absorptive capacity as a dynamic capability aimed at knowledge creation and utilisation in order to sustain competitive advantage. As the theory of dynamic capability overlaps to a large
extent with absorptive capacity, in the remainder of this thesis the term absorptive capacity will be used, although it may indeed also be labelled a dynamic capability.

Other explanations for why internal competencies are important for external integration have also been offered. Ellegaard et al. (2003) describe the increased attractiveness firms gain from higher competencies, making it easier for them to find a willing partner. Gulati (1999) also reports that firm capabilities will influence alliance formations. While these views are certainly acknowledged, the effects described by these authors also fit well with the absorptive capacity framework.

**Competitive priorities**

Absorptive capacity provides the firm with the means to extract value from external sources, but the needs of firms differ and depend to a large extent on the competitive position the company is in. Many authors have attempted to provide frameworks, usually dichotomies, defining the basis of competition. The next few paragraphs will review some of these, but the aim is not to be all-inclusive. It is rather to highlight the development within the field, as well as to provide some justification for the chosen framework. There is quite a large difference in focus among the authors reviewed. Some authors discuss the competitive priorities (Christensen, 1997; and Porter, 1980), and some focus on industry dynamics (Utterback, 1994), whereas others examine the consequences of these (Ulrich, 1995; Fisher, 1997; Christopher, 2005).

The most well-known author in the field of strategy is Porter (1980, 1985), who proposed that firms should position themselves through either cost leadership or differentiation. Differentiation is attained by providing customers with something they are willing to pay more for, most often through a perception of quality. Porter also added another dimension: broad or niche market, which can be applied to both cost leadership and differentiation. The major weakness with Porter’s framework is that it assumes a stable market, where firms can position themselves depending on where it is most lucrative. In a fast-moving market there is little time to position the firm; providing a customer with some extra value added is very difficult when customer demands evolve rapidly. Attaining cost leadership might also not be very relevant if the product is only manufactured for a few months or can command a premium price anyhow due to limited supply or other unfilled customer demand. Another weakness with Porter’s framework is that it does not take into account that companies have unique resources that will have a significant impact on their ability to position themselves.

Ulrich (1995) as well as Ulrich and Ellison (2005) proposed a dichotomy based on the product architecture. They distinguish between modular and integral architecture, where new technologies tend to have more integral product architecture. When the product becomes mature, the interface between components becomes standardised, allowing a more modularised design. The modularised design in turn facilitates a shift towards vertically disintegrated firms, where each firm is focusing on one or a few components. Through this shift, the cost of production is reduced and quality can also be improved.

Fisher (1997) argues that it is important to match the product with the right supply chain. He distinguishes between products with predictable demand versus products with unpredictable demand. For products with predictable demand an efficient supply chain is...
called for, and for products with unpredictable demand a market-responsive supply chain is ideal. Christopher (2005) has a similar approach, although he calls the two types of supply chains lean (efficient) or agile (responsive). Cagliano et al. (2004) study empirically how a lean, agile, or ‘traditional’ supply chain impacts manufacturing performance and find that both lean and agile outperform the more backward ‘traditional’ supply chains. They conclude that the effectiveness of either strategy depends on contingency factors, which is in line with both Christopher (2005) and Fisher (1997). Cagliano et al. (2004) did not research these contingencies but recommends that for further research.

Utterback (1994) focuses on the industry dynamics of innovation, where firms in innovative industries prioritise product development. When the industry matures, the focus tend to shift to process improvement; the quality as well as the cost of the product are thus enhanced.

Christensen (1997) is inspired by both Utterback (1994) as well as Ulrich (1995), and bases his conceptual framework on industry dynamics. However, in Christensen’s (1997) framework there are more than two phases of competition. He identifies four, although he acknowledges that there could be additional or fewer depending on industry. These four phases of competition are functionality, reliability/quality, convenience and cost, and they are separated by disruptive shifts in technology or market. Typically a new product competes over functionality but when the functionality overshoots the requirements of most customers an opportunity opens for an alternative product with less functionality but superior reliability. The new product is seen as disruptive as it redefines the basis of competition.

As mentioned, most authors have proposed dichotomies, whereas Christensen (1996) suggests four phases. However, a later paper (Christensen et al., 2002) proposes a dichotomy of functionality vs. non-functionality. Many of the proposed frameworks (e.g. Porter, 1980; Christopher, 2005) do not take into account the dynamic aspect of competition that results from innovation. However, a simple distinction between innovation and non-innovation-based competition is also unsatisfactory. Even with firms that are not at the leading edge there is plenty of scope for differentiation, be it the result of disruptive shifts or not. For example, in a mature industry like automotive, different car companies certainly have different business logic - just compare Ferrari with Toyota. Both firms are highly profitable but would certainly not remain so if they adopted each other's strategies. On the other hand, for a company with a radically new technology, e.g., teleporting, the strategy of either Ferrari or Toyota is likely to be redundant. A useful framework for companies’ competitive priorities should thus accommodate both innovation as well as the dimensions of stable industries. This thesis will therefore use a framework with three phases of competition, which will be referred to as functionality, market responsive as well as cost. The framework is a synthesis of the previously mentioned literature, although it can be said that it is to a larger extent based on Christensen (1997). The theoretical framework is meant to describe the underlying competitive priorities of the firms, whereas the consequences are the subject of the research. Also note that Christensen (1997) proposed four phases, whereas three are deemed sufficient for the purpose of this study. Both reliability/quality as well as convenience need input from the market and are thus included in the term market responsive.
One problem that occurs when looking at individual firms is that their main competitive priority is a result of deliberate strategic positioning as described by Porter (1980, 1985) in combination with industry dynamics. Companies can be assumed to act according to their competitive priorities irrespective of the source of that priority. This thesis will thus simply acknowledge that different competitive priorities exist, and that they have profound implications for the need for integration (figure 2).

![Diagram](image)

**Figure 2. The basis for and consequences of competitive priorities.**

**The Conceptual framework**

The last part of this chapter will attempt to integrate the various streams of literature that has been discussed, and to provide a conceptual framework that will bind them together with the three papers that are included in this thesis.

According to Christensen (1997), when a company is focused on the competitive priorities typical for the phase its industry is in, e.g., functionality, it tends to ignore external or internal improvements in other areas, such as convenience. There is basically nothing wrong with that, as the company sees functionality as the key to commercial success, and improvements in other areas do not contribute to competitive advantage. Since companies tend to be better at absorbing knowledge related to their competitive priorities than knowledge in other areas, absorptive capacity is thus directly related to competitive priorities. The conceptual model will thus suggest that investment in manufacturing will always yield absorptive capacity, but the company will be better at absorbing knowledge related to its competitive priorities. This is in line with the concept of relative absorptive capacity (Lane and Lubatkin, 1998), as well as path dependency (Cohen and Levinthal, 1990). Moreover, the company’s investments in manufacturing are likely to be directed at areas which will improve its competitive priorities, thus further reinforcing the path dependency. If, for example, a company is focusing on improving flow-oriented manufacturing, it will be better at absorbing techniques such as *kanban*, than improvements in machining steel.

Furthermore, Cohen and Levinthal (1990) assert that there may be a trade-off between communicating internally or externally. In order to stay competitive, the trade-off must be based on what will contribute most to the firm’s overall strategy. Implicitly they are asking
for a framework for understanding how a decision on that trade-off is made, and the Christensen (1997) framework provides an opportunity to do that. The Christensen framework provides a basis for understanding where communication is most effective; where the communication is most intensive, the need for absorptive capacity will also be greatest.

When the competitive priorities are matched with adequate levels of absorptive capacity in the right domains, performance is expected to improve. The conceptual model can be graphically illustrated by Figure 3:

![Conceptual framework](image)

**Figure 3. Conceptual framework.**

**Competitive priorities**

Competitive priorities refer to the priorities of the focal firms in meeting customer demand. There are many models for describing these priorities, but a modified version of Christensen (1997) will be used. According to the model used in this thesis, companies compete primarily over functionality or price of the product. A third group of companies, termed market responsive, are in between these two extremes, since they compete on criteria for which they need input from the market, such as quality and convenience. Moreover, the competitive priority results from the dynamics (and the maturity) of the
industry, as well as the company’s strategic positioning within its industry. As has been described previously, competitive priorities will influence both the need for external integration as well as the required absorptive capacity.

**Absorptive capacity**

Absorptive capacity can be described as consisting of two main parts as described by Cohen and Levinthal (1990), three in Lane and Lubatkin (1998), or four in Zahra and George (2002). As this thesis is concerned with two main dimensions, external integration and manufacturing competence, a two-dimensional construct will be adopted. This choice is justified since the distinction between internal and external is prominent in the supply chain literature and forms a substantial part of the employed theory. Moreover, the ‘additional’ dimensions of absorptive capacity are also to a large extent inherent in the model but classified differently. Furthermore, the question was raised earlier as to whether communication is really an absorptive capacity or a mechanism for which absorptive capacity is required. Hence, it may be appropriate to make a clear distinction between factors that allow the firm to make internal use of knowledge and mechanisms for acquiring that knowledge.

Absorptive capacity refers to balancing manufacturing competence with external integration, and successfully exploiting them both for commercial purposes. Both sides of the circle in Figure 3 are essential; with only one side present, no effective absorptive capacity can be expected. This line of argument is partly in line with Zahra and George (2002), who argue that it is not enough to have a potential absorptive capacity, which is to acquire and assimilate knowledge, if the firm lacks realised absorptive capacity, i.e., the ability to transform and commercialise it (see also March, 1991). When the two sides are developed to a similar extent, the firm can be considered to have a well-developed absorptive capacity. The arrows in the middle refer to the fact that combining the two dimensions is a never-ending process where advances in one area must be coupled with advances in the other to continuously elevate the level of absorptive capacity.

The absorptive capacity required to be successful is moreover dependent on competitive priorities. A firm that competes primarily over the functionality of its products is likely to benefit from absorptive capacity geared towards innovation (see also Lin et al., 2004). Integration activities likely to be important for this type of firm include joint product development or collaborative research projects. For market-responsive firms as well as cost-focused firms, absorptive capacity can be of a different kind because the demands of the relationship are different, and external integration might be more focused on customer relationship management, logistics, projects aimed at reducing costs, etc.

**External Integration**

External integration refers to the way the firm integrates or collaborates with its customer and suppliers in both product and process improvement. Other aspect of external integration are certainly also feasible, but they are not covered in this study.
Manufacturing competence

Within the term manufacturing competence two basic kinds of competencies will be considered in this thesis, although it can rightfully be argued that many more exist. The purpose of the framework is not to list all manufacturing competencies that will contribute to absorptive capacity, but to provide a model for understanding the need to balance external integration with internal manufacturing competence. The two types of competencies that will be considered are the ability to improve manufacturing operations as well as the structure of internal integration and communications involving manufacturing.

Performance

When the two sides of the model have been balanced, preferably at a high level, increased performance can be expected. Performance can, however, be improved in many ways, and some performance factors are likely to be more important for some firms than for others. The areas where performance will improve most are likely to be in the same areas that absorptive capacity has improved most. If a firm has an effective strategy, these areas are also going to be where the company’s focus lies, i.e., its competitive priorities. In other words, if the firm is effective in providing the absorptive capacity it needs, performance will improve in those areas that are most important for its competitive priorities. If, on the other hand, there is a mismatch between the performance improvements the firm seeks and the absorptive capacity it provides, little performance improvement can be expected.

A refined version of the model

For the third paper a refined version for the previously presented model was used. This model takes into account the differences between Cohen and Levinthal’s (1990) as well as Zahra and George’s (2002) arguments. After analysing these it was apparent that they were partly describing different aspects of the concept. Whereas Cohen and Levinthal (1990) are mostly concerned with the sources of absorptive capacity, Zahra and George (2002) investigate different types of that capacity and in what phases of integration they may be vital. The framework used for the third study encompasses both of these dimensions (Figure 4) and is a more detailed picture of the absorptive capacity circle of Figure 3.

According to the conceptual model, and in line with Cohen and Levinthal (1990), there are two sources of absorptive capacity: body of knowledge and structure of communication. The framework stipulates that the two dimensions must be combined in order to achieve a positive outcome.
Concluding remarks on the conceptual model

Note that there is a clear difference between the proposed model and the one described by Cohen and Levinthal. Cohen and Levinthal (1990) also mainly distinguish between two dimensions, but their two dimensions are the stock of current knowledge as well as the structure of communication, both internal and external. The reason for the divergence is that this model fits in better with the supply chain management and supplier integration literature, where the distinction is often made between external and internal (see e.g., Droge et al., 2004). This model is also partly congruous with that of Zahra and George (2002), who differentiate among four dimensions, where three are represented by the manufacturing competence dimension (assimilation, transformation and exploitation) and one (acquisition) by external integration. However, Zahra and George’s (2002) acquisition dimension also contains some elements of what is here classified as manufacturing competence, as they rightly point out that prior knowledge will help firms identify valuable knowledge for acquisition. Zahra and George’s (2002) dimensions of absorptive capacity are more clearly contrasted with Cohen and Levinthal’s (1990) in Figure 4. This framework posits that the two dimensions, external and internal, must be balanced in order to be successful, and hence knowledge, represented by manufacturing competence, is in the right-hand side of the model. This line of argument is also in line with March’s (1991) concept of exploration and exploitation.

Summary

Supply chain management and external integration have been identified as the key to competitive advantage, but the actual results from the literature are not always encouraging, highlighting the need to look for prerequisites. The concept of absorptive capacity provides a useful framework for explaining the need for internal competencies in
order to benefit from external integration. The concept has been used in studies of R&D as well as in the field of knowledge management, but has not yet been used in a manufacturing setting. This thesis posits that the concept is equally beneficial for manufacturing and also that it is related to competitive priorities. A framework for linking absorptive capacity with internal competence development, external integration, competitive priorities as well as plant performance has been presented.
3. Research Questions

Provided that absorptive capacity is a valid concept, that there is indeed a need for internal resources or competencies in order to extract, absorb and exploit external knowledge, what are the implications for manufacturing? The overall purpose of this research is, as previously mentioned, to analyse the need for manufacturing competence in order to turn external integration to competitive advantage, by further developing and utilising the concept of absorptive capacity. By using the absorptive capacity concept, the proposition is that manufacturing competence is no different from R&D competence, in that it underpins the ability to absorb external knowledge. Supplier integration is one commonly used element of interacting with the external environment, and is ideal for testing the validity of the framework. The first research question can thus be phrased:

1. To what extent does manufacturing competence contribute to the success of supplier integration?

The conceptual framework used for answering this question is based on the concept of absorptive capacity (Cohen and Levinthal, 1990), but operationalised for a manufacturing setting. From a theoretical point of view, a sub-question could thus be phrased: Is absorptive capacity a valid construct in a manufacturing setting?

In order to investigate the overall framework presented in Figure 1, different parts and assumptions must be separated in order thoroughly to analyse their significance. The framework stipulates that competitive priorities will influence the need for competencies and the absorptive capacity they support. Analysing that directly is a rather difficult task, due to high complexity and the interdependencies among the many factors, and can in essence only be done using qualitative methods involving multiple case studies. It is, however, feasible to investigate the need for external integration depending on the competitive priorities using survey data. But by doing this it is implicitly acknowledged that all firms possess a certain degree of absorptive capacity so that the outcome of integration will indeed reflect their competitive priorities. The second research question can, thereby, be phrased:

2. To what extent do competitive priorities influence the level as well as the outcome of integration?

The conceptual framework used for answering this research question is the one developed by Christensen (1997), as it provides a dynamic view of product life cycles and competitive priorities. The result will also provide some indication as to where the need for absorptive capacity-inducing competencies will be greatest, as different types of integration with different content will probably require different types of competencies. In order to gain further insight into what constitutes the absorptive capacity of firms, there is a need to conduct a practically oriented case study. The research question for that study can be phrased as:

3. How does the absorptive capacity of a manufacturing firm look in practice?

The last research question implies an empirically based refinement to the framework used in the first study. Absorptive capacity is once again the central theme, but for answering this question a more open-ended approach is required. A sub-question could thus be phrased: What factors contribute to, and how do they influence, the absorptive capacity of a manufacturing firm?
The aim of this thesis is to answer these three questions, including sub-questions, using the theoretical framework deduced from the literature and tested using empirical data.
4. Methodology

This chapter is dedicated to describing and discussing the methodology that was used for the empirical part of this research, and is divided into five parts. The introduction discusses how the research questions shape the choice of methodology. The second part describes the quantitative, i.e. survey, part of the study, and the third part describes the qualitative analysis, consisting of a single pilot case study. The fourth part discusses validity and reliability for both the quantitative as well as the qualitative part of the study. In the fifth and last section, the methodology is summarised, together with some concluding remarks.

Introduction to methodologies

According to most scholars, the main requirement of a research methodology is that it should be suitable for answering the research questions (e.g., Silverman, 2000; Yin, 2003). In other words, there is no ‘best’ methodology, and a prudent researcher should adopt the practices best suited to the task at hand.

The three research questions are of distinctly different characters. The first one, to what extent does manufacturing competence contribute to the success of supplier integration, implies theory testing, which requires its own specific set of logic. The phases in this type of research are literature review, designing a conceptual framework, operationalising the framework, testing the framework, and then analysing the results. For this type of question, generalisability is at a premium, since the usefulness of the framework is highest if it can be proven that it applies to a wide range of cases. One of the best ways of assuring generalisability is to have a large sample size, and a large-scale survey is a practical way of accomplishing that. Other methods are certainly also possible, but conducting in-depth case studies of a very large number of firms is simply not feasible except for large research teams.

The second question, to what extent do competitive priorities influence the level as well the outcome of integration, also implies theory testing. The aim of this particular study is once again to get a high level of generalisability, which favours a survey. The study aims to answer a ‘how much’ type of question (the level of integration) as well as a causal relationship (how does it influence…). A survey is ideally suited for answering the ‘how much’ questions, but the causal relationship questions are worth paying particular attention to. To overcome the risk of drawing causal conclusions from a correlation between two factors, a solid theoretical framework is required (see e.g., Forza, 2002).

The third question, how does the absorptive capacity of a manufacturing firm look in practice, is of an exploratory character. Provided that the concept of absorptive capacity is valid, why does the observed phenomenon take place? A survey cannot, despite substantive efforts to devise an all-encompassing instrument, take into account all the potential factors that might influence absorptive capacity. In order to answer this question satisfactorily, a qualitative study is thus called for. There are, however, many different methodologies that could be appropriate for this task, and combining different types according to the situation allows the methodology to match the task as well as possible.

Different methodologies will thus be applied in order to answer the different research questions, where the key distinction is between quantitative and qualitative. The first two
research questions are answered using quantitative methods, and more specifically large-scale surveys. The large-scale survey was not only used to answer the research questions, but also to develop a framework for the qualitative part, i.e. for answering the third research question. The qualitative element of this thesis is, however, rather small, consisting of only one pilot case study. The aim is to be able to extend the study in the near future by using the developed framework, which may possibly be further refined using the findings from the pilot case study.

In this study, there was ample theory to build up a theoretical construct without any need for an explorative qualitative study at the early stages. The constructs, described in chapter 2, are fairly straightforward; a broad survey would provide enough details to answer the research questions adequately. What no survey can provide, however, is detailed accounts of complex relationships among many variables. Thus, there was a need to follow up the survey with a more detailed qualitative study. There was also a practical reason to conduct the quantitative part of the study before the qualitative - a more or less immediate access to a substantial database whose value would deteriorate if the quantitative study were to be postponed. The collection and use of the database will be further discussed in the next few paragraphs.

**Quantitative methodology**

The main element of this research consists of a large-scale survey that was mailed out during the early months of 2004 to the plant managers of a representative sample of the Swedish manufacturing industry. All plants in the sample had more than 50 and less than 6500 employees and operated in the following sectors: metal goods, machinery, office equipment and computers, other electronics, telecommunications, instrumentation, and automotive (ISIC codes 28-35). This constitutes a diverse cross-section of both the Swedish as well as the European manufacturing sectors. Because many of these firms compete successfully in the global marketplace, the results are of interest for manufacturing firms competing world-wide. A representative sample is desired as the aim is to investigate the validity of the previously mentioned conceptual framework for general manufacturing environments. The sample was limited to firms with at least 50 employees, since smaller firms have limited resources for developing elaborate manufacturing and supply chain practices and programmes.

The total population was 1003 firms, from which 606 were randomly selected, in accordance with five strata (see Table 1). The number was later adjusted to 563 due to factors such as that the company was no longer in business. After sending three reminders, complete responses from 267 companies were obtained, a response rate of 47%. A separate analysis of non-respondents was conducted by telephoning a random and stratified sample of non-respondents. When comparing the answers on key questions (regarding size, kind of production, whether the company has design capability, as well as the complexity in design and production), no bias was detected. Another analysis comparing early and late responses confirmed the validity of the sample. The survey instrument includes a total of 51 questions, resulting in 198 items. These cover many different areas but this paper is only concerned with those questions dealing with internal competencies, supplier integration and plant operating performance.
The survey contained a set of questions, 13 in total, about the change the manufacturing department has witnessed in the last three years. There were also 12 items describing the performance improvement of the manufacturing department. That these two topics are strongly linked is theoretically well understood and the survey did indeed show a strong correlation between them. The survey had five items concerning relations with suppliers and four items about customer relations.

There were ample studies predicting that both manufacturing competence and external integration contribute positively to plant performance, but the link between these two was less developed. When it became apparent that those firms that had positive development of the manufacturing department also were more likely to have a strong correlation between the variables concerned with customer/supplier relations and plant performance, an interesting subject for a thesis was established. Studies explaining the observed phenomenon were thereafter reviewed, and the most promising explanation was absorptive capacity (Cohen and Levinthal, 1990). The first phase of the research can thus be described as being a mix between inductive and deductive reasoning. The second element of the quantitative data analysis had a clear deductive approach. During a course in innovation management, an illuminating book by Christensen (1997) was read, and curiosity of the researcher compelled him to test how Christensen’s theories relate to integration.

After the appropriate literature had been reviewed, a conceptual framework for investigating the desired phenomenon was devised. The operationalisation of the concepts had to be coherent with the identified literature, but also with the data that had already been collected. This poses some issues concerning validity which will be further discussed later in this chapter. After the appropriate statistical analysis had been conducted using the SPSS software package, the results were presented in two conference articles that were accepted at the 2005 and 2006 EurOMA conferences. The second paper of this thesis is identical to the one presented in the 2006 conference, whereas the first paper has been reworked for publication in the International Journal of Manufacturing and Technology Management.
Qualitative Methodology

The findings of the two survey-based papers did not provide a complete and accurate picture of the phenomena predicted by theory. The solution was thus to extend the research to case studies. Due to time constraints only one case study was done, which will serve as an illustrative example of the concepts described in chapter 2. The aim was to develop the research procedure so that more extensive multiple case studies can be conducted after completing this thesis.

The qualitative element of this study will eventually consist of multiple case studies of Swedish manufacturing firms but, as mentioned, at this stage it will be limited to one pilot case study. The full multiple case study may be a central part of a later PhD thesis.

The main source of inspiration for planning and conducting the case study has been the seminal work of Yin (2003). This work is a widely quoted qualitative methodology book in the fields of operations management as well as related disciplines. The widespread use of the book can be seen as comforting, as a rigorous following of the procedures described in the book can hardly be seen as unconventional. However, an uncritical adoption of any model is always dangerous. It is important to pay attention to the context, and in a research setting that means, more than anything, looking at how the chosen methodology conforms to the requirements of the research question. Another work that serves as a guideline when attempting qualitative research is Voss et al. (2002), who describe how case studies can, and have been, used in operations management. An author who is highly sceptical about an overly positivist approach to case study research is Silverman (2000), and may thus serve as a useful counterweight to Yin (2003).

A case study protocol, prepared according to the guidelines in Yin (2003), consisted of the following parts: an overview of the research project, as well as the case study questions together with instructions for the interview procedure. The objective of the case study protocol is to help the interviewer keep the interview procedures similar and according to plan, as well as to facilitate a reliable inter-case as well as cross-case analysis. It was highly useful to have such a document prepared in advance, although this particular protocol had serious shortcomings. The most serious one was that there were a large number of questions that called for fairly short, almost survey-like answers. Another problem was that the same protocol was used for all interviewees regardless of their position within the firms. Subsequent questions for the sales managers included items concerning supplier relations. On the other hand, the firm was rather small so most managers had some knowledge in areas that were not part of their formal job description. All the same, limiting the questions to the areas where the interviewee has most expertise saves time and facilitates more comprehensive answers. However, the objective of a pilot case study is, after all, to refine the questions and procedures that will be used when embarking on the actual study. Due notice is taken of the shortcomings and efforts will be made to improve these areas when preparing for future case studies.

The first firm to be studied was selected for having most of the required characteristics, i.e., it was a manufacturing firm that has manufacturing competence as the key to its long-term survival (it is a contract manufacturer, without an engineering design department). It is fairly successful as a supplier to major Swedish industries like Ericsson and ABB, and it supplies complex products and strives to increase the level of sub-assemblies. A practical
reason for selecting this particular supplier is also that one of its managers, who is also in the process of doing a PhD, volunteered to be a key informant.

The interviewees were selected based on a mutual understanding of who possessed most of the relevant knowledge. Their roles are the CEO (and production manager), market (sales) manager, sales engineer, quality & environmental manager and purchasing manager. Individual interviews were subsequently conducted with each one, lasting between one and two hours. All interviews were conducted during a single visit. The interview transcripts were later reworked and tabulated while taking precautions to establish a trail of evidence. The evidence was complemented by the obtained documents, including the annual financial report. The results, presented in tabular form to ensure multiple sourcing of evidence, were then reworked into a written document. Subsequent reassessments of the document produced a draft paper which was reviewed by the key informant.

Validity & Reliability

Construct, internal and external validity as well as reliability are key concepts in a positivist attempt at research, and these four will each be discussed in the following paragraphs.

Construct validity

Construct validity refers to whether the reported phenomena genuinely reflect actual events or if they have been clouded by the researcher preconceptions. The researcher should rigorously approach the subject in such a manner as to minimise potential bias and assure objectivity (Yin, 2003). In quantitative research, construct validity is focused on the convergence between different measures of the same construct as well as the difference between constructs, although the latter is not used commonly in operation management research (Forza, 2002). Testing for construct validity can be done using factor or confirmatory factor analysis, and that was indeed successfully carried out in papers 1 and 2.

However, there may still be some concerns about construct validity in these two papers. In the first paper, absorptive capacity is assumed to increase when investing in manufacturing competence, as was discussed in the literature review. There are, however, many ways of operationalising the construct, and the construct used in paper 1 may not be optimal. But it is indeed in line with previous research, including Cohen and Levinthal (1990), as absorptive capacity is seen as a by-product of some forms of investment.

The operationalisation of competitive priorities in paper 2 may also cause some concern. The survey instrument did not specify whether the competitive priorities describe order winners or order qualifiers (see Slack, 2005); doing so could have caused confusion among the respondents. Therefore, it is not entirely certain that the questions used captured the intended measure of competitive priorities, which according to the theory of this paper should be seen as the order winners.

There was also a fairly straightforward operationalisation of integration, which was just supplier integration in the first paper and customer, supplier and internal integration in the second. More items could have been included in order to have a more complete
assessment of the level of integration, but more measures may result in lower convergence. The measures that were employed do indeed show a very high level of convergence as demonstrated by the factor analyses.

Assuring construct validity is difficult in a case study, whereas in a survey you can follow a rigid, widely recognised set of procedures when operationalising the conceptual framework. In a case study a researcher must carefully pre-select the variables he intends to study and demonstrate that measuring the selected variables is done in a way consistent with the pre-defined selection (Yin, 2003). Yin recommends using three methods for assuring construct validity: establishing a chain of evidence, using multiple sources of evidence and having key informants review a draft case study report. Silverman (2000) maintains that there is no simple ‘golden key’ to validity, and questions the effectiveness of these methods. He is particularly critical of the likelihood of achieving better validity by using multiple sources of evidence, as many people within the same organisation will hold the same views without it actually being the ‘whole truth’. Although Silverman (2000) does have a valid point, the alternatives he offers are much more time-consuming and would require the researcher to be embedded in the organisation for quite some time. Due to time constraints as well as the fact that the case study was designed as a pilot study, Yin’s (2003) methodology seems sufficiently appropriate for the task at hand. Surely no methodology is perfect, and subsequently no result of a qualitative study could have zero margin of error. The quest for perfection is more important than perfection in itself.

The chain of evidence was established using the following logic: First the field notes were rewritten to increase clarity and annotated in areas of interest. The different variables were written in a tabulated form to establish patterns as well as coherence between the different respondents, and conclusions were drawn based on the table and a draft case study report was written. The case study report was reviewed by the key informant to ensure that the observed phenomena were reasonably coherent with her experience as a manager at the studied firm. Multiple sources of evidence mostly consist of different interview data, although Yin (2003) does recommend using other secondary data as well. Although only a few relevant documents were obtained (such as annual reports), these were certainly also included.

**Internal validity**

Internal validity is a concern for explanatory studies such as this, where the researcher is trying to establish causal relationships. There are some problems one should pay attention to. For example, if the researcher claims that A causes B, is the opposite true? Or, is there perhaps a third factor C that causes both A and B? Yin (2003) does not offer any simple solutions to this problem, but the key is to have a rigid theoretical framework. The framework presented in chapter 2 stipulates that manufacturing competence would give a company an absorptive capacity to benefit from supplier integration. Cohen and Levinthal (1990) pointed out that absorptive capacity is usually a by-product of investment in a certain area, in this case manufacturing competence. That means that reverse causality cannot be true according to the theory used in this thesis, i.e. an absorptive capacity cannot give the firm a higher investment in manufacturing competence. The other type of error, a third factor causing both manufacturing competence and an ability to integrate
suppliers, is not plausible either, as the very definition of competence is the set of underlying abilities that allow the company to improve. An unknown factor that underlies the underlying competencies does not make any sense.

Another issue concerning internal validity is the concept of inference. A researcher makes an inference when a causal relationship is not directly observable, for example a researcher might conclude that the result A occurred because of action B. In this case the researcher must consider potential rival explanations and, by using multiple sources of evidence (in case study research) as well as a sound theoretical framework, establish that the only reasonable explanation is indeed that B caused A. This thesis aims to establish that the presence of manufacturing competence causes the link between supplier integration and plant performance to become stronger. If that is the case, the conclusion is that the cause is an absorptive capacity that has been gained through an investment in manufacturing competence. A number of rival explanations can indeed be contemplated. First, the effectiveness of supplier integration is not dependent on manufacturing competence but on competence in managing suppliers, which in turn is dependent on manufacturing competence. This explanation is indeed plausible, but it is only a variation of the proposed explanation - the underlying competence is still the source of the absorptive capacity. Second, the presence of manufacturing competence can be directly attributable to (and owned by) suppliers, if many suppliers work at the focal plant. This would still imply that the manufacturing competence at the production site is the root cause of the effectiveness of integration (although it would be defined as suppliers’ internal integration), and it does not matter much whether that competence is formally owned by the focal firm or its suppliers.

**External validity**

External validity, also known as generalisability, refers to whether the finding is generalisable beyond the studied case. When doing a survey, it is quite easy to achieve high levels of external validity (or statistical generalisation) and the key is to have a large sample size with a high response rate representing the group of firms that are the subject of the study. The survey that forms the backbone of this thesis has 267 respondents and a response rate of 47%; the sample does adequately represent the entire Swedish manufacturing industry. These numbers are very high indeed, implying a high level of generalisability. In a case study the same methodology is not applicable, as that would imply studying a large number of firms. The alternative methodology used in case studies is instead analytical generalisation, where the researcher chooses a case specifically suitable for testing and validating the theoretical framework (Yin, 2003). In order to increase the external validity, the study can then be repeated and the results replicated. In this study the results of the pilot case study are analysed using the theoretical framework that has been partly validated using the survey and strongly supported by theory. When the multiple case study part will commence, a central part of that will naturally be cross-case comparison, which will further increase the external validity.
Reliability

The aim of ensuring reliability is that another researcher analysing the same data using the same theoretical framework would arrive at the same conclusion. The aim is thus to minimise errors and bias. This is not a major concern for quantitative research if widely accepted statistical tools are used. In a case study, one way of assuring high reliability is to collect as many reliable documents as possible, in addition to using a case study protocol (Yin, 2003). An obvious requirement for any good researcher is personal integrity and rigour; this is particularly true for quantitative researchers. The aim of this study is certainly to achieve a high level of reliability, and the main strategy for achieving this is to use a highly structured approach, as has been described previously. Particularly for a fairly inexperienced researcher, and in order to achieve high reliability, it is also useful to rely on key informants and other researchers. The aim of the pilot case study is also to refine the procedures for collecting and analysing the data in order to conduct more reliable research in the later multiple case studies.

Summary

In this chapter the need for choosing a methodology suitable to the questions the research aims to answer has been highlighted. For two of the three research questions, quantitative analyses are the most suitable. Qualitative methods are also conceivable, but generalisability would be a major challenge. Moreover, the resources required to answer these two questions using qualitative methodologies are beyond the most well-funded PhD student. The third research question, on the other hand, is ideally suited for a qualitative approach, as it aims to provide detailed knowledge about a phenomenon in its natural setting. The employed survey has a large sample size and a high response rate, assuring a high level of generalisability. Some concerns about validity have also been discussed in this chapter. The general conclusion is that, although these concerns cannot be entirely dismissed, some essential steps have been taken to enhance validity.
5. Overview of papers

Paper 1: Manufacturing Competence: A Key to Successful Supplier Integration

It was in the spirit of Cohen and Levinthal (1989, 1990) that the first study of this thesis was conducted. The aim was to investigate if investment in manufacturing will yield similar results to investment in research and development when it comes to integrating parts of the external environment, while still acknowledging the multidimensional nature of the construct. At this stage the aim was not to investigate exactly what competencies or mechanisms constitute the absorptive capacity, but merely to validate the concept for a manufacturing setting using the large-scale survey described in the methodology chapter. The aim was thus to find out whether an investment in manufacturing, seen as an improvement in any parameter, would make integration of suppliers more successful than it would be without such an investment. The hypothesis of the paper was formulated as Supplier integration is more likely to contribute positively to plant performance if accompanied by a high level of manufacturing competence.

As Cohen and Levinthal (1990) are rather vague about what actually constitutes absorptive capacity, this paper is based on but one interpretation of the concept. Other interpretations of the concept, even within this context, are certainly possible. The results obtained from a study based on a different interpretation may deviate significantly. Moreover, it could also be argued that supplier integration is a part of a more widely defined manufacturing competence, but for the purpose of this study it is useful to keep the two separated. In a sense manufacturing competence is therefore defined as the manufacturing-related competencies that are not concerned with interactions with the external environment.

The focus of the paper is the highlighted section of Figure 5, i.e. the moderating effect of manufacturing competence. The line between manufacturing competence and plant performance is dashed as it is acknowledged that a direct relationship exists but it is beyond the scope of the paper.

![Figure 5. Conceptual framework for paper 1.](image-url)
The firms were divided into two clusters depending on their manufacturing competence and a correlation analysis was conducted between supplier integration and the various performance indicators. If indeed, the firms with higher manufacturing competence are in a better position to benefit from supplier integration, a strong positive correlation should be found. The performance of the high competence cluster is also likely to be on a higher level, but as mentioned the focus lies only on the extent supplier integration contributes to performance. The expected performances of the two clusters are illustrated by Figure 6.

![Figure 6. Expected performance improvement.](image)

Manufacturing competence is, however, a multidimensional construct in itself, and some competencies can be more important for some firms than for others. To partially solve this problem the data analysis was done separately for three different types of competence. This does not imply that these measures of competence would be all-inclusive but serves to highlight some competencies that may have different impacts on the ability to integrate suppliers. Two of the considered types of competencies concern the manufacturing department’s ability to improve in the use of advanced technology and the other in areas associated with lean manufacturing. Since other studies have highlighted the need for internal integration mechanisms for external integration (Droge et al., 2002; Hillebrand and Biemans, 2004), it is reasonable to include some measure of internal mechanisms as a component of manufacturing competence. In this paper the use of cross-functional teams was used to approximate such mechanisms, as this kind of teams has been widely advocated in the lean manufacturing literature (e.g., Clark and Fujimoto, 1991).

**Results**

As seen from Table 2, the results are somewhat mixed. When looking at the ‘technology’ factor there is strong support for the hypothesis, as there is a significant correlation between supplier integration and twelve performance indicators for the high competence cluster, compared to only one for the low competence cluster. For the ‘lean manufacturing’ factor, it is rather more even - only two indicators support the hypothesis,
although they are the most important ones: change in market share and financial results. There is, however, opposing evidence from four performance indicators. For the ‘cross-functional team’ factor, correlations between supplier integration and six performance indicators support the hypothesis and two contradict it. We can thereby conclude that the evidence is not particularly strong; apparently only ‘technology’ and ‘cross-functional teams’, as measured in this paper, have an impact on the effectiveness of supplier integration. This is rather surprising considering that supplier integration is often regarded as a key component of lean manufacturing (see e.g., Lamming, 1996).

Table 2: Results from paper 1 (Partial correlation analysis)

<table>
<thead>
<tr>
<th></th>
<th>Technology</th>
<th>Lean Mfg.</th>
<th>Cross-func. team</th>
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<tbody>
<tr>
<td></td>
<td>High</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>n=178</td>
<td>n=74</td>
<td>n=111</td>
<td>n=141</td>
</tr>
<tr>
<td><strong>Operational Perf.</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Productivity</td>
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<td></td>
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<tr>
<td>Product quality</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Production cost</td>
<td>.16*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivery lead time</td>
<td>.19*</td>
<td></td>
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<tr>
<td>Production lead time</td>
<td>.26**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivery dependability</td>
<td>.18*</td>
<td></td>
<td></td>
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<tr>
<td>Product mix flexibility</td>
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<tr>
<td>Volume flexibility</td>
<td>.23**</td>
<td></td>
<td></td>
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<tr>
<td><strong>Innov.</strong></td>
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<td></td>
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<tr>
<td>Time-to-market</td>
<td>.23**</td>
<td></td>
<td>.24**</td>
</tr>
<tr>
<td>New prod. development cost</td>
<td>.27**</td>
<td>.22*</td>
<td>.34**</td>
</tr>
<tr>
<td>New products. rel. to competitors</td>
<td>.24**</td>
<td>.26**</td>
<td>.33**</td>
</tr>
<tr>
<td>Changes in new products</td>
<td>.33**</td>
<td>.33**</td>
<td>.24**</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplier prices</td>
<td>.21**</td>
<td></td>
<td>.24**</td>
</tr>
<tr>
<td>Reduced capital tied-up</td>
<td>.17*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in market share</td>
<td></td>
<td>.35**</td>
<td>.26**</td>
</tr>
<tr>
<td>Change in financial results</td>
<td>.20**</td>
<td>.25**</td>
<td>.28**</td>
</tr>
</tbody>
</table>

*p<.01, ** p<.05 significance (two-tailed)

The result appears to be clearer for the technology factors compared to the other two factors. The relative weakness of the results is, however, further covered in the Discussion chapter. Nevertheless, the results of the paper suggest that the absorptive capacity is important for effective utilisation of supplier competencies, and is at least partly embedded in the manufacturing competencies of the focal firm. In other words, a company must first develop internal competencies before it can fully benefit from supplier integration.
Paper 2: Internal and External Integration and Its Effect on Manufacturing Firms’ Competitiveness

As was the case with the first paper, the aim of this paper was also to study the contribution of integration to performance under certain conditions. In the second paper, three types of integration were contemplated: internal (manufacturing-engineering design), customer and supplier, as well as the moderating impact of competitive priorities. As the literature review pointed out, there are many authors who have described the competitive priorities of firms, and there is a convergence of views even though the authors have widely different emphases (see literature review). Paper 2 presents the employed framework as a modified version of Christensen’s (1997) framework, but the framework is also to some extent influenced by other authors.

Christensen (1997) highlights the importance of looking outside the focal firm for sources of innovation and future revenue. Failure to do so can render the company less competitive in the short term, and prove lethal in the case of a disruptive shift in customer preferences or technology. The sources of innovation can also reside within the firm, and it is important to ensure frequent communication between different departments in order effectively to harness the firms’ inherent innovative capabilities. However, for integration to be desirable, the benefits from integrating various sources should support the overall objective of the firm. These benefits should be lower cost, for the price-sensitive firms, and a higher level of innovation, for more innovative firms. This paper explores whether such integration does bring the intended benefits, and also if there is any other effect on several other performance indicators.

The aim of this paper is thus to investigate to what extent the integration of suppliers, customers and the manufacturing department can support the competitive priorities of the focal firms. The paper explores both the level of three types of integration, internal, customer and supplier, as well as the outcome of that integration. No hypothesis was formulated for this paper.

This paper draws on the same large large-scale survey that was sent out during 2004 to the plant managers in a representative sample of Swedish manufacturing firms. The methodology was similar to the one used in the first paper, as both relied on dividing the firms into groups and conducting correlation analyses. The basis of the division was in this case competitive priorities, and the firms were divided into three groups, functionality focused, market responsive and cost focused. The second paper, moreover, consisted of two parts, investigating the level as well as the outcome of all three types of integration.

Results

For the level of integration no distinction between the groups was detected except that the firms focused on functionality had significantly more integration of the manufacturing department and the department responsible for engineering design. This finding is supported by literature, including Christensen (1997). The need quickly to convert designs into manufactured products, and the challenge to do so, is most important in sectors experiencing rapid technological change.

Comparing the outcome of integration, it differs widely depending on the firm’s competitive priorities, see Table 3. Functionality-focused firms seem to benefit mostly
from internal and supplier integration, with the greatest benefits in the areas of innovation and flexibility/lead time. The market-responsive firms gained only from customer and supplier integration in terms of improved dependability of deliveries as well as more effective new product development. The cost-focused firms did not see any gain from internal integration either, whereas customer and supplier integration contributed to flexibility and rather surprisingly to some innovation factors. The majority of performance indicators were, however, not correlated to internal, customer or supplier integration. The results suggest that a shift in competitive priorities should be accompanied by a change in both the scope as well as the content of internal and external integration.

Table 3: Competitive priorities and the effects of integration

<table>
<thead>
<tr>
<th>Functionality focus</th>
<th>Market Responsive</th>
<th>Cost focus</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Productivity</td>
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<td>Product Quality</td>
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<td>Production cost</td>
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<tr>
<td>Delivery lead time</td>
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<td>New prod. rel. to competitors</td>
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<td>Changes in new products</td>
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<td>Change in market share</td>
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<tr>
<td>Change in financial results</td>
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</table>

^ A I = internal integration, C = customer integration S = Supplier integration; *p<.01, ** p<.05 significance (two-tailed).
Paper 3: Manufacturing Competence and External Integration: Absorptive Capacity in a First-Tier Supplier

The third part of this research set out to explore in more detail how absorptive capacity could manifest itself in a manufacturing firm. This included trying to highlight factors that may improve the absorptive capacity as well as finding evidence of some of the integration mechanisms for which this capacity is required. As the first study adopted a rather simple view of absorptive capacity, the framework needed for the third study needed to be refined. In particular the different phases that require different types of absorptive capacity play a prominent role in the framework which is based to a large extent on Zahra and George (2002) as well as the original proponents of the concept, Cohen and Levinthal (1990).

According to the conceptual model (see Figure 4 in chapter 2), and in line with Cohen and Levinthal (1990), there are two sources of absorptive capacity: body of knowledge and structure of communication. As the aim of this study was to analyse the relationships between manufacturing competence and customer and supplier integration, these two will represent the two dimensions mentioned earlier. The framework stipulates that the two dimensions must be combined in order to achieve a positive outcome.

The study is based on a single case study methodology and uses Yin (2003) as the principal guideline. The target company was chosen as they cooperate extensively with their customers and to some extent also their suppliers. The choice was also influenced by relative ease of access.

Results

The results show that some of the manufacturing-related competencies are required for effective external integration. For company A the most important one is what has been termed ‘combinative competence’ (Kogut and Zander, 1992), i.e., the ability to combine different competencies in order to produce value. Other important competencies that have an impact are the ability to achieve short change-over times and industrialisation. Areas that have an impact but the company in which may be deficient to some extent include logistics, purchasing and component knowledge.

The company employs many different mechanisms that constitute its structure of communication with its customer and suppliers, e.g., customer selection and segmentation, alignment of manufacturing strategy, joint product and process development (which is usually initiated by the customer), supplier evaluation, as well as comparing their own manufacturing operation with suppliers. The effectiveness of many of these mechanisms depends to a large extent on manufacturing-related competencies.

Similarity of competence, in this case between the customers and the focal firm, gives a high level of relative absorptive capacity. Both customers and the focal firms have broad competencies that allow them to integrate various internal and external sources. The focal firm, in contrast, has a lower level of absorptive capacity relative to its suppliers, because the latter have focused on developing niche skills not possessed by the focal firm. Better component knowledge would address some of those problems, but so far the company has solved the problem by utilising their customers’ knowledge of components. This pooling of competencies can be termed a collective absorptive capacity.
The findings of this paper should not be viewed as evidence per se, but rather as an illustration of how some of the common competencies and mechanisms can be studied using a newly developed framework of absorptive capacity. Many of the findings may seem trivial, but in the literature they have not previously been analysed and presented as building blocks of absorptive capacity.
6. Discussion

The discussion chapter of this thesis is divided into four parts. In the first three the findings of the three papers will be discussed; the last part will provide an overall discussion.

Discussion of paper 1: Manufacturing Competence – A Key to Successful Supplier Integration

The literature suggested that supplier integration is generally associated with performance improvements, although some results have been mixed. Primo and Amundson (2002) recommended using multiple performance indicators to produce a more nuanced view of the benefits of external integration. Another advantage with more performance indicators is that in a statistical analysis it is easier to find a significant correlation, but that also means that there is a risk that significant correlations may appear due to random patterns in the data. Nonetheless, multiple performance indicators were used and significant correlations were found on numerous occasions.

The findings of the paper were in line with Cohen and Levinthal (1990), as well as with the other empirical studies that had a straightforward interpretation of absorptive capacity (see chapter 2). This straightforward interpretation means that R&D or manufacturing spending can be used as a proxy for absorptive capacity. This study shows that an increased level of investment in manufacturing does have a similar effect and that the absorptive capacity that has been gained can be exploited by integrating suppliers.

The results from the first paper were, however, not as clear as hoped for, although there are more significant positive correlations for the firms deemed to have a higher manufacturing competence compared to the firms with lower competence. However, for a number of factors no significant correlations for either group were detected. There can be a number of explanations for this, and in the next few paragraphs some of them are mentioned.

First, according to both Cohen and Levinthal (1990) and subsequent authors like Zahra and George (2002) or Lane and Lubatkin (1997), absorptive capacity is a rather complex construct. It involves not only the level of previous investments, although that is in focus in Cohen and Levinthal (1989, 1990), but also factors such as the relatedness of the knowledge, the type of knowledge as well as the type of communication with the external environment, to mention a few. In this paper we adopted the rather simple approach as used by Cohen and Levinthal (1989), Veugelers (1997) and Stock et al. (2001), and simply considered absorptive capacity a result of previous investments in manufacturing. It may, however, not be sufficient in order to capture the full diversity of the concept (see also Mowery et al., 1996).

Second, as absorptive capacity is path dependent (Cohen and Levinthal, 1990), there must be a fit between the absorptive capacity and the knowledge it seeks from external sources as well as the mechanisms it uses. The types of absorptive capacity were measured along only three dimensions, in addition to the integration mechanisms, but not the type of knowledge the firm is attempting to acquire. It is possible that there is a mismatch
between these in some of the companies. The supplier integration is bound to fail no matter how much absorptive capacity they have in the domain we have measured, if it does not correspond to the knowledge the firm is seeking.

Third, Lane and Lubatkin (1998) emphasised the relative level of knowledge between the two firms and Mowery et al. (1996) showed that related competencies enhance absorptive capacity. However, only the level of competence of the focal firm was measured, not the level of its suppliers. This means that there is no way of telling if the competencies the firms have invested in are related to those of its suppliers. Ideally the investment in manufacturing competence should have been measured at both firms and only if they invest in similar competencies can the absorptive capacity be expected to improve, although in practice that is very difficult to do using a survey methodology.

**Discussion of paper 2: Internal and External Integration and Its Effect on Manufacturing Firms’ Competitiveness**

In a sense, the rationale for conducting the second study was similar to the rationale for conducting the first study, i.e., to explain the variation in perceived benefits from integration activities by dividing the firms into different clusters. However, the second study was not aimed at exploring the impact of absorptive capacity. Instead, competitive priorities together with an emphasis on innovation and industry dynamics were in focus. The study was also more ambitious; three types of integration were contemplated compared with only one for the first study.

The results of this study were broadly in line with Christensen (1997) and Christensen et al. (2002). Internal integration was, as expected, higher for the functionality-focused firms, but contrary to expectations supplier and customer integration did not differ. The outcome of integration did, however, vary depending on the companies’ competitive priorities, as predicted by the literature. The results indicate that whereas firms seem to integrate externally irrespective of competitive priorities, the outcome differs. There are two possible explanations for this: either the content of their integration efforts differs resulting in different outcomes or their integration efforts are not in line with the demands of their competitive priorities.

However, as was the case with the first study, the results were not as clear as hoped for; there are numerous potential reasons for that. First, the usual concerns about how the concepts have been operationalised can be raised. Second, an underlying assumption of the paper was that firms are behaving rationally and that the integration mechanisms are designed to support their competitive priorities. That may, however, not be the case, as some of these mechanisms may be left over from a previous era where the firms’ competitive priorities were different. The integration mechanisms may have been ideally suited for previous tasks, but due to new strategic positioning or industry dynamics they are no longer suitable. This explanation is rather similar to the phenomenon described by Hill (2000), where firm strategy or products have changed but the firm’s manufacturing strategy has not. This means that there is a need to ensure that the integration mechanisms do indeed fit the overall strategy of the firms, particularly when the firms’ competitive priorities have changed.
A third explanation is that the mechanisms do indeed fit the overall competitive priorities of the firm but that they lack the absorptive capacity in the other dimension, ‘body of knowledge’, required for utilising these mechanisms effectively. This would imply that competitive priorities and absorptive capacity are indeed closely linked and that a holistic approach where all relevant factors will be taken into account is called for. Hence, there was a strong motivation for conducting the third part of this research.

Discussion of paper 3: Manufacturing Competence and External Integration: Absorptive Capacity in a First-Tier Supplier

The first paper was conducted as a pilot case study and aimed to achieve two different tasks: to illustrate what absorptive capacity can look like and to evaluate the conceptual framework. In terms of accomplishing the first task, the study was largely successful. Although the findings were not particularly extensive, many of the rather common competencies and activities that may take place in most manufacturing firms do contribute to the absorptive capacity. Perhaps most firms and individuals do not regard these as absorptive capacity, due to their everyday nature as well as the fact that they were originally developed to take care of a specific task and not to build up absorptive capacity. However, this only confirms the very nature of absorptive capacity, as Cohen and Levinthal (1990) noted that absorptive capacity is typically obtained as a side effect of investment in a particular area. However, at times firms may not have the absorptive capacity required to develop their businesses, and this is particularly true when the market experiences rapid technological change (Cohen and Levinthal, 1990). In these cases it is prudent to invest in knowledge that may not produce immediate benefits, but will still build up absorptive capacity. The case study firm was in the midst of industry-wide restructuring, where suppliers are asked to take ever more responsibility for product development as well as other additional services. Perhaps this is one of those times where a shift in the market should be accompanied by more investment in absorptive capacity?

As for evaluating the conceptual framework, the study was very successful. The framework provides a focused way of looking into something that may look ordinary but can reveal the sources of absorptive capacity as well as the associated mechanisms for external integration. The case study also provided some clues as to where one can start to disentangle the mysteries of absorptive capacity. The major weakness of the employed framework is that it is not always clear how to classify the competencies and mechanisms: sometimes the same one can appear in multiple instances.

Overall Discussion

The model presented in chapter 2 (Figure 3) provides an overall framework for all three parts of this research. The first paper comprises all parts of the model except competitive priorities, the second paper includes all parts except manufacturing competence and the third study encompasses the entire model. The entire model has thus been used and some reflections on its value are in order.

The main advantage with the proposed model is that it is generic. With slight modifications it could be used for many different purposes. For example, the model could
be modified by substituting competitive priorities for any contextual variable or manufacturing competence for any other competence or factor that contributes to the body of knowledge. External integration can also be substituted for any mechanism that facilitates knowledge transfer. It would indeed be interesting to see the model being used in another context.

Another advantage of the conceptual model is that it is solidly supported by theory. Most authors within the field have to some extent recognised the importance of its components. The empirical studies of this thesis also lend support to the conceptual model. Conversely, the main disadvantage derives to a large extent from the same broadness that was described as an advantage. Operationalisation of the components becomes harder, as there is little or no consensus on how the concepts should be interpreted. Great responsibility lies on the individual researcher to interpret the model in a fashion coherent with theory as well as the context for which it is employed.

The theory used in the conceptual model is, as has been frequently mentioned, based on the notion of absorptive capacity. There was, however, no coherent absorptive capacity theory available, where the most advanced attempt is Zahra and George (2002). That meant that a significant part of this thesis has been to develop the concept towards a unified theory. The attempt has been rewarding in two ways. First, the process has provided a more holistic understanding of the different streams of literature. Second, the theory development phase has facilitated a more focused approach to case study research. Overall, the absorptive capacity does offer a way to better understand the dual roles of knowledge and competence inside the firm. There are, however, many interpretations of the concept to choose from. The choice is dependent on the task at hand and influenced by the experience of the individual researcher.

Two very different methodologies were employed in this research, survey and case study, and they provided very different insights of the area of interest. Through the survey, a general picture emerged as to what extent the different components, i.e. competitive priorities, manufacturing competence and external integration, interact and contribute to competitive advantage. Although details of the complexity were certainly lacking, they still gave a good understanding of when and why external integration is beneficial. The survey also allowed the development of the concept of absorptive capacity, naturally with the support of other studies. However, using surveys alone would create a rather abstract picture of reality; the need to do some down-to-earth case studies becomes apparent.

The case studies provided more details into what types of competence may be required in order to effectively integrate external sources as well as a better idea of what kind of mechanisms may be used. It must, however, be emphasised that the findings of the case study were largely dependent on the findings of the survey. Without the survey the case study would have lacked focus and, although potentially equally interesting, the findings would be of a different and more general character. A main strength of the thesis is, thus, that through the combination of different methodologies, a better focused and more in-depth study was feasible. The picture that emerged from the survey was modified but nonetheless reinforced by the findings of the case study.
7. Conclusions

The first three parts of this Conclusions chapter are concerned with answering the three research questions. Part four in this chapter will be concerned with the overall conclusions and managerial implications. The fifth and last section will provide some suggestions for further research.

Research question 1:

What is the significance of manufacturing competence for supplier integration? (Sub-question: Is absorptive capacity a valid concept in a manufacturing setting?)

This research question is answered by the first paper, titled “Manufacturing competence – A key to successful supplier integration”. The conceptual framework used for answering the first research question was based on a reworked notion of absorptive capacity. The study showed that manufacturing competence does indeed have some impact on the effectiveness of supplier integration, although the results were not as clear as hoped for. The reason for the somewhat ambiguous finding can be many and are often related to validity and complexity. Absorptive capacity is a complex construct, where many factors will hold sway. The study suggests that manufacturing competence will influence the outcome, but other factors should also be taken into account. There is, however, no guarantee that manufacturing competence will be the most significant contributor to absorptive capacity. Other unidentified factors contributing to absorptive capacity may have not only a larger influence on the ability to integrate suppliers, but they may also influence manufacturing competencies. As implied by the conceptual framework in chapter 2 a factor that is likely to have a significant impact on absorptive capacity is competitive priorities.

The answer to the sub-question would, therefore, be a of a “yes, but…” character. The study does show that firms with higher manufacturing competence have a higher correlation between supplier integration and various performance variables than firms with lower competence do. Absorptive capacity is most likely a valid concept, also due to the strong support the literature provides, but the way it has been measured in this study may be somewhat simplistic.

Research question 2:

How do competitive priorities influence the level as well the outcome of integration?

The second research question is answered by the paper titled “Internal and external integration and its effect on manufacturing firms’ competitiveness”. In answering this question, a modified version of Christensen’s (1997) framework was used. The paper showed that competitive priorities have a marginal influence on the level of integration. Functionality-focused firms have a higher level of internal integration than market-responsive or cost-focused ones. The level of customer and supplier integration, on the other hand, is similar in all three groups. The outcome of integration does, however, differ considerably. Internal, customer and supplier integration are associated with improvement in different performance variables depending on competitive priorities.
Functionality-focused firms shows achieved most gains in lead-time and innovation-related factors, market-responsive firms in flexibility and time-to-market, and cost-focused companies in flexibility and rather surprisingly in some innovation-related factors.

Provided that firms integrate irrespective of their competitive priorities, but have different results to show for it, one can assume that the content and expectations of the integration effort are different. In order effectively to integrate, a firm needs to have absorptive capacity, but since the content of the integration is different there are likely to be different sources of absorptive capacity. As the need for integration varies depending on the competitive priorities, it is important to make sure the firm has the absorptive capacity to benefit when the competitive priority changes, for example when the industry matures.

**Research question 3:**

*How does the absorptive capacity of a manufacturing firm look in practice? (Sub-question: What factors contribute to, and how do they influence, the absorptive capacity of a manufacturing firm?)*

Much of the knowledge that exists inside the firm, as well as the mechanisms for utilising it may seem self-evident and adapted for a certain task. However, the same competencies and mechanisms can be seen as having a secondary function and that function is to build up the firm’s absorptive capacity. It may at first sight seem trivial to study some very commonly occurring phenomena, but using a highly focused framework those phenomena can provide insight into how this ‘mysterious’ absorptive capacity will influence the effectiveness of external integration.

Indeed, by studying a fairly ordinary first-tier supplier with mostly generic manufacturing competencies, the research questions posed at the beginning of the thesis have to a large extent been answered. Absorptive capacity resides within the knowledge the company possesses and is utilised via internal and external communication. Two examples of the knowledge that was found to have an impact are knowledge of components (which the company lacks to some extent) and a combinative competence (which is the company’s ‘core’ competence). For the focal firm, combinative competence means the ability to combine their own competencies in different areas with input from external parties, in order to produce a complete product or sub-assembly while taking responsibility for product development and industrialisation. These competencies are useful when trying to assess external parties as well as when embarking on joint product or process development.

**Overall conclusions and managerial implications**

The purpose of this thesis was to analyse the need for manufacturing competence in order to turn external integration into competitive advantage, by further developing and utilising the concept of absorptive capacity. The purpose was achieved, since it has provided some evidence of the role manufacturing competence plays, but the evidence is not all-conclusive. Other types of competence and mechanisms will also play a role and including all in the same thesis would be overly ambitious. The need for integration that results from competitive priorities has also been satisfactorily investigated, although
different measures of competitive priorities as well as the different integration mechanisms may have a divergent impact.

In the manufacturing strategy literature, a common theme is strategic fit. It is argued that the manufacturing strategy should fit the overall business strategy (Hill, 2000). The same line of argument has been put forward in this thesis, although in a slightly different context. Paper 2, “Internal and external integration and its effect on manufacturing firms’ competitiveness”, concluded that all three types of integration, internal, customer and supplier, should fit the competitive priorities of the firm. In paper 1, “Manufacturing competence – A key to successful supplier integration”, it was argued that manufacturing competence will have an impact on the effectiveness of supplier integration. The same can be expected for customer integration as well as it is just a different side of the same coin (see literature review). If the arguments of papers 1 and 2 are combined and extended, it can be proposed that there should be a fit between the competitive priorities and the firm’s absorptive capacity so that it can provide the foundation for effectively integrating external sources.

The managerial implication is that firms should start by analysing their competitive priorities and after that embark on a strategy to align both their internal competencies and external integration so that they support their competitive priorities. The reason for developing competencies internally is, however, not only to directly support the competitive priorities but also to provide the firm with the absorptive capacity needed to succeed in integrating customers and suppliers. Companies that aim to achieve competitive advantage by utilising their customers and suppliers without developing competencies in-house may be misguided. Only a corresponding development of internal competencies gives a company the absorptive capacity needed to reap the benefits of the upstream and downstream supply chain.

**Suggestions for further research**

The first suggestion for further research is naturally to extend the third study, as it was originally designed as pilot study to test the usefulness of the conceptual framework. An extension would involve multiple case studies in order to provide a more comprehensive overview of exactly what competencies contribute to absorptive capacity and what mechanisms can be used to exploit that capacity.

The link between competitive priorities and the need for absorptive capacity has not been explored, although it is an important part of the conceptual framework presented in Figure 3. It may be expected that functionality-focused companies have a need for innovation-related absorptive capacity, and subsequently different internal and external integration, compared to market-responsive and price-focused firms. A final question is: can well-developed absorptive capacity safeguard against disruptive changes in product or market?
References


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