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Product Innovation in Small Established Enterprises
Managing Processes and Resource Scarcity

Doctoral Thesis by

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Abstract

This thesis examines product innovation processes in small established enterprises. The research questions are: (1) what motivates small established enterprises to innovate, (2) how do small established enterprises perform product innovation, and (3) how do small established enterprises manage resource scarcity in their product innovation processes? To answer the research questions, a multiple case study approach was chosen with three small established enterprises as cases and different product innovation processes as embedded units of study. The data collection method used was observation during a period of five months, complemented by interviews and secondary data. Product innovation in small established enterprises seems to be motivated by solving existing customers' problems and the need for a sustained steady cash flow. A steady cash flow is also found to be a prerequisite during the product innovation processes. Product innovation seems to occur when there is a risk of decreased cash flow and/or when existing customers can be satisfied with new products that increase their loyalty so as to secure future sales, cash flow, and the enterprise's survival in the long run. Promising innovation ideas alone do not result in product innovation. An innovation idea must also have supportive existing customers for product innovation to occur.

Product innovation processes in the studied small established enterprises are found highly context dependent, intertwined in operational processes and made possible by a small organic organization and closeness to existing customers. The product innovation processes are further found to follow a flexible and informal overall scheme optimized for decreasing market and technology uncertainty and risk, dealing with resource scarcity, and facilitating fast and easy commercialization to avoid or moderate dips in cash flow. The design processes within the innovation processes can be linearly structured or cyclical and experimental, depending on the experienced novelty.

To manage resource scarcity during the product innovation processes, the studied small enterprises used many different bootstrapping methods in combination. These methods can be divided into three categories according to their overall functions: for using existing resources more efficiently, for increasing resources and to secure a fast payback on resources invested in NPD. The studied small enterprises were due to their resource scarcity further found to favor an innovation strategy, only involving new products done with known technology and targeting existing markets. This way to innovate, which creates new products in a resource-efficient way that are accepted by the enterprises' existing markets, seems to prevent unsuccessful product innovation, while at the same time excluding technologically radical innovation and innovation targeting new markets.

Keywords: innovation process, small enterprises, product innovation, resources, resource scarcity, SMEs, bootstrapping, cash flow, commercialization, design process, lead users, motivation, NPD, small companies, small firms, innovation management, Penrose, resource dependence theory

Foreword

At the beginning of my PhD studies it was difficult for me to understand what small enterprise innovation was and how product innovation processes were done in small established enterprises. In an initial research study not included in this thesis but found in my licentiate thesis, 18 small enterprise owner and managers were interviewed regarding how they performed their product innovation processes. These interviews showed that there were many good and promising innovation ideas in the enterprises, but they were most often not realized into new products. Further, only a very few of the interviewees could put into words how they performed their innovation processes. The majority could not. Some talked about all the things that they ought to do when they realized new products but did not have the time to do, such as using a structured way to innovate, doing formal marketing research, setting requirements in advance, and documenting their work. Some also thought that they did not perform innovation in an efficient and correct way because they did not do these things. A few mentioned the phrase "sitting on the lap of the customer" but could not in detail describe what it meant, more than being close to customers during product innovation processes. However, through this research journey, I have found explanations to the above: why not all good and promising innovation ideas are realized, why structured, formal marketing research, requirement setting in advance and documentation in most cases is not necessary nor beneficial, and what "sitting on the lap of the customer" means.

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Possible readers of this thesis are owner-managers and employees involved in product innovation in small established enterprises, policy makers involved in support programs targeting small enterprises, large enterprise managers dealing with innovation in collaboration with small established enterprises, and of course my fellow scholars. I hope all of you reading this thesis will enjoy and learn something new that you can use.

Gävle, October 2013

Lars Löfqvist

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Appended papers

Paper A Löfqvist, L. (Submitted) The context of innovation in small enterprises: leadership, organization, and linkages, Submitted to *International Journal of Entrepreneurship and Innovation Management*.

Paper B Löfqvist, L. (2010) Product and process novelty in small companies' design processes, *Creativity and Innovation Management*, 19(4), 405-416.

Paper C Löfqvist, L. (2012) Motivation for innovation in small enterprises, *International Journal of Technology Management*, 60(3/4), 242-265.

Paper D Löfqvist, L. (Submitted) Managing resource scarcity in small enterprises' innovation processes, Submitted to *International Journal of Innovation Management.*

1 Introduction

1.1 Background

Innovation is important to small enterprises. When large enterprises are downsizing to enhance their efficiency, politicians and policy makers highlight the idea of supporting and researching small enterprises. Innovation in particular is believed to be a key to success for these small enterprises, because of its purported link to future welfare, job creation, and economic growth (Roth et al., 2011). This focus on small enterprise innovation seems reasonable when considering that 99 percent of all enterprises are small, employing 67 percent of all workers in the private sector (European Union, 2008), and represent a substantial part of all innovation done (Barrow, 1993; SCB, 2012). Despite this, the theory building regarding innovation in small enterprises is limited, while most empirical research on innovation has been done on large enterprises (Hörte et al., 2008). Tan et al. (2009) claim the research on innovation in small enterprises mainly uses theory derived from research on large enterprises and favors using top-down approaches such as quantitative survey research, which misses taking the specific characteristics of small enterprises into consideration. In line with this, researchers (for example Audretsch, 2001; Rothwell and Dodgson, 1994) have expressed their doubts that innovation theory derived from research on large enterprises can be applied directly to small enterprises. Curran and Blackburn (1994) further highlight the noticeable lack of observations of real activities in general in small enterprises. This notion is particularly valid for the process of innovation in small enterprises. To my knowledge, no studies seem to have followed the whole process of developing product innovations in small enterprises, despite this having been put forward as needed for theory development (Forsman and Rantanen, 2011). Regarding how to improve the innovativeness in small enterprises, it is crucial to understand how the innovation processes actually are performed. Without deep knowledge of these processes, efficient and effective improvements will probably be difficult to achieve.

Established small enterprises have historically gained little attention in innovation research. It has been more popular to research newly founded small enterprises with high-tech product innovations that have large market potentials (Nooteboom, 1993). However, this kind of small enterprises represents only a very small fraction of all small enterprises (Veugelers, 2008). Further, they are most often financed by external risk capital, which creates slack that is used to speed up the innovation work, development, and growth rate (Churchill and Lewis, 1983). Small established enterprises, on the contrary, do not usually have this slack for innovation and must do their product innovation processes at the same time as they keep their daily operational processes running. Furthermore, daily operations consume most available resources (Johansen and Christiansen, 2009). This brings us to one key question to understand and promote innovation processes in small established enterprises: How do they manage scarce resources?

It is generally known that small established enterprises have scarce resources, a situation that Adams (1982) and Rothwell and Dodgson (1994) specifically propose to be the main barrier to innovation. At the same time, studies (e.g., Dalrymple, 2007; Löfqvist, 2007; Stauffer and Kirby, 2003) have indicated that small established enterprises have many promising innovation ideas suitable for new products. This shows an interesting challenge: small established enterprises have many promising innovation ideas but resource scarcity often hinders these ideas from being realized into new products. Despite the lack of resources for innovation, SCB (2012) and Smith (2009) have found that small established enterprises seldom raise external finance for their innovation efforts. Innovation processes further entail high risk and uncertainty, and in small established enterprises the risk in innovation is proposed to be even higher than in large enterprises. The reason is that they normally cannot spread risk over different innovation projects as large enterprises can, due to their often narrower markets and few products of their own (Nooteboom, 1993). Furthermore, the buffers to handle unsuccessful innovation are usually limited (Mazzarol and Reboud, 2005). The relative cost for innovation is also proposed to be higher compared with larger enterprises (Madrid-Guijarro et al., 2009).

Despite the difficulties of product innovation, small established enterprises nevertheless do product innovation and launch new products on the market (SCB, 2012; Vossen, 1998). This fact raises questions. What motivates small established enterprises to do product innovation, despite the high risk, uncertainty, and costs? And how is product innovation performed when sufficient resources seem not to be present? Innovation processes consume many resources (Smith, 2009), but where do the resources needed for innovation come from and what are the characteristics of these resources? How are the resources used within the product innovation processes? The above-mentioned questions are only fragmentarily answered or not answered at all by the existing literature, which motivates a study that takes the whole product innovation processes in small established enterprises into consideration, focusing on these unanswered questions.

1.2 Purpose and research questions

The purpose of this study is to deepen and enrich the knowledge of product innovation processes in small established enterprises. Specifically, the research questions are:

1. What motivates small established enterprises to innovate?

2. How do small established enterprises perform product innovation?

3. How do small established enterprises manage resource scarcity in their product innovation processes?

1.3 Delimitations

This thesis examines product innovation processes in small established enterprises, which means that there are some delimitations worth mentioning. Types of innovation other than product innovation, such as marketing, organizational, and process innovation, are not included. The focus is on small established enterprises. Newly founded small enterprises, which tend to be studied in entrepreneurship research, are not covered because they are not considered as established on their markets and to have shown viability in a longer time perspective. Small high-tech enterprises financed by external risk capital are not covered either. Small franchise enterprises are also excluded, because they belong to a larger overall organization that sets most of the rules for the enterprises. Regarding resources in the product innovation processes, the analysis will be limited to the resources of personnel, knowledge, and capital. Material resources such as plants and machinery are excluded.

2. Theoretical framework

The theoretical framework aims to present some relevant theories and concepts in the previous research on innovation, product innovation processes, small enterprises, and resources, which are the main theoretical base for this study.

2.1 The concept of innovation

The concept of innovation was introduced by Schumpeter (1943) as the introduction of new products, new methods of production, new sources of supply, new ways of transportation, new markets, and new forms of industrial organization. In this early view, innovation was done by entrepreneurs in new enterprises, involving radical changes that wipe out existing ways of doing things; innovation creates a "creative destruction." This initial view on innovation has been broadened by many researchers in many different ways. To study innovation in enterprises is a common organizational context in innovation management, a research field that deals with how innovation processes are managed efficiently and effectively (Bessant and Tidd, 2007). Most research done on innovation management has focused on how to manage innovation in large enterprises (Millward and Lewis, 2005).

Innovation can be done in many different areas in enterprises, including product offerings, processes, organizations, value capturing, customer experience, market presence, networking, and in the brand (Sawhney et al., 2006). However, the classic way to see innovation is product innovation, which this thesis focuses on. Product innovation can be defined as *the process within enterprises of developing and commercializing new products, such as new or improved goods and/or services*. The definition shows that product innovation includes new goods or services or a combination of both. Innovation is further defined as a process even though innovation can be seen as both a process and an outcome (Utterback et al., 2006). In this thesis the term *innovation process* is used when I want to stress the process. Research on innovation as a process is particularly underdeveloped in the literature; most research has focused on innovation as an outcome (Crossan and Apaydin, 2010). Innovation processes are comprehensive and start with an innovation idea, problem, or other input in some form and stop when the outcome is adopted in the targeted context for the outcome (Adams et al., 2006). For this study's focus on product innovation processes in enterprises it means that both new product development (NPD) and commercialization will be covered.

Strongly associated with innovation is novelty. The chosen definition of product innovation contains the dimension of newness. This raises questions about what is meant by new and the magnitude of newness. To estimate novelty is a difficult task, according to Howard et al. (2008), but a common classification is to put the degree of novelty on a scale from incremental to radical. Radical innovation contains more novelty than incremental innovation. The European Union (2005) and O'Shea and McBain (1999) propose this scale, but how to estimate novelty is not clear and seems to be a highly subjective task. Some attempts to give

guidelines regarding this have been presented. Bessant and Tidd (2007) propose that if innovation is seen as an output, incremental innovations are minor improvements to existing products with a low level of novelty, while radical innovations are totally new products with a high level of novelty. Reid and de Brentani (2004) describe a typical incremental innovation as an improved product using already existing technology and targeting an already existing market, whereas a radical innovation includes new technology and is launched in new markets.

When discussing newness a relevant question is: new to whom? From which perspective is this newness perceived? Tidd and Bodley (2002) state that the perspective is individual and relative: some may perceive that a new product is an innovation, whereas some may not perceive it as an innovation at all but similar to something already existing. A common classification of the perspective of newness uses three different concepts: new to the enterprise, new to the market, and new to the world (Crossan and Apaydin, 2010; European Union, 2005). New to the enterprise is the lowest level, in which a new product is perceived as new for the particular enterprise but not necessarily new for other enterprises, markets, or the world. New to the market is when an enterprise first introduces a new product to a specific market. New to the world is when an enterprise is the first to introduce a new product to all markets and industries. This study will use the lowest level of novelty, new to the enterprise, as the level that perceives the novelty for a new product. This choice suits the purpose of studying enterprises' innovation processes in this thesis. The enterprises do the innovation processes, meaning they are the main perceivers of the novelty during these processes.

Innovation is in general held up as a positive thing in society, moving society forward and helping to create future welfare, jobs, and economic growth (Roth et al., 2011). From an enterprise perspective, research on large enterprises has highlighted some motives to innovate. One motive mentioned is strategic innovation, with the aim to gain competitive advantages over the enterprise's competitors (Dosi, 1988; Johne, 1999). Increased profit is another proposed motive (Cooper et al., 2001; Dosi, 1988) as well as growth of the enterprise (Johne, 1999). But one can ask, despite these proposed positive views and positive effects of innovation, why is more innovation not done if it is so great? This brings us to the "dark side" of the concept of innovation and innovation management. Innovation means a high amount of risk, uncertainty, and ambiguity; future new products are to be created of which the understanding and knowledge initially are limited and fuzzy. Furthermore, innovation is a complex, fragile, and vulnerable activity. Many things can go wrong, and there is a great risk for failure (Dougherty, 1992). Innovation also needs many resources in both NPD and commercialization (Mazzarol and Reboud, 2005), and there may be uncertainty whether the resources put into NPD will be repaid if the new product does not succeed on the market. This can mean financial loss for the enterprise. The great amount of resources needed, together with the inherent

uncertainty and risk, are probable parts of the explanation why product innovation is hindered, difficult to perform, or not always preferred by enterprises.

2.2 Product innovation processes

Product innovation processes are not an isolated part of an enterprise but are found to be dependent on the context in which they occur. Examples of this context are leadership, strategy, resources, organization, creative climate, culture, and internal and external linkages (Bessant and Tidd, 2007; Goffin and Mitchell, 2005). Karlson (1994) emphasizes that the particular product to be developed also highly affects the innovation process. There is widespread confusion regarding how innovation should be managed (Roth et al., 2011). The research done that explicitly investigated this issue, by for example Burns and Stalker (1961) and Tidd and Bodley (2002), has concluded that there is no single best way to manage and organize innovation processes. There are many different descriptions of product innovation processes in the literature; next, incremental and radical product innovation processes as well as innovation process models will be further described.

2.2.1 Incremental and radical innovation processes

Incremental and radical innovation processes are two polar types of product innovation processes. Lynn and Akgün (1998), Lynn et al. (1996), and O'Shea and McBain (1999) propose that incremental innovation processes build upon existing knowledge and experience and may therefore represent less novelty, uncertainty, and risk. The product to be developed in incremental innovation processes often has known characteristics and properties from the beginning, because it is often similar to something already existing. This makes the process suitable for more structure, and activities can be sequentially executed in a linear way. In addition, incremental innovation processes are problem oriented and aim to first analyze the design problem before trying to solve it. On the contrary, radical innovation processes include more perceived novelty and uncertainty (Peters, 2006). The goal and the new product are fuzzier in radical innovation processes than in incremental innovation processes and cannot be determined in detail from the beginning. When the knowledge of the new product's characteristics cannot be determined by pure analysis, the needed knowledge must be created by synthesis (Lynn and Akgün, 1998; Lynn et al., 1996; O'Shea and McBain, 1999).

Regarding the structure of radical innovation processes, they are usually not linear but have a more cyclical structure, due to loops of learning experiments. A solution is initially created and then tested to gain new knowledge, allowing the creation of a new solution to test, and so on. Dougherty (1992) and Veryzer (1998) assert that it is common and appropriate to test versions of the product concept with customers, users, or other actors to gain feedback and new knowledge about the new product, its usage, its market, and its customers and users. The new knowledge yields somewhat reduced uncertainty and ambiguity

for each experimental loop (Lynn and Akgün, 1998). The experiments also give direction to the development efforts when the way forward is learned by excluding less suitable ideas and solutions (Engwall, 2004). These successive approximations strive to gain as much knowledge and reduction in uncertainty as possible, as it will be possible to find a final solution manifested in the new product.

The higher uncertainty in radical innovation processes also means an increased need for flexibility to cope with unforeseen difficulties (Tidd and Bodley, 2002). This leads to difficulties in applying planned, linear, and structured innovation processes. Engwall (2004) and Lynn and Akgün (1998) believe that a linear and structured innovation process might be counterproductive and unsuitable if high uncertainty is present, as in radical innovation. Dougherty (1992) highlights the knowledge-creating dimension that is especially relevant for more radical innovation processes. The lack of knowledge in more radical innovation processes mean knowledge creation and knowledge collection are needed to be able to merge the enterprise's technological possibilities with the market's wants and needs into a new product. To get a deep and rich understanding of the complex design problem that is to be solved, tacit knowledge[1] must be collected. Polanyi (1967) states that tacit knowledge is best gained through direct interaction and communication (preferably face-to-face) with potential customers and users to get a deep and rich understanding of the new product's requirements, its usage, and how it will solve customers' problems, as well as how the customers appreciate the value.

Incremental and radical product innovation processes seem to demand different kinds of organization in enterprises. Burns and Stalker (1961) studied how different kinds of organization affect and support different kinds of innovation processes. They found two opposite ways (systems), mechanistic and organic systems respectively, to organize an enterprise according to the task to be done. A mechanistic system was found appropriate when an enterprise works under quite stable conditions. In a mechanistic system, problems and tasks are broken down into subproblems solved by different specialists inside a hierarchically divided organization with mainly vertical communication and information flows. The mechanistic system is proposed as suitable during common operational processes and incremental innovation processes. An organic system is appropriate during unstable conditions of change, with tasks that are not so easily broken down into separate subtasks and distributed to specialists within a hierarchical organization. Under these conditions, different people in the organization need to communicate horizontally. Organic systems are more suitable for technical and commercial changes, as in radical innovation processes, which mean new problems to solve and the need for new information to be communicated and created between different actors within the organization. An

[1] Tacit knowledge is knowledge that persons have but are not necessarily aware of and cannot easily articulate (Polanyi, 1967).

organic system facilitates a continual redefinition of tasks through interaction with others and through information and advice, rather than top-down instructions and decisions. Engwall (2004) has also examined these two different organizational forms and how they affect innovation processes, and he emphasizes the need for a looser but also smaller organization, with a common language, when solving high-novelty tasks as in more radical innovation.

2.2.2 Innovation process models

There are many different innovation process models in the literature that aim to describe and illustrate product innovation processes. The product innovation process models usually consist of different activities, stages, or phases (Karlson, 1994). Hobday (2005) and Howard et al. (2008) have done meta-analyses of innovation process models and concluded that most innovation process models are linear and often fail to use the common iterative feedback loops present in innovation. Lynn et al. (1996) conclude that most innovation process models fit incremental innovation work best, because of their linearity, and that there is a great lack of innovation process models suitable for radical innovation. Furthermore, different models have different purposes; they can *describe* or *prescribe* the innovation processes. The describing models try to describe how innovation processes are done on a generic level. The prescribing models are usually less generic but more procedural and systematic and are proposed to be suitable for use in practical innovation work (Kahn et al., 2006).

Despite the popularity among scholars of creating innovation process models, they are often criticized. Hobday (2005) has summarized the most common critiques. The most serious criticisms from a scientific point of view are that most models are based on perceptions which lack theoretical or empirical evidence. Further, the models are seldom empirically tested and verified. Other criticisms by Hobday are:

- The models give a simplistic representation of the highly complex process that innovation processes are.
- The models are too rational, which badly corresponds to the chaotic nature of innovation processes that empirical research has shown.
- The innovation processes models do not correspond to contingencies and are presented as relatively independent processes in enterprises despite empirical evidence showing a high context dependence.
- They are presented as "deterministic" and present only one best way to do innovation.
- The innovation process models are most often designed for leading large enterprises, and they demand resources, formality, and an organization rarely present in small enterprises.

Despite the above criticisms, Hobday (2005) asserts that innovation process models can be valuable for benchmarking or comparing innovation processes

against but warns that following them strictly is misleading; innovation processes must obey their particular circumstances. Crossan and Apaydin (2010) highlight another interesting flaw in product innovation process models: The commercialization part of product innovation is seldom included. The deficiencies of current innovation process models yield some advice that may be useful in this study. Innovation process models can be used to compare product innovation processes against, but care is needed. Descriptions of product innovation processes must be empirically based and obey the context. In addition, it is necessary to include the commercialization part and not only NPD in descriptions of product innovation processes.

2.3 Small enterprises and product innovation

2.3.1 Small enterprises

This study defines the small enterprise[2] as an *enterprise with less than 50 employees,* in accordance with the European Union (2003) definition. This is a quantitative definition, chosen because of its uncomplicatedness, but Street and Cameron (2007) highlight that there are also many qualitative definitions of small enterprises that bring up the characteristics of a small enterprise but do not mention quantitative measures. Describing the characteristics of small enterprises is a challenging task. Nooteboom (1994) states that there is a great diversity among small enterprises, but Laforet and Tann (2006) argue that on a general level small enterprises have many similar characteristics across sectors. This paradox can be explained: In comparing different small enterprises with each other a great diversity of characteristics will emerge, but if small enterprises are compared with larger enterprises and their specific characteristics, small enterprises show many distinct characteristics unique to them. Rothwell and Dodgson (1994) summarize the differences between small and large enterprises: small enterprises have behavioral advantages but not the material advantages that large enterprises have. Ghobadian and Gallear (1997) describe the difference as that small enterprises generally are flexible, with a low level of bureaucracy, have rapid internal communication and coordination, and can change and adapt fast and easily. Pilemalm (2002) describes small enterprises as having fuzzy multifunctional roles for employees and a lack of clearly defined departments. But small enterprises have scarce resources due to scale-related disadvantages, something many researchers have highlighted (see Penrose, 1959; Welsh and White, 1981; Zontanos and Anderson, 2004). Large enterprises, on the other hand, have more resources but are usually more stiff and bureaucratic (Rothwell and Dodgson, 1994).

[2] Small enterprises have many synonyms: small businesses, small companies, small firms, small ventures, small SMEs (Small and Middle-sized Enterprises) and small SMBs (Small and Middle-sized Businesses). When the term "small enterprise" is used in this thesis, small established enterprise is meant, if not otherwise explicitly stated.

2.3.2 Small enterprise product innovation

Nooteboom (1994) tries to describe the differences between innovation in small and large enterprises as follows: large enterprises are good at large-scale production of new products, marketing, and fundamentally new basic technologies; small enterprises are good at serving niche markets, creating customized products, and commercialization of new products. Scott et al. (1996) found small enterprises to have limited opportunities and resources to develop new technology by themselves, which mainly ties them to existing levels of technology. As a possible consequence of this, Dallago (2000) shows that small enterprises mostly innovate with simpler technology than large enterprises; Mosey (2005) describes the commonness of using known technology in new novel ways in new products. This way to innovate most often results in incremental innovation (Subrahmanya, 2005). Incremental innovation is often associated with market pull innovation; van de Vrande et al. (2009) found that market pull innovation dominates in small enterprises, which seem to have better opportunities for such innovations, since they are close to their customers and have good contact with their needs. Ghobadian and Gallear (1997) express that small enterprises commonly have a limited customer base, and Nooteboom (1994) and O'Dwyer et al. (2009) point out that the limited number of customers most often is found in certain niche markets. Hadjimanolis (2000) and Rothwell and Dodgson (1994) suggest that this provides a "closeness" to these customers with easy contact and short lines of communication. Belotti and Tunälv (1999) assert that innovation rarely is strategic in small enterprises. Lindman (2002) further supports this and finds that a reactive behavior to innovation is more common than a proactive one.

High cost and risk have been suggested as barriers for product innovation in small enterprises. Comparing small and large enterprises, Nooteboom (1993) states that the risk in innovation is higher for small enterprises because they cannot easily spread risk among different innovation projects due to their often narrower markets and few products of their own. As a consequence, unsuccessful innovation projects cannot easily be outweighed by successful ones. Madrid-Guijarro et al. (2009) further state that the cost of innovation has a greater impact on a small enterprise than a large enterprise. Nooteboom (1993) highlights the unorthodox economy common in small enterprises. Jarvis et al. (2000) exemplify this by concluding that traditional economic theories of profit maximation fit less well with the reality and goals of small enterprises, for whom cash flow and liquidity are more relevant and important economic aspects. For example, a constant cash flow is necessary for the enterprise's survival, and small enterprises are sensitive to any disturbance in the cash flow through the enterprise (Welsh and White, 1981). Buffers to mitigate variations in cash flow are usually not present in small enterprises (Mazzarol and Reboud, 2005) which makes it difficult to cope with a negative cash flow for longer times (Welsh and White, 1981). Leiponen and Byma (2009) report that small enterprises prefer speed to market to gain return on innovation investments, while Mazzarol and Reboud (2005) and

Westhead and Storey (1996) find that the sensitivity for disturbance in cash flow contributes to short-term returns being more favorable than long-term returns in innovation. Lawson et al. (2006) suggest that cash flow is more central than risk and return in small enterprise innovation.

Subrahmanya (2005) brings up some reasons for small enterprises to innovate; the most important ones are quality improvements, cost reduction, and satisfying customer and market needs. Van de Vrande et al. (2009) suggest that innovation in small enterprises is done to serve customers with products that solve their problems or to open up new markets. Cannon (1985) explicitly states that support from existing customers is a success factor during innovation processes in small enterprises, and without this support innovation often fails. Innovation has further been found by Adams and Walbank (1983) to be most successful if existing customers are targeted. Johansen and Christiansen (2009) found that small enterprises do not generally see themselves as innovators but see innovation more as solving customers' problems.

No studies have been found that follow product innovation as a process over time within small enterprises, nor are there studies describing whole product innovation processes including both NPD and commercialization. Instead of following product innovation processes over time, the existing research has examined the innovation processes in small enterprises as snapshots, using interviews or survey-based research. The closest description found of a whole product innovation process in small enterprises is given by Mazzarol and Reboud (2005, 2006), who describe some events during whole product innovation processes. They found that if a leading customer is positive about an innovation idea, the small enterprise is likely to start developing the new product, establish a relationship with this leading customer, and use this to assist the development and diffusion of the new product. This is beneficial because NPD consumes resources, affecting the cash flow negatively, which means that a fast return on resources invested in NPD is important for a sufficient cash flow. That there is a customer willing to adopt the new product contributes to a fast and easy diffusion of the new product. Belotti and Tunälv (1999) and van de Vrande et al. (2009) have also proposed that cooperation and working closely with customers during product innovation processes is common in small enterprises. Nooteboom (1994) describes it as especially useful to codevelop new products with more trendsetting potential customers in more radical innovation processes.

Regarding the formality and structures of product innovation processes, empirical research by Johansen and Christiansen (2009), Lindman (2002), and Pilemalm (2002) finds innovation processes in small enterprises to be informal and weakly structured. Mosey et al. (2002) and Bolinao (2009) report that formal and systematic innovation processes do not fit the infrastructure of small enterprises and demand too many resources. Lindman et al. (2008) found examples of linear and structured design processes, but these kinds of processes were found by Millward and Lewis (2005) to be very difficult to manage, due to

small enterprises' autocratic management style, turbulent organization, and lack of resources. Guimarães et al. (1996), Lindman et al. (2008), and Millward and Lewis (2005) have studied the development work in innovation processes. They found cyclical and flexible innovation processes that were highly search-oriented, dynamic and iterative, with cyclical loops of learning experiments. Guimarães et al. (1996) found small enterprises' innovation processes to be a learning process. Lack of knowledge and resources necessitated improvising and creativity in the use of existing knowledge and resources in the innovation processes. The use of external expertise was found to be rare; knowledge was mainly gained from suppliers or other small enterprise managers. Feedback from customers and users during the innovation processes was common and extensive.

There seems to be a lack of models of small enterprises' innovation processes. Only three different linear and structured innovation process models, by Bruce et al. (1999), Ammar et al. (2011) and al-Tarawneh et al. (2011), have been found in the literature that explicitly claim to be suitable for small enterprises. Upon examining the basis for these models, I found they lack an empirical basis, the models' validity is unclear, and they have not been tested properly. Furthermore, these models seem to be highly inspired by existing models derived from research on large enterprises -why they should be suitable for small enterprises was not fully explained. It must also be seen as doubtful if other more general innovation process models are valid for small enterprises when Hobday (2005) concludes that these are mainly designed for leading large enterprises with more resources and forms of organization and leadership that differ from small enterprises. Hörte et al. (2008) and Tan et al. (2009) describe the research done on product innovation in small enterprises as immature, fragmented, and lacking in theory building. This comment seems especially relevant for product innovation as a process in small enterprises. My conclusion is that the knowledge on product innovation processes in small enterprises appears to be limited and fragmented, with no clear description of them in the literature.

2.4 Theories and research streams on resources

Many researchers have emphasized that small enterprises have scarce resources. One of the research questions in this thesis deals with how scarce resources are managed during product innovation processes in small established enterprises. *Resources* is a broad term; several theories and research streams explicitly deal with the concept both on an abstract and on a more practical level. This section will bring up some of these theories and research streams.

2.4.1 Two theories on resources

Penrose's resource theory

Penrose (1959) defines an enterprise as a bundle of resources that are managed to create products that can be sold on a market. For every activity the enterprise does it must allocate resources, and these create services (i.e., functions). The combination of different resources creates efficiency; novel combinations of

different resources create innovation. This view may be suitable for this study, because product innovation includes the creation of products that are sold on markets and the resource scarcity present in small enterprises can require efficiency in the use of resources. Penrose does not explicitly define the resources but suggests that the existence of unused production services that available resources create is to be seen as waste.

The resource dependence theory

An externally oriented, boundary-including resource theory presented by Pfeffer and Salancik (2003) is the resource dependence theory. It takes the boundary of the enterprise as well as the context of the enterprise into consideration and presupposes that organizations do not possess all needed resources themselves and need to interact with the environment to get needed resources. Power is intrinsically related to resources, because those that possess needed resources have power and can influence the organization and its actions. This means that context influences organizations and their actions, and that organizations must adapt to their contexts. In addition the resource dependence theory proposes that it is probably only large enterprises with many resources that may have the power to change the context and the environment. To change the environment is difficult for small enterprises, and these smaller organizations are highly interdependent on their context. Hillman et al. (2009) describe that most research on the resource dependence theory has focused on how enterprises can decrease or control their environment dependencies. Research on the resource dependence theory seems not to have had an impact on innovation research, yet it does deal with resource scarcity and will be useful in explaining how resource scarcity is managed during product innovation processes in small established enterprises. Hadjimanolis (2000) finds that due to small enterprises' lack of resources they are more likely to need to gain resources from the external environment for doing their product innovation processes.

2.4.2 Research streams on resources in small enterprises

Scarcity of resources is highlighted by Adams (1982) and Rothwell and Dodgson (1994) to be the predominant obstacle to innovation in small enterprises. Operational processes, and urgent problems within these processes, have been found to consume most available resources in small enterprises (Hadjimanolis, 2000; Johansen and Christiansen, 2009). There is some research that explicitly focuses on how small enterprises get resources and manage their resource scarcity, both in general and in product innovation, as for example on networking and the concepts of bootstrapping. These research streams will be described and examined on how they relate to scarce resources and product innovation in small established enterprises.

Networking

Hadjimanolis (2000) and Nooteboom (1994) both find that due to resource scarcity small enterprises need to find extra resources for innovation externally, and small enterprises frequently engage in some form of external linkages with

external actors in innovation. Vertical networking with suppliers and customers is frequently used in innovation in small enterprises (Freel, 2000). Horizontal networking and collaboration has been found by van de Vrande et al. (2009) to be less frequent in innovation, and a majority of small enterprises develop their innovations alone without support from horizontal actors (Lindman, 2002; Mazzarol and Reboud, 2005). Rosenbusch et al. (2011) add that to develop a new product internally in the enterprise yields a better result than developing it in formal collaboration with horizontal actors. Van de Vrande et al. (2009) tries to explain these findings, suggesting that horizontal networking demands higher transaction costs, with too many resources needed to manage coordination and responsibility issues and to solve cultural differences between actors.

Bootstrapping

Bootstrapping is a concept first brought up in the business arena by Bhidé (1992), but the term *bootstrapping* has historically been used figuratively to describe an impossible task, as "to pull (lift, raise, etc.) oneself (up) by the straps of one's boots" (Zimmer, 2005). There seems to be no precise definition of bootstrapping in business. However, an often-used definition of bootstrapping is brought up by Winborg and Landström (2001) as *the use of methods to meet the need for resources without relying on long-term external finance*, which in reality means that the needs for resources are secured mainly without any financial transactions. Tömöry (2010) and Vanacker et al. (2011) conclude that central in most studies on bootstrapping are the identification and description of methods (bootstrapping methods) used for gaining needed resources from within the enterprise or from the external environment. Most research on bootstrapping (for example Brush et al., 2006; Carter and Van Auken, 2005; Winborg and Landström, 2001) focuses on gaining financial resources, but in a shorter time perspective to solve more urgent resource demands. Bootstrapping is claimed by Carter and Van Auken (2005) and Tömöry (2010) to be widely used by small enterprises. Despite this, Smith (2009) concludes that the research on bootstrapping is limited and fragmented. Most bootstrapping research (for example Bhidé, 1992; Jones and Jayawarna, 2010; Lahm and Little, 2005) has focused on newly founded small enterprises and how these get resources to create the new enterprise and make it run, which is also identified by Tömöry (2010) as the phase of an enterprise lifecycle when bootstrapping is most used. Bhidé (1992) and Patel et al. (2011) indicate that enterprises abandon bootstrapping and go into using more long-term external financing when they get more established in the market.

This study focuses on small established enterprises, but Bhidé's (1992) seminal study, which focused on newly started small enterprises, still presents some general guidelines for bootstrapping worth considering:

- Get operational fast even if the market is small, and imitate competitors to save marketing research.

- Focus on cash flow by a quick break-even with cash-generating activities, use cash flow from other activities for launching the new business, and use cheap marketing and selling techniques such as relationship marketing and personal selling.
- Customize products and add with personal service so as to offer clear advantages that solve customer's problems.
- Avoid hiring expensive, well-educated, experienced people in the business.
- Grow no faster than can be afforded and controlled, and invest only when there is no alternative and never in advance of needs to create space for learning and solving problems when they occur.
- Focus on cash and nothing else. Earn margins from day one to cover costs and finance growth.

Research on bootstrapping in innovation in small enterprises is scarce. The only studies found have been done by Brush et al. (2006), Freear et al. (1995), Harrison et al. (2004), Patel et al. (2011), Smith (2009), and Tömöry (2010), but the findings from these studies are modest. Freear et al. (1995) and Harrison et al. (2004) identified some bootstrapping methods used in innovation: working overtime, customer-funded innovation, and turning consultant projects into commercial products. Smith (2009) identified bootstrapping methods as borrowing from suppliers, special deals with customers, the usage of free or low-cost labor, special deals for space, and the usage of non-equity funds. Brush et al. (2006) found such bootstrapping methods as prepaid expenses and royalties, and Freear et al. (1995) mention that bootstrapping in innovation involves customers and suppliers.

2.5 Theory gap summary

Research has been done on product innovation in small enterprises, but the findings are fragmented. There seem to be no full descriptions or theories on whole product innovation processes in small enterprises. The closest description found is given by Mazzarol and Reboud (2005, 2006): leading customers' appreciation of an innovation idea is likely to start NPD, and these customers both assist during NPD and also facilitate the fast diffusion of the new product, which is proposed to be beneficial for cash flow. Some general characteristics of product innovation processes in small enterprises are known: the processes are informal, weakly structured, iterative, dynamic, search-oriented and involving customers. Some innovation process models for small enterprises have been proposed, but the empirical basis and validity are questionable. It is also uncertain how valid research done on large enterprises' innovation processes is for small enterprises, because of the great difference between the two different kinds of organizations. The limited knowledge of how small established enterprises perform their product innovation processes justifies the research question: *How do small established enterprises perform product innovation*?

Research on large enterprises has suggested strategic innovation to gain competitive advantage, profit, and growth as motives for product innovation, but the literature is not clear if these also are valid motives for product innovation in small enterprises. Research is scarce regarding what motives small enterprises have for product innovation, only mentioning the following motives and objectives: satisfying customers and market needs, serving customers with new products that solve their problems, opening up new markets, improving quality, and reducing cost. The limited number of studies bringing up motives for product innovation in small enterprises, as well as the uncertainty if motives mentioned for product innovation in large enterprises also are valid for small established enterprises, justify the research question; *What motivates small established enterprises to innovate?*

There are theories and research streams that deal with resources and resource scarcity in enterprises, such as Penrose's resource theory, the resource dependence theory, networking, and bootstrapping. These theories and research streams deal with resource scarcity in different ways, but how they relate to resource scarcity in product innovation processes in small established enterprises needs to be further investigated. What is known is that small enterprises have scarce resources and seek and find additional external resources for innovation through external networks. These networks mainly involve vertical actors as customers and suppliers. There are anecdotal findings that bootstrapping methods are used mainly for gaining financial resources for innovation in small enterprises, but how the resource allocation in product innovation processes is carried out is less explained. This motivates the research question: *How do small established enterprises manage resource scarcity in their product innovation processes?* The lack of knowledge on product innovation processes in small established enterprises in general justifies this study as a whole.

3. Research methodology

This chapter aims to describe and discuss the research methodology used for answering the research questions as well as how the research was carried out. Research quality will also be discussed.

3.1 Pre-thesis activities: Interviews with 18 small enterprises

Not covered within this thesis but worth mentioning in this methodology chapter are the pre-thesis activities I performed (Löfqvist, 2007). During 2006, I visited 18 different small enterprises and interviewed owners and managers, as well as some employees, in a semi-structured mode, regarding how they perform product innovation. Findings from the interview study were that product innovation processes in small enterprises were hardly ever done in a formal and systematic way and that the interviewees had difficulties in describing how they actually did their product innovation processes. This indicated that the product innovation work involves much tacit knowledge that is not easy, or might be impossible, to capture in a good way by interviews. Interviews alone seem to be limited; there may be a need for another data collection methodology that better studies the tacitness of small enterprises' product innovation processes. This motivates a research methodology that allows product innovation processes in small enterprises to be studied more directly in context and over a longer time.

3.2 Methodological approach

3.2.1 A case study approach

Eisenhardt (1989) describes a case study approach as qualitative research that is good at answering such exploratory and explanatory research questions as "why" and "how." Further, case study methodology is appropriate when the units of study are not fully understood (Voss et al., 2002), complex, and hard to isolate from real-life context (Yin, 2003). Pettigrew (1990) explicitly recommends case study research for studying processes of change, as product innovation processes are. Gillham (2000) describes how qualitative case studies allow the researcher to go more deeply into complex phenomena in organizations to get an inside perspective of the phenomenon under study. With the chosen exploratory and explanatory research questions, the characteristics of product innovation processes, and the tacitness of these in small enterprises, a longitudinal case study methodology with a few case enterprises seems to suit this study well and was chosen as research methodology.

3.2.2 Case selection and description of case enterprises

Pettigrew (1990) and Yin (2003) stress the importance of choosing cases that will result in an optimal contribution to theory and have high probability of helping to answer the research questions. Important in this research was to find suitable small established enterprises that carry out product innovation processes. The enterprises should be the cases, their product innovation processes be the units of study. The basic criteria used in the search for suitable case enterprises were that the enterprises should have less than 50 employees, be established on the

market for several years, have operational processes running, have their own products, do product innovation processes, and launch new products. Furthermore it was important to have good access to the enterprises so the innovation processes could be studied over time.

Two of the 18 interviewed enterprises in the pre-thesis activities, called Enterprise 1 and Enterprise 2, fulfilled the basic criteria. In addition, they were believed to be quite honest about their enterprises, easy to deal with, and curious about what the research was and if it could benefit them in some way. Furthermore, they believed that they had problems with their product innovation processes but did not know how to solve these problems, so they welcomed any advice on that. I was invited to be at Enterprises 1 and 2 as much as I wanted and needed, which for access reasons was a good thing. I chose to do longitudinal case studies of Enterprises 1 and 2. Enterprise 1 was a manufacturing enterprise producing mechanical products (elevated, earthquake-proof industrial floors), and Enterprise 2 was a software business (booking systems for the tourism industry). This difference in product categories between the enterprises was considered beneficial, because it would enable comparing and drawing conclusions about differences in product innovation processes that do or do not depend on the specific kind of new products to be developed.

Most data collected within this study were gained from Enterprises 1 and 2. But when the data collection from these enterprises was finished, it was decided that one more small enterprise, considered exceptionally efficient and effective in their product innovation processes, should be included in the research. It was also felt that further data from a small enterprise that also did business-to-consumers (B2C) new products was needed to contrast with the data from Enterprises 1 and 2, which mainly did business-to-business (B2B) new products. An extensive search for this additional enterprise began when different small enterprises were examined from their websites and public material available. As a result of this search I found Enterprise 3. This was a manufacturer of mechanical products (small portable sawmills) for both the B2C and B2B market, and had extensive public written material and a website describing the enterprise, its product innovation processes and its products. In addition two master's theses on the enterprise were found, which provided a broad description of the enterprise and its activities. It was determined that this enterprise fulfilled the basic criteria, seemed to have efficient and effective product innovation processes, and did B2C products. The product development manager at Enterprise 3 was contacted and was positive about participating in the study. A basic description of the three case enterprises is given below in Table 1.

Some additional characteristics can be added regarding how the three studied enterprises are structured. It is hard to give a clear and accurate description of the overall organization of the enterprises, because the enterprises' organizations were flat and flexible, as well as fuzzy regarding the roles and work done by the people working at the enterprises. The small size of the organizations meant

clearly separate departments were lacking. Many workers had multiple responsibilities within the enterprises and did a lot of different working tasks on a daily basis. Rearrangements of working tasks was common in the enterprises. Some of the people at the companies had official titles, but in practice much other work could be done by people with other titles, or people could do work not in their job descriptions. In Enterprise 1 the product innovation processes were mainly carried out by five persons: the product development/quality/ environment manager, the owner, the managing director, the purchasing manager (former product development manager) and the main salesperson. In Enterprise 2 the product innovation processes were mainly done by six persons: the owner-manager, the strategic manager, the system developer, the main programmer and two programmers. In Enterprise 3 the product innovation processes were mainly done by three persons: the product development manager, the founder-manager and a product developer.

Table 1. A basic description of the three case enterprises in the study.

	Enterprise 1	**Enterprise 2**	**Enterprise 3**
Type	Manufacturer B2B	Software B2B	Manufacturer B2C and B2B
Products	Elevated, earthquake-proof industrial floors	Booking systems for the tourism industry	Small portable sawmills
Ownership	Privately owned	Privately owned	Family owned
Foundation of enterprise	1969	1992	1989
Employees	23	9	25
Number of persons involved in the innovation processes at the enterprise	5	6	3
Customers	One big, many small	Many small	Many small
Market	Sweden and the world	Sweden	Sweden and the world

3.3 Research process

3.3.1 Sources of data

In this study several different data collection methods were used. Eisenhardt (1989) advocate the use of many different methods and sources to collect data in qualitative case study research, because it strengthen the study's validity by allowing findings to be cross-checked.

According to Yin (2003), there are six different main sources of data in case studies. These sources are documentation, archival records, direct observation, participant observation, interviews, and physical artifacts. Different methods suit different situations; in this research all these sources were used in different situations. The participating enterprises were studied in different ways. Enterprises 1 and 2 were mainly studied in the same way and used the same kinds of data collection methods. Enterprise 3 was studied with a different mix of data collection methods. Table 2 summarizes the different sources of data and data collection methods used in the three studied enterprises. The below table gives

quite a formal description of the different sources of data and data collection methods used. The research process was not straightforward, especially regarding the five months of observation time at Enterprises 1 and 2 and the method for analysis of the collected data. The studies at the enterprises will be further described in section 3.3.2, followed by section 3.3.3 on how the data was analyzed.

Table 2. The different sources of data used in the studied enterprises.

Source of data	Enterprise 1	Enterprise 2	Enterprise 3
Documentation	Website, brochures, drawings, and manuals	Website, brochures, flow charts of the functionality of products, and manuals	Website, articles, manuals, brochures, the enterprise's own newspaper, and master's theses about the enterprise
Archival records	Drawings and documented information about a former product innovation process	Documented information from former customer meetings	Not used
Observation	Both direct and participant observation, 2 days a week over 5 months, approximately 6 hours per day. Observation of product innovation processes as well as other activities at the enterprise. Followed different persons in their work, such as the product development manager, managing director and the owner. Participated in meetings, problem-solving work, and social events. Gave advice regarding problematic issues in product innovation processes.	Both direct and participant observation, 2 days a week over 5 months, approximately 6 hours per day. Observation of product innovation processes as well as other activities at the enterprise. Followed different persons in their work, such as the strategic manager, owner manager and programmers. Participated in meetings, problem-solving work, and social events. Gave advice regarding problematic issues in product innovation processes.	Visited the enterprise and got a guided walk around the enterprise's premises. Met employees in their work as well as customers and a lead user showing a lead-user invention for the enterprise.
Formal interviews	Formal interviews with people involved in the product innovation processes, 1-2 hours per person, 5 interviews.	Formal interviews with people involved in the product innovation processes, 1-2 hours per person, 6 interviews.	2.5-hour formal interview with the product development manager
Informal interviews	Informal interviews and plentiful informal discussions and communication with almost all persons at the enterprise. Approximately 2 hours of informal discussion with persons at the enterprise per day at the enterprise.	Informal interviews and plentiful informal discussions and communication with all persons at the enterprise. Approximately 2 hours of informal discussion with persons at the enterprise per day at the enterprise.	15-minute informal interview with the founder-manager.
Physical artifacts	Studies of the enterprise's products regarding design, complexity of solutions and technology used through real products, drawings, and brochures describing the products.	Studies of the enterprise's products regarding interface, complexity of solutions and technology used through using the products, flow charts of the functionality, and brochures describing the products.	Studied the enterprise's products regarding design, complexity of solutions and technology used on real products at the visit at the enterprise, as well through brochures describing the products.

3.3.2 The studies at the enterprises

The data collection started with a period of five months when I was at Enterprises 1 and 2, four days a week, about six hours per day. The studies at both Enterprises 1 and 2 were quite similar in characteristics and content and will be described together. Then the data collection from Enterprise 3 will be described, which differed from the two former enterprises.

The studies of Enterprises 1 and 2

Entering Enterprises 1 and 2, I was astounded at how hectic and turbulent the work was within the enterprises. There were continuous streams of urgent issues that arose, meaning the enterprises' plans had to be changed on a daily basis. This way of working looked chaotic for me in the beginning. Examples of this turbulence include changed customer requirements on new products, urgent problems with products at customers' locations that had to be fixed, problems in production and sales and the multiple responsibilities by the employees that required them to do many different kinds of working tasks on daily basis. There was a constant lack of time and more to do than there were resources, and there were usually no extra buffers to deal with all the unexpected urgent issues that arose. The enterprises had to use lots of creativity and prioritize how to use existing scarce resources in the most efficient ways. Central to the work at the enterprises was the focus on production and sales to uphold the cash flow and keeping existing customers satisfied, because it benefits sales and the much needed steady cash flow. It was always important to solve existing customers' problems; the enterprises did plenty of services for customers that they did not directly get paid for just to keep the customers satisfied. When things arose that threatened the cash flow, other activities were put aside to get resources to quickly solve these things.

Relatively quickly I realized that more formal, structured, and objective data collection would be difficult, or even impossible, to do. As a researcher it was necessary to adapt to the enterprises' reality, mirror their way of working, and be as flexible as the enterprises themselves to be able to interact with and study them. Further, it was important to not disturb the operational processes in the enterprises, because they were needed to constantly run because of the much needed production, sales, and cash flow. One example of the flexibility required was having to postpone interviews several times when urgent things occurred that these persons had to deal with. But it happened that people got some free time, for example when different customer meetings were cancelled with short notice. When this happened I quickly took advantage of these events and asked the involved persons if it was possible to do the interviews straight away, which in many cases it was. When interviews were postponed I studied the urgent issues that occurred to understand the importance of these events. When it was impossible to get in touch with persons in the enterprises, I dealt with this in other ways, such as observing other work, conversing informally with other

employees about their work, summarizing already collected data, or trying to plan further data collection.

An initial task for me was to build trust and credibility and get to know the different persons within the enterprises, thus gaining acceptance by the enterprises and deeper access into the studied phenomena. The first task was to interact with the persons in the enterprises by being involved in activities, giving the enterprises direct benefits. These direct benefits included advice on how to speeding up problematic processes in the enterprises, providing a different perspective, and proposing solutions to different problems. People at the enterprises later told me that my willingness to provide these benefits was crucial; otherwise it would have been hard for them to justify my long-term presence at the enterprise, when they did not have many resources to give away for free to a researcher. By continually getting valuable things in return, the enterprises did not consider the resources invested in me a problem for them. They expressed that they got more back than they invested themselves in the research. The plentiful interaction and benefit-giving activities had the effect of building trust and credibility. The enterprises opened themselves up further for deeper access into their processes, thoughts, and views on different aspects.

Most (not all) persons in the enterprises were on a practical "hands-on" level in their work and thoughts about what they did in the enterprises. They did not have the time, or maybe not the ability, to raise themselves to a higher abstract level that the researcher mainly was on when theorizing and problematizing on product innovation processes. When persons had difficulties in higher thought themselves and discussing issues on a higher abstract level, I had to interact at a more practical level as a means of reaching a fruitful discussion with those persons. This was a starting point and it was usually no problem later on to slowly introduce more abstract theoretical and problematizing thoughts and concepts into the discussions. However, in discussing product innovation processes and other issues related to the research with almost all persons at the enterprises, two persons came to be central and key informants at the enterprises, especially valuable regarding my unit of study of product innovation processes. These were the product development/quality/environmental manager at Enterprise 1 and the strategic manager at Enterprise 2. These two persons were deeply involved in the product innovation processes and interested in understanding their own enterprises and their product innovation processes better. In comparison with most other persons at the enterprises, these two persons had less difficulty in discussing issues on a higher abstract level, but also had deep knowledge of the practical dimensions of the same issues. Following these two persons in their work with plentiful informal communication was valuable not only because they were great sources of data, but also for access reasons since these were central actors in the product innovation processes.

It was difficult to balance the quality of interaction and objectivity regarding what was studied. Interaction with persons within the enterprises was needed to build

trust and credibility and get access, but the interaction had to at the same time not affect the studied phenomenon too much. This was a central issue and problem, thought of every day at the enterprises. I was constantly awareness of this issue and wrote down reflections on how this would affect the collected data. This issue was also discussed with the persons at the enterprises. They thought that the interaction was needed and did not think that it affected much what I studied because they said it did not affect much how they worked, but only sped up certain problematic issues. In addition, both the enterprises and I knew which these issues were. We also discussed how these issues would have been solved if I had not interfered. Further, they thought that I was flexible and tried not to disturb the operational and product innovation processes much.

The longer observation time at Enterprises 1 and 2 meant product innovation processes could be studied directly in their natural context in a longitudinal way. The product innovation processes were studied by direct observation and questions could be asked directly of the persons doing the product innovation work regarding what they did and thought about different issues and aspects within this work. The managers and other employees had to reflect over their work in real time; in this way much tacit knowledge was collected. This tacit information could not be collected in the formal and informal interviews done, because the interviewees could not articulate information in these situations.

Much of the work in the product innovation processes was fragmented in time and place in the enterprises. There could be both long and short pauses in these processes because of other work in operational processes and urgent problems that those involved had to solve. Important for me was to be alert to be able to study the product innovation processes when they started again after these pauses. Equally important was to study the context and special settings in the enterprises when product innovation processes occurred, as well the context and special settings when they were paused or did not occur. In practice it was not always easy to clearly separate what was product innovation work and what was work in operational processes through the intertwinement of different processes. Everything observed that had a possibility to be related to product innovation work was noted. The combination of direct observation and informal communication also made it possible to position the product innovation processes in a past, a present, but also a future time perspective, when past events could be discussed, but also thoughts and future plans of the product innovation processes had not yet been completed. Gaps occurred in the data collection because I was only present at each enterprise two days a week. After being away from an enterprise, I asked about the events and activities that had happened since the previous time and discussed with the persons at the enterprises to fill in these gaps. Furthermore, I could study prototype development and drawings to fill data gaps.

Not much formal documentation was done by Enterprises 1 and 2, which made historical tracking of events difficult. Some clues about past product innovation

processes could be gained from the enterprises' existing products, when they were the results of past product innovation processes. In particular, the characteristics of technology and solutions used and the complexity of the products could be studied by examining the products. However, formal interviews were found to be most useful for tracking historical events as well as other broader patterns of the enterprises and their product innovation processes. The formal interviews were done in an unstructured to semi-structured way, with broader themes to cover and predefined, mostly open-ended, questions. All central persons involved in the product innovation processes within Enterprises 1 and 2 were formally interviewed. They were identified as central actors through observation and informal discussion with people at the enterprises. The interviews asked questions not only on product innovation processes but also about the enterprises and their contexts, in order to put the product innovation processes in context. I also asked for attitudes and thoughts about innovation and product innovation processes. Quite central was also to get an understanding of the different persons in the enterprises and how these persons' characteristics and behavior affect the enterprises' product innovation processes. Examples of themes covered in the formal interviews are:

- The enterprise's characteristics and behavior in general,
- Different persons' roles, relations, and work,
- The enterprise's customers and market,
- The characteristics of the enterprise's products,
- The enterprise's history of product innovation,
- Experience and knowledge of product innovation,
- Organization of product innovation activities,
- Practical NPD work,
- Commercialization of new products,
- Successful and less successful product innovation processes,
- Linkages and roles of external actors in the product innovation processes,
- Economic aspects of the enterprises in general and product innovation processes in particular,
- Difficulties and barriers for product innovation,
- Facilitating aspects for product innovation processes,
- Characteristics of different product innovation processes and their execution.

New knowledge gained and learned during the interviews and particularly interesting areas that arose in interviews were incorporated in later interviews. Questions that were missed in early interviews were asked later of the interviewees in informal discussion. It was not possible to get access to detailed economic figures in the studied enterprises. However, economic issues for the small enterprises and the product innovation processes were discussed and

described by the persons at the enterprises, but without bringing up the actual figures.

During the observation time at the enterprises it was possible to cross-check findings from different sources. What was said in interviews and informal discussions did not always match what could be observed. The persons at the enterprises were not conscious of this, but expressed certain beliefs in the interviews that were not in accordance with the observations. In many cases they did not do what they claimed they did. An example is the belief some persons expressed that some innovation processes are strategically planned, whereas in reality they were not. These contradictory findings were discussed with the persons to clear them up. Different people's opinion of certain events could also be checked; many times there were different opinions between different people. In these cases the reasons for these different views were sought after by asking deeper questions of these persons about their opinions and thoughts. If these deeper questions only gave limited understanding of the differences, I looked into the context, background, and interests of the persons to get a deeper understanding. In some cases underlying relationships and past conflicts between employees affected their thoughts about different things. Both Enterprises 1 and 2 had family members and friends employed, which also meant business and family and friends relations could affect the enterprises' work, something especially present in Enterprise 1. It further turned out to be beneficial to study both Enterprises 1 and 2 in parallel during the five months of observation. This allowed direct comparisons between the enterprises and their product innovation processes, enabling small differences to be caught that probably would not have been noticed if only one enterprise was studied. Interesting and relevant findings found in one enterprise could also be checked for in the other enterprise.

Continually during the studies of Enterprises 1 and 2 I took notes about the collected data and documented field diaries. In the evenings, after being at the enterprises, I sorted out, condensed, summarized, and documented the notes and compared different sources of data. This way of working generated over 600 pages of notes. In the evenings, working with the data, gaps in data and contradictory findings were identified; the next day at the enterprises I planned how to collect further data, how to fill in identified data gaps, as well as how to check contradictory issues with the persons at the enterprises. The planning often did not hold -the turbulence in the enterprises most often spoiled the plans. However, data needed and contradictions were sorted out with the persons at the enterprises and data gaps were filled, but it usually took some more time than initially planned. By documenting needed data, contradictions, and data gaps, they were not forgotten and could be collected and sorted out when an opportunity arose.

After five months at the enterprises not many new things happened that not had been observed and noted before. I assumed that more observation time would not give much more valuable data and that an empirical saturation had been

reached. At this moment the observation study was stopped. Three months later I visited the enterprises again for one day each and the same feeling of empirical saturation was felt. A bit later, when the data had been compiled and summarized, seminars were held at Enterprises 1 and 2, in which the findings were presented to the enterprises for validation. Continuous contact with Enterprises 1 and 2 was maintained after the initial longitudinal study. Contact with Enterprise 1 was mainly with the product development/quality/ environmental manager; regular contact was maintained for about two years until this person left the enterprise. Contact with the strategic manager in Enterprise 2 has been maintained through the whole research process. He even left the enterprise after about one year, but still had good insight into the enterprise through his wife still working there. A few studied product innovation processes at the enterprises were not finished when I left the enterprises. Through the regular contact with the enterprises these processes were followed up regarding how they continued and their results.

The study of Enterprise 3

Enterprise 3 was studied after Enterprises 1 and 2, and I used a different mix of data collection methods. No long observation was done at this enterprise because it was located quite far away from the researcher's location. But this enterprise had much public written material about the enterprise and their product innovation processes and products. I visited Enterprise 3 and interviewed the product development manager, a central person in the enterprise who was deeply involved in most processes within the enterprise. The fact that Enterprises 1 and 2 were studied before Enterprise 3 and important new knowledge was gained through these cases made it possible to fine-tune questions to be covered in the interview. The semi-structured interview covered the same themes as the interviews done in Enterprises 1 and 2. The enterprise's extensive written material about itself and its product innovation processes also allowed for an initial understanding that facilitated the interview. The data from the enterprises' public written material was also cross-checked at the interview. The interview with the product development manager took 2.5 hours, and a short informal interview with the founder-manager was also carried out, as well as a guided tour around the enterprise, meeting other employees and a few of the enterprise's customers, including a lead user[3] showing his lead-user invention for the enterprise. After the interview, some additional questions arose that were asked and answered by e-mail by the product development manager. The findings were also checked for accurateness by e-mail and phone with the product development manager. Later communication validated findings and early conclusions.

[3] Lead users are users that face needs that will be general in a marketplace earlier than other users, and they benefit greatly if a solution to these needs is obtained. Lead users modify existing products and create lead-user inventions to satisfy their unmet needs (von Hippel, 1988).

Summing up the interaction with the studied enterprises

Figure 1 below shows an illustration of the data collection periods and the contacts with the studied enterprises.

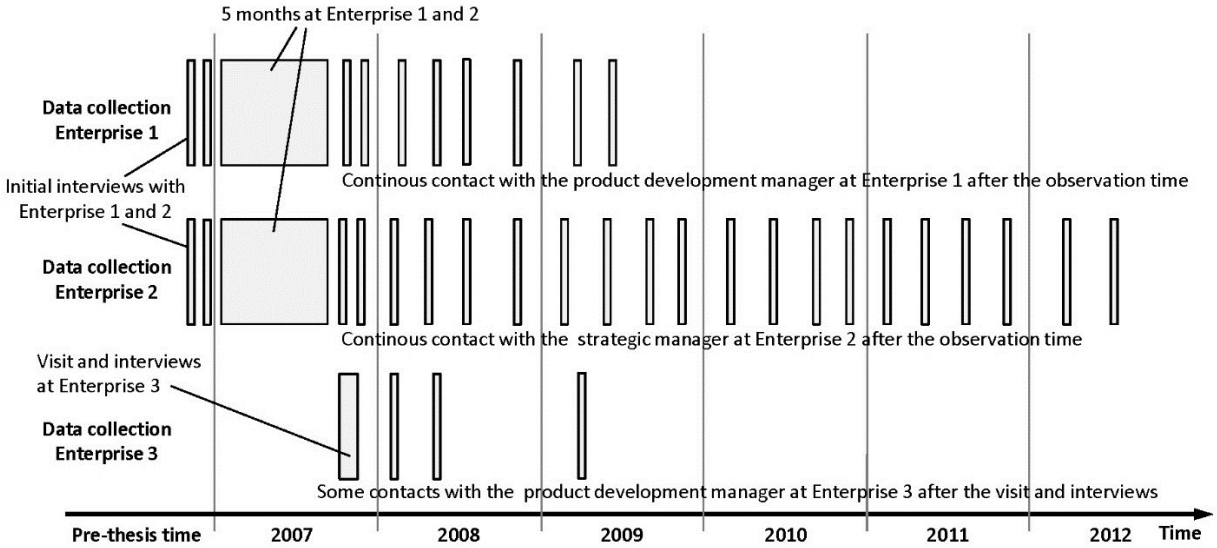

Figure 1. The interaction with the studied enterprises.

As can be seen in figure 1, contact with the enterprises was maintained after the main data collection periods. These contacts were initially focused on gaining additional data and validating findings, but evolved into fruitful discussions, especially with the strategic manager at Enterprise 2, of the findings, analysis, and conclusions of the data.

3.3.3 Analysis of data

The analysis of the collected data was a long process that already started during the data collection period at Enterprises 1 and 2 and continued almost through the whole research process. The data were complex and to a large degree unstructured from the beginning. What I realized from the longitudinal observation studies was that for understanding the product innovation processes it was necessary to also understand the context in which they occurred. During the data collection this was done by also studying the enterprises and the wider context they worked in. This holistic research approach also contributed to the complexity of the data. To be able to make sense of and interpret the data, I had to read much relevant theory and iterate between the data and theory in an abductive way (Alvesson and Sköldberg, 1994; Eisenhardt, 1989). Trying to making sense and meaning of the data without taking theory into consideration from the beginning would probably not have worked, or would at least have taken much more time because of the large amount of complex and fragmented pieces of data. A strictly grounded approach was not used for this reason. Figure 2 illustrates but simplifies the research process, which was actually much more iterative in reality regarding the phenomena under study and the literature used. The figure shows the main phenomena under study in the data, theories used, major insights, as well as which research paper was the result of each loop of abductive analysis.

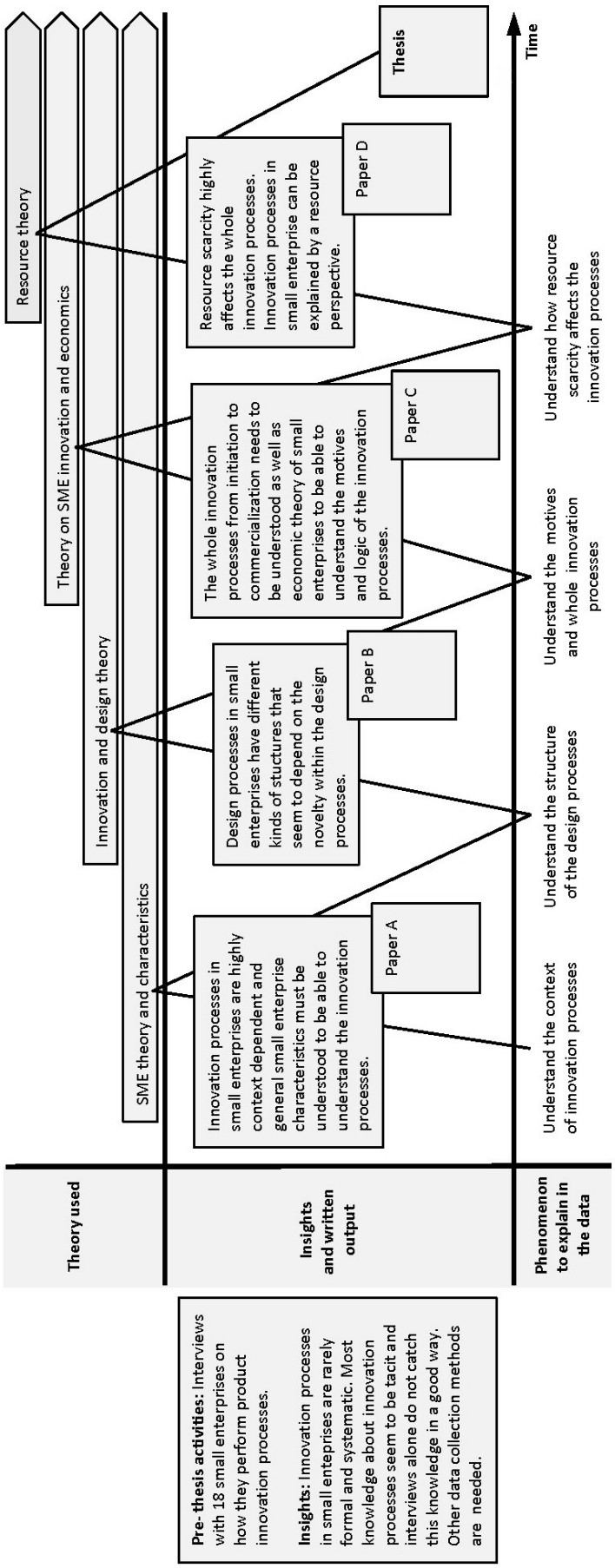

Figure 2. The research process.

To be able to understand the product innovation processes it was necessary to understand the context of the innovation processes and especially the specific kind of organization, the small enterprise, in which they occurred. With the help of the theory of the general characteristics of smaller enterprises and a generic reference model of product innovation processes by Bessant and Tidd (2007), the context of the product innovation processes in the studied enterprises was examined and analyzed, which resulted in research paper A. The analysis then continued, analyzing the structures of the design processes within the found product innovation processes. To be able to understand these structures, general innovation and design theory was read and the design processes found were mapped with the help of a generic reference model of the design process by Cross (2008). This resulted in research paper B. Having gained an understanding of the context and the design processes within the studied enterprises, it was then time to examine and understand the motives for product innovation and the whole product innovation processes from initiation to commercialization. To do this it was necessary to read theory specifically dealing with innovation in small enterprises, as well as theory of economics in small enterprises. This resulted in research paper C. At this moment in the research process I knew how the studied enterprises' product innovation processes could be described but not how they could be explained in an accurate way. However, realizing that the product innovation processes might likely be explained by a resource perspective, I read resource theory in order to analyze the product innovation processes from a resource perspective. This resulted in research paper D as well as this thesis covering all the research papers.

Another dimension of the data analysis was the more practical work with the collected data, which was intertwined and done in parallel with the abductive iterations between data and theory. A central part of this work was to deal with the complexity of the data as well as data with different characteristics, due to being collected with different data collection methods. Data from the different sources had to be sorted out and structured to be able to synthesize it. With the help of the generic reference model of product innovation processes by Bessant and Tidd (2007), which contains clearly defined contextual factors of innovation processes, much work was done trying to separate the context from the product innovation processes within the studied enterprises. The next thing to do was to put the different kinds of design and product innovation processes together to give a description of how they were performed. The characteristic and context of each product innovation process was mapped, and activities and events were put in order to find the overall structures. The generic design process model by Cross (2008) was used to map the particular structures of each design process found. When the characteristics, context, content, and sequence of activities of each product innovation process were known, these processes were put together as a whole by a grounded bottom-up approach using no reference model. Within this work a lot of coding and classification of data was done to be able to see underlying patterns and causal relationships present below the more obvious

patterns of data and events. Extensive tables were created to put the categories into. These categories were, when needed, merged together or divided into subcategories. In addition to this extensive work of bringing structure and meaning to the data, the analysis also involved cross-case analysis, within-case analysis, and comparisons between different product innovation processes. Further, realized and unrealized[4] product innovation processes were compared.

3.4 Research quality: Summing up

According to Yin (2003) there are four conditions related to quality in case study research: construct validity, internal validity, external validity, and reliability. These issues will only be briefly discussed below: Most of these issues have been described in the previous sections on the research process.

3.4.1 Validity

Construct validity is about establishing the correct operational measures for the studied phenomenon. Three ways to increase the construct validity in case studies are to use multiple sources of evidence, to establish a chain of evidence, and to have key informants review findings and conclusions (Yin, 2003). All these things were done, as was described in the previous sections of this chapter. In addition, the phenomenon under study has been examined in different settings, both B2B and B2C enterprises, as well as product innovation processes in different industries with both physical artifacts and services as end results.

Internal validity is about establishing the causal relationships between certain events that lead to other events. This kind of validity is mainly an issue in explanatory case studies (Yin, 2003). Explanatory claims are made in this thesis, mainly regarding causal relationships within the product innovation processes and between these processes and the context. These causal relationships have been validated by the key informants in Enterprises 1 and 2.

External validity deals with the question of whether findings and conclusions from the study are generalizable beyond the actual case enterprises in the study. A case study is generalizable to theoretical propositions and to broader theory, but not to other populations. The goal is to create and/or expand and generalize theories, not to show how common certain phenomena are in a statistical way. External validity is increased if the findings and conclusions can be used in other contexts or situations in other studies with the same results (Yin, 2003). The use of multiple cases and multiple units of study in this research strengthens the external validity more than a single case study, or unit of study, would have done. The reason for this is that the studied phenomena have been found similar in different cases and units of study. An additional thing that may increase the validation and generalization of the results and conclusions from this study is that

[4] Unrealized product innovation processes are innovation processes that were started but were abandoned and left uncompleted, not resulting in new products launched on the enterprises' markets.

findings and conclusions have been presented to several small enterprise owners, managers, and employees during the last years of the research process. They have validated findings, conclusions, and causal relationships and agreed that they think it gives an accurate description of how product innovation processes normally are done in small established enterprises. Firestone (1993) discusses validation and generalization and how a richly detailed description of cases and the cases' contexts helps readers make their own estimations about the validity and generalizations of the findings. Hopefully the description of the research process within this chapter, together with the descriptions of the case enterprises and the product innovation processes found in the appended papers, increase the validity and generalization of the findings and conclusions.

3.4.2 Reliability

Reliability is about how it is possible to do the same study again and reach the same findings and conclusions (Yin, 2003). The characteristics of this study make it hard or even impossible to do the exact same study again. There are two main reasons for this; first, it is not possible to find the same research objects again when they have been affected by the research done as well as other changes occurring at the enterprises, and second, the highly abductive research process, with its many iterations, will be hard or impossible to replicate. Still, the reliability is increased by the usage of field diaries that documented the data collection process as well as the description of the research process given in this chapter. Hopefully the description will contribute to the trustworthiness of the study despite a low reliability in a strict meaning.

4. Summary of appended papers

This thesis is built on four research papers: A, B, C, and D, dealing with different parts and aspects of product innovation processes in small established enterprises. All papers used data from the three studied enterprises. The different product innovation processes found are described in Papers B and C. Papers B and C both studied processes, but the division between different processes was done in different ways. Paper C describes 11 different realized and not realized product innovation processes. Paper B describes the 8 different design processes found within the product innovation processes. A short summary of the four appended research papers and their findings and conclusions is presented next.

4.1 Paper A

Title: The context of innovation in small enterprises: Leadership, organization, and linkages

Author: Lars Löfqvist

Status of publication: Submitted to *International Journal of Entrepreneurship and Innovation Management*.

Research question: How do leadership, strategy, resources, organization, creative climate, and linkages affect the innovation processes in small established enterprises?

Main findings and conclusions: This paper highlights the high context dependence of innovation processes in small established enterprises. The context dependence contributes to the apparent difficulty or impossibility of separating innovation processes from other processes in small enterprises. The most important external actors in small enterprise innovation processes are found to be existing customers, because they provide needed resources. A variety of different communication channels with these customers seem beneficial for innovation processes. Horizontal linkages and actors are found to be of minor importance in the product innovation processes. Relationship marketing with existing customers is found important, and small enterprises can relatively easily take advantage of lead-user inventions due to the closeness to the customers. Small enterprises are further found to have a natural structure for an innovative organization if leadership is uniform and delegated, but the creative climate is vulnerable due to interpersonal conflicts, individual traits, and unconstructive feedback. Furthermore, the study shows that strategy seems to be of minor importance when it comes to which new products to realize. Customers' problems and needs and resources seem to determine which new products are realized.

4.2 Paper B

Title: Product and process novelty in small companies' design processes

Author: Lars Löfqvist

Status of publication: Published in *Creativity and Innovation Management*, Volume 19, Number 4, pp. 405-416, 2010.

Research questions: How do small companies execute their design processes within their new product development activities? How do the relative novelty of the product being developed and the relative novelty of design processes to the designers and others involved affect the design processes?
Main findings and conclusions: In this paper design processes were studied. Design processes are seen as a subprocess of innovation processes in which the creation of the product concept is done. Eight different design processes were examined. The relative novelty of the new product to be developed and the relative novelty of design processes (i.e., the experience and knowledge about design processes that those involved have) affect the design processes. If the relative novelty of both the new product to be developed and of design processes is low, a linearly structured design process was found to work. In this design process the new products' requirements are easier to determine in advance and done before development work begins. A design process that is cyclical and experimental was found to work irrespective of the relative novelty, which means that this kind of design process does not depend upon the innovativeness of the new product or the experience and knowledge about design processes. In cyclical and experimental design processes the new product's characteristics and properties are learned during the development process through learning experiments in which solutions are tested on the design problem to be solved with the help of feedback from customers. In both linearly structured and cyclical, experimental design processes, extensive involvement and feedback from customers was found, despite the fact that the theory holds this is only needed within high-novelty design processes. Close relations to customers and the turbulent environment of the small enterprises may explain this. The turbulent environment affects the whole enterprise, including the design processes, and adds novelty and uncertainty, which increase the need for validation from customers on the design processes. Linearly structured design processes were further found to be unsuitable when high novelty is present.

4.3 Paper C

Title: Motivation for innovation in small enterprises
Author: Lars Löfqvist
Status of publication: Published in *International Journal of Technology Management*, Volume 60, Number 3/4, pp. 242-265, 2012.
Research questions: Which factors affect the motivation for small enterprises to realize innovation ideas into new products? How do these factors affect the innovation processes?
Main findings and conclusions: In this paper 11 different product innovation processes (8 realized and 3 unrealized) were analyzed regarding factors motivating small enterprises for realizing innovation ideas into new products. Ten different but interdependent motivating factors were found to affect the motivation to realize innovation ideas into new products. These factors are owner-manager support, committed resources, the possibility to reuse or use existing technical solutions in new products, the possibilities to gain synergy

effects between different innovation processes, technical feasibility, consistency with the enterprise's current product base, customer financing, the risk of losing customers, specific requests for a new product, and a strong and clearly defined customer problem or need. The four latter, externally oriented, factors were identified as the main motivating factors, and conclusive whether product innovation processes were realized or not. The factors shape the innovation processes to follow this scheme: (1) identify existing customers who want or need a potential new product based on an innovation idea, (2) get support from these existing customers, (3) execute NPD in close interaction and communication with these customers, (4) quickly sell the new product to these customers, (5) sell the new product to other customers. The scheme is executed in a flexible and informal way and optimized for decreasing market and technology uncertainty and risk, dealing with resource scarcity, and facilitating quick and easy commercialization to avoid or reduce dips in cash flow. Supportive existing customers of an innovation idea are found crucial for realizing innovation ideas into new products. They give needed resources, facilitate NPD and help with fast and easy commercialization, avoiding or reducing dips in cash flow when resources invested in NPD are quickly repaid. The findings further show that the need to maintain a sustained steady cash flow seems to be the overall motive for product innovation in small enterprises. Cash flow issues determine how the innovation processes were done, when they were done, and the result of the product innovation processes. The focus in the innovation processes on solving existing customers' problems with new products gives the result of satisfied and loyal customers, which benefits future sales and cash flow and the enterprises' survival in the long run. To satisfy customers' wants and needs seem not to be conclusive on its own for realizing innovation ideas into new products in small enterprises. Product innovation also must result in a steady cash flow.

4.4 Paper D

Title: Managing resource scarcity in small enterprises' innovation processes
Author: Lars Löfqvist
Status of publication: Submitted to *International Journal of Innovation Management.*
Research question: How do small enterprises manage resource scarcity in their product innovation processes?
Main findings and conclusions: Small enterprises are found to use many different bootstrapping methods in combination for managing their resource scarcity during their product innovation processes. These bootstrapping methods involve resources from the enterprise and external actors, with a focus on existing customers. Examples of bootstrapping methods used are: the approach to only invest resources on NPD and realize innovation processes if existing customer(s) are involved, intertwinement of the innovation processes, resource efficiency in the usage of flexible and informal product innovation processes, reuse of existing solutions, and the use of lead users and their inventions.

The bootstrapping methods were found to fulfill three different overall functions:

- To increase resources,
- To use existing resources more efficiently,
- To secure a fast payback on resources invested in NPD.

Small enterprises' resource scarcity shapes product innovation and seems to force the enterprises to involve the market of existing customers from the very beginning and through the whole product innovation processes. The studied small enterprises were found, due to their resource scarcity, to favor an innovation strategy only involving new products done with known technology and targeting existing markets. This strategy seems to avoid unsuccessful innovation but at the same time exclude technologically radical innovation and innovation targeting new markets.

5. Analysis and discussion

5.1 What motivates small established enterprises to innovate?

Innovation processes for both realized and unrealized products were analyzed regarding whether factors mentioned as motives or as affecting the motivation for product innovation in large enterprises were also valid for product innovation in small enterprises (Paper C). Strategy, competition, profit, growth, novelty of innovation ideas, source of the innovation idea, and degree of labor intensity of the innovation were all examined to determine if they had an impact on whether innovation occurred or not. No connections were found between these motives and factors and whether an innovation idea was realized or not into a new product. The innovation processes were not found to be strategic regarding which innovation ideas to realize. Instead, existing customers' support of an innovation idea was found to determine which innovation ideas were realized into new products. The choice of supporting new product development (NPD) rested on existing customers and was not controlled by the enterprises. Competitors were further found not to be considered as threats against the enterprises or triggers of innovation, since competitors had different customers to serve. The few competitors the enterprises had were only monitored sporadically; resources to do competitor analyses were scarce. Profit and growth were not found to be motives for product innovation either. These aspects were not considered important by the studied enterprises or present as ideas in the product innovation processes.

The product innovation processes were based on market pull, which confirms previous research (van de Vrande et al., 2009). However, whether the innovation ideas originated with the enterprises or existing customers did not affect whether they were realized or not, a finding that contrasts with Lichtenthaler and Ernst's (2006) finding that an enterprise's own ideas are favored. Both innovation ideas generated by the enterprises and those generated by existing customers were realized in new products. The novelty of the innovation ideas (and the uncertainty that novelty usually gives) did not affect whether an innovation idea was realized or not either, which contrasts with findings by Crossan and Apaydin (2010) and Dosi (1988). For example, Enterprises 1 and 3 did not know all requirements and appearance of new products in advance but learned these things during NPD. This resulted in high novelty and uncertainty during the product innovation processes.

Nor did the degree of labor intensity of the innovation processes, meaning how labor-intensive they were, affect whether an innovation idea was realized or not. Enterprises 1 and 2 undertook quite large innovation processes regarding the amount of work needed in NPD. High novelty, and the uncertainty this normally gives, as well as huge amounts of work were consequently not barriers for product innovation in the studied enterprises.

The above findings show that small enterprises seem not to have the same motives for product innovation as large enterprises. However, there must be an underlying reason and motive to why small enterprises do product innovation. Through the analysis and comparison of realized versus not completed or abandoned innovation processes, 10 interrelated factors were found that affected the motivation to innovate. Among these factors, the need for a steady cash flow stood out as distinctively motivating product innovation in the studied enterprises. The conclusion from Paper C was that the need for a sustained steady cash flow was not only the main motive but also a prerequisite for product innovation to occur.

The need for a sustained steady cash flow seems to affect the product innovation processes in several ways. Cash flow issues seem to affect how the product innovation processes were done (i.e., always involve supportive existing customers from the very beginning so as to secure fast commercialization and payback on resources invested in NPD, as well as to secure a steady cash flow). Cash flow issues also affect when product innovation was done, as well as the result of the innovation processes. Product innovation occurred in Enterprise 1, for example, when an important existing customer would have left the enterprise if a certain new product was not realized, which would have decreased the cash flow. Another example, from Enterprise 2, was that customer-financed product innovation was initiated when the cash flow was decreasing and needed to be increased. But as a general rule, product innovation occurred when existing customers' problems could be solved by new products and these products could be adopted quickly by existing customers, a thing accomplished by involvement of supportive existing customers. This gave the overall result of satisfied and loyal existing customers, which increase the probability of future sales, a sustained steady cash flow, and the enterprise's survival in the long run. The studied enterprises had a limited number of customers. Losing one or a few of these by not solving their problems with new products would decrease the much needed cash flow. Mittal and Lassar (1998) propose that keeping existing customers is generally cheaper and more resource efficient than finding new ones. This may also be part of the explanation for the studied enterprises' heavy focus on satisfying their existing customers. Their limited resources probably make it difficult to find new customers as replacements for lost customers and may be the explanation for the found importance of keeping existing customers loyal through solving their problems by product innovation.

The research that explicitly brings up motives and objectives for product innovation in small enterprises proposes such objectives as quality improvements, cost reductions, and satisfying customers and market needs (Subrahmanya, 2005). Motives mentioned by van de Vrande et al. (2009) are to serve customers with new products that solve their problems and to open up new markets. The findings in this study show a focus on satisfying customers' needs if this could be done by new products that solved existing customers'

problems and at the same time benefited and took into consideration the much needed steady cash flow. Identified customer problems did not alone lead to product innovation in a straightforward manner; this study found that one or a few supportive existing customers were also necessary to get resources to do the product innovation processes as well as to achieve a steady cash flow. Opening up new markets, getting new customers, or reducing costs were not found to be motives for product innovation. Possible reasons for not targeting innovation efforts for new markets or at new customers can be potential problems collecting knowledge needed within the product innovation processes about the new product's requirements, usage, and market demands. Innovation requiress the collection of deep and tacit knowledge, which is preferably created and collected in close interaction with customers (Dougherty, 1992). The studied enterprises' closeness to existing customers favors the collection of knowledge from them, not from new customers in new markets that the enterprises do not have close and trusted relations with.

The central issue of a sustained steady cash flow in the product innovation processes may be further supported and understood if some economic aspects of small enterprises in general are highlighted. Nooteboom (1993) states that small enterprises have an unorthodox economy; Jarvis et al. (2000) say that traditional financial theories of profit maximation fit less well with the reality of small enterprises -cash flow and liquidity are more relevant economic aspects. Welsh and White (1981) stress that a steady cash flow is necessary for small enterprises' survival, because they are sensitive to any disturbance in the cash flow. Further, small enterprises have difficulties in coping with a negative cash flow for longer times (Welsh and White, 1981), and usually limited buffers to compensate for a negative cash flow (Mazzarol and Reboud, 2005). The studied enterprises had a heavy focus on keeping up production, sales, and solving existing customers' problems, because these would provide the much needed steady cash flow. When product innovation could contribute to steady cash flow, innovation occurred. A good example of the central issue of cash flow in the studied enterprises was that operational processes and innovation processes were found to steal resources from each other so as to benefit the steady cash flow in the most optimal way. When problems occurred in production and sales that threatened the steady cash flow, product innovation processes were found to be deprioritized so as to quickly get resources to solve these things. When product innovation processes were done to secure a sustained steady cash flow, resources to do these were partly stolen from operational processes through the intertwinement of product innovation and operational processes. One can wonder: When cash flow issues are so central for small enterprises in general, why should they not also be central in and affect product innovation? The findings in this study show that this seems to be the case. Product innovation in small enterprises seems to be motivated by satisfying existing customers, solving their problems with new products as a way to secure a sustained steady cash flow.

5.2 How do small established enterprises perform product innovation?

5.2.1 The overall scheme of the product innovation processes

Product innovation processes in the studied small enterprises were found to be context dependent regarding leadership, resources, organization, creative climate, and external linkages, but not regarding strategy (Paper A). The product innovation processes were further found intertwined with the enterprises' other operational processes, to the extent that they were difficult or impossible to separate. Further, small enterprises apparently have a natural structure for an innovative organization. The studied enterprises had small and flexible organizations with closeness between employees. The internal communication and coordination were easy and informal, and decision making was fast. This corresponds well with Burns and Stalker's (1961) and Engwall's (2004) descriptions of an organic organization being suitable for more radical product innovation.

As a matter of fact, the studied enterprises did not have the means to create a mechanistic organization -they lack personnel and departments to build a hierarchical organization from. However, this organization was found vulnerable, since nondelegated power and authority, unclear leadership, and interpersonal conflict may decrease the creative climate, directly affecting the product innovation processes negatively. A high amount of creativity was found to be needed in the product innovation processes in the studied enterprises. Creativity was not only needed in NPD to create the new product but also to provide resources for NPD. The studied enterprises' organic organizations, together with the close and trusted relationships with existing customers, and the smooth, easy, and plentiful communication, gave good prerequisites for innovation. However, this was found to be not enough for product innovation to occur when resource scarcity, cash flow, and market and technology uncertainty and risk also had to be managed during the product innovation processes. The study for Paper C found that all realized product innovation processes followed a specific, chronological overall scheme executed in an informal and flexible way. This scheme is presented below, slightly modified to highlight the focus on innovation ideas for new products that will solve existing customers' problems, and to reflect that both existing customers and the enterprises could come up with innovation ideas.

1. Focus on innovation ideas, either from the enterprise or existing customers, that have a potential to solve existing customers' problems.
2. Couple an innovation idea with one or a few existing customers that want a new product based on the idea and also support the NPD.
3. Execute NPD in close interaction and communication with these customers.
4. Quickly sell the new product to these customers.
5. Sell the new product to other customers.

This overall scheme includes the dimension of time. Time has not been covered well in previous research on product innovation processes in small enterprises; the focus has mainly been on their general characteristics. The scheme relates to Mazzarol and Reboud's (2005, 2006) findings that leading customers' appreciation of an innovation idea is likely to start NPD, that these customers assist during NPD, and that the fast diffusion of the new product benefits cash flow. Cannon's (1985) findings that state that customer support in innovation is a success factor and Adams and Walbank's (1983) assertion that innovation is most successful if existing customers are targeted are both supported by this research. The scheme is found to solve the crucial issues of resource scarcity, cash flow, and market and technology uncertainty and risk, efficiently merging the enterprise's technology possibilities and market demands and needs together manifested in new products. The logic behind the found scheme will be further elaborated below.

The studied enterprises focused on innovation ideas that will solve existing customers' problems, which are also highlighted as common by Johansen and Christiansen (2009). However, innovation ideas with a potential to solve existing customers' problems did not alone result in product innovation. Supportive existing customers were also needed for innovation to occur. The innovation ideas need to be coupled with one or a few supportive existing customers. The unrealized product innovation processes, which were abandoned or incomplete, failed to couple the innovation ideas with supportive existing customers. Because the potential new product will solve the existing customers' problems, it directly shows the value of the innovation idea to the existing customers, causing one or a few of these to support the NPD and contribute their own resources to NPD. The supportive existing customers give resources to NPD because they want the new product to be realized.

The studied enterprises' markets, which consist of the enterprises' existing customers, were not passive actors during the product innovation processes. New products were developed in close interaction and communication with supportive existing customers. This meant that the enterprises' technological possibilities were efficiently merged with customer and market wants and needs during the product innovation processes, as Dougherty (1992) describes product innovation processes. This close collaboration with existing customers during NPD is what some small enterprise owners and managers call "sitting on the lap of the customer" during product innovation processes. An alternative way to see this close work between the enterprises and supportive existing customers is that a small piece of the market (the supportive existing customer) is put into the innovation process to support it with resources, especially qualitative knowledge regarding the new product's requirements, usage, and market demands.

An innovation idea can be described as an uncertain and ambiguous description of a potential new product (Gutiérrez, 2012), which means further deep knowledge of the new product's requirements, usage, and market is needed for

defining the new product. This deep knowledge was gained from the supportive existing customers during the product innovation processes. The supportive existing customers also bought the new product when NPD was finished. This contributed to a fast payback on resources put into NPD, avoiding or reducing dips in the cash flow that may be caused by resource consumption during NPD. After this initial sale of the new product to the supportive existing customers, the studied enterprises sold the new product to other customers as well, further contributing to the cash flow. This sale of the new product to other customers was also done even in the case that particular existing customers had financed the NPD, as found in Enterprise 2. The overall scheme can also be seen as prototyping: a new product is created and tested on a small sample of the enterprise's market (i.e. the supportive existing customers). When this has been shown successful, the new product is offered to the whole market.

While supportive existing customers lower the market uncertainty and risk by being potential buyers of the new product, provide needed resources for NPD, and facilitate a steady cash flow by quickly buying the new product, there are still technology uncertainty and risk left for the enterprises to manage during the product innovation processes. The studied enterprises lowered the technology uncertainty and risk by only using already known technology, combined in new ways in new products. Further, they held down the complexity of solutions and reused already existing solutions in new products.

5.2.2 The design processes within the product innovation processes

In the third stage in the overall scheme, new products were developed in close interaction with supportive existing customers. Here the design process is found when the design problem is examined, defined, and solved (Cross, 2008). In Paper B the design processes were examined regarding their structures in relation to the relative novelty for design processes (i.e., the enterprise's experience and knowledge about design processes), as well as the relative novelty for the new product to be developed. Relative novelty is directly related to the perceived uncertainty and ambiguity during the design processes. Two opposite kinds of design process structure were found: (a) linearly structured and (b) cyclical and experimental. The linearly structured design processes were found to work in low-novelty situations and found unsuitable in high-novelty situations, which matches findings by Engwall (2004) and Lynn et al. (1996). Since no linearly structured design processes were found in the two situations with mixed relative novelty, it is unknown if linearly structured design processes are suitable to use in these situations. The cyclical and experimental design process was found to work independently of the degree of novelty and innovativeness of new products as well as the in-house experience and knowledge about design processes, and consequently worked in every situation. Figure 3 below shows a matrix illustrating the two different design processes found in relation to the relative novelty of design processes and the product to be developed.

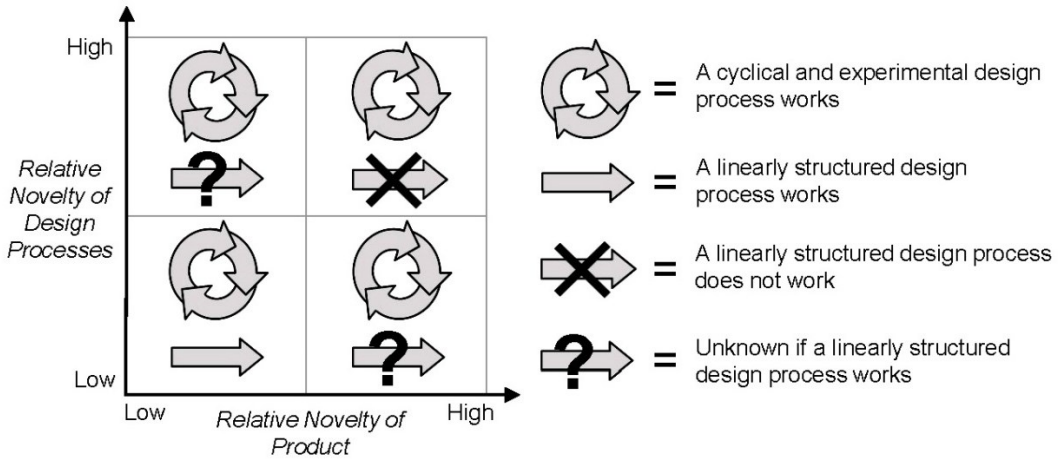

Figure 3. Design processes in relation to different kinds and grades of relative novelty.

The greatest difference between the two kinds of structures found was that in the linearly structured design processes the requirements for new products were set at the beginning of the design process and the development activities were planned and executed in a sequential way. This was facilitated by the low novelty and uncertainty of new products, which meant the final characteristics of new products could be accurately determined in advance. The products developed in the linearly structured design processes were software, a product category that Jonassen (2000) states has better structured and less ill-defined design problems in comparison with physical artifacts, a fact that contributes to a lower uncertainty. In the cyclical and experimental design processes the final characteristics of potential new products were to a higher degree unknown from the beginning due to a fuzzy, ill-defined design problem to solve, involving high relative novelty and uncertainty. Knowledge of the new product's characteristics was learned during cyclical loops of learning experiments, when different solutions were generated and evaluated with the help of feedback from supportive existing customers. In this process, both the design problem and solution space were concurrently explored. Both kinds of structures of the design processes were executed in an informal and flexible way, to handle the involvement of supportive existing customers, deal with the internal and external turbulence in the enterprises, and take advantage of suddenly available resources. The involvement of customers in the linearly structured design processes was an unexpected finding in Paper B: The literature mentions customer involvement as crucial only in high-novelty innovation processes (Dougherty, 1992; Veryzer, 1998). The deeper analysis of the whole product innovation processes in Papers C and D adds the probable explanation to the found customer involvement in also the low-novelty design processes. Supportive existing customers need to be involved from the beginning and throughout the whole innovation processes, so they can provide resources and facilitate the fast commercialization needed for securing the cash flow.

5.2.3 Customer involvement within the product innovation processes

The studied enterprises focused on and integrated their existing customers in their product innovation processes. There are generally considered to be many advantages to integrating customers into innovation processes, but research mainly done on large enterprises also shows risks with relying on and listening too much to existing customers. Enkel et al. (2005) assert that listening too much to customers may hinder radical innovation. My findings partly support this view, but for small enterprises it may be less realistic to do more technologically radical innovation, due to their resource constraints.

Enkel et al. (2005) mention other risks with listening too much to existing customers, such as loss of know-how to disloyal customers, misunderstandings between customers and employees, dependence on customers' views and demands, and serving niche markets only. Regarding the studied enterprises, these risks may be considered less serious. Some of these things were not considered as risks but were used as beneficial assets in the product innovation processes. The enterprises put effort into building trust and loyalty with their existing customers, because it benefits the product innovation processes and a sustained steady cash flow, as shown in Papers A, C, and D. The close and trusted relations and communication with the supportive existing customers during the whole innovation processes limited the risk of misunderstandings. The supportive existing customers also understood the enterprises' capabilities, which decreased the risk of misunderstandings and mitigated the dependence on customers' views. The existing customers were further quite loyal and no serious loss of know-how was found in the studied enterprises. There was a strong dependence on customers' demands in the product innovation processes, but this was a positive thing used for securing revenue to get a steady cash flow. The studied enterprises served niche markets only, but it would probably be too risky and resource demanding to go outside their current markets during their product innovation processes. It can be speculated what would happen if there were major changes in customers' demands and the enterprises' markets. That could be a risk for the enterprises, but may be managed to some extent because the enterprises were small and flexible, so may be able to adjust themselves to these changes.

5.3 How do small established enterprises manage resource scarcity in their product innovation processes?

All three studied enterprises had scarce resources regarding personnel, knowledge and capital, with most resources put into the daily operational processes in the enterprises, which matches findings by Hadjimanolis (2000) and Johansen and Christiansen (2009). The challenge for the enterprises was to run their operational processes and do the product innovation processes at the same time, employing persons with multifunctional responsibilities in both kinds of processes. Deprioritizing the operational processes to get more resources to the

product innovation processes was not an option, because the operational processes, such as production and sales, must run to maintain the much needed cash flow. At first glance the enterprises do not seem to have enough resources to do product innovation; still, they did and launched new products that were accepted and bought by the enterprises' customers.

Innovation processes consume a considerable amount of resources (Smith, 2009); Paper D brings up different approaches the studied enterprises used to gain resources to do the product innovation processes and manage their resource scarcity. These approaches were identified as bootstrapping methods. Financial bootstrapping was defined as *the use of methods to meet the need for resources, without relying on long-term external finance* (Winborg and Landström, 2001), and this was what the studied enterprises did. No external finance from traditional financial institutions or venture capital was used to get resources to do the product innovation processes, which means that the studied small enterprises bootstrapped their product innovation processes. The different bootstrapping methods described in Paper D were divided into three different overall categories due to the overall functions they fulfill: to use existing resources more efficiently, to increase resources, and to secure a fast payback on resources put into NPD. The three different categories of bootstrapping methods will be described and explained in sections 5.3.1-5.3.3. In section 5.4 the characteristics of the bootstrapping methods and their implications on the product innovation processes will be further discussed.

5.3.1 Bootstrapping methods for using existing resources more efficiently

Efficiency for small enterprises in this context means ways of using their own resources smarter, minimizing the need for resources, and gaining increased efficiency in their processes. Here are some examples listed of bootstrapping methods identified in Paper D for using existing resources more efficiently, followed by a description of how the methods work:

- Use of supportive existing customer(s) through the whole innovation processes,
- Informal and flexible product innovation processes,
- Formal planning of the use of resources in a portfolio management process,
- Intertwinement of different processes,
- Reuse of existing solutions,
- Usage of already known technology,
- Reduction in the complexity of new products,
- Competing innovation ideas.

The studied enterprises use of supportive existing customers through the whole innovation processes was found to have several resource-saving functions. The

existing customers' appreciation and support of an innovation idea quickly shows the enterprise if an innovation idea has commercial value. This saves on resources, because it decreases the need for resource-demanding market research. The supportive existing customers also give feedback on the innovation process, helping to steer NPD in the right direction, which decreases the probability that too many resources are put into less suitable solutions. Further, the supportive existing customers also facilitate fast and resource-efficient commercialization, with low transaction costs, by quickly buying the new product when NPD is finished. Innovation further needs the acquisition and creation of knowledge (Lynn and Akgün, 1998; Veryzer, 1998), and the close interaction and communication with some targeted existing customers was also a resource-efficient way to get trustworthy, qualitative market information needed in the innovation processes. This resembles the findings by Mosey et al. (2002). Qualitative knowledge collection was also found easy to combine with other operational processes, such as sales, support, and marketing. The close and friendly relations with existing customers also facilitated the easy identification and adoption of lead-user inventions for Enterprise 3.

The studied enterprises had informal and flexible product innovation processes in practice, which matches findings by Johansen and Christiansen (2009), Lindman (2002), and Pilemalm (2002). Paper D concluded that high flexibility was needed in the studied enterprises to interact with supportive existing customers and handle operational processes concurrently with the innovation processes. Many unforeseen things happened on a daily basis, which caused a turbulence that affected the product innovation processes. The flexibility of the small enterprises mitigated and worked as a buffer for these things. For example, flexibility was needed to be able to handle production and sales problems. If they are not solved fast, it quickly affects the cash flow negatively, an undesirable risk because small enterprises are very sensitive to disturbances and dips in the cash flow (Welsh and White, 1981). The customers' problems with current products must also be solved quickly, because good relations with current customers increase the probability that they return for purchases, which benefits cash flow. Due to the multifunctional roles by those involved in the enterprises, they had to solve these customer problems, which means they sometimes deprioritized innovation processes. Further, the flexibility meant that suddenly available resources in the enterprises could be quickly seized and used in the product innovation processes. This decreases the amount of unused resources and contributes to a steady stream of resource-efficient work. Examples of suddenly available resources were free time due to cancelled meetings, unexpected revenue, and lead-user inventions that could be adopted.

The informality was striking in the studied enterprises. The natural setting for innovation in small enterprises is a small organization. Formality, written rules, and documentation seem less necessary, because most important things in the product innovation processes seem to be relatively easily shared and understood.

The informality also suited the interaction with the supportive existing customers involved in the innovation processes, as well as a better match with the enterprises' other informal operational processes that the innovation processes interacted with. Formal approaches seem not to yield many advantages but only create unnecessary work for small enterprises in product innovation. Enterprise 1 actually tried a formal and systematic prescriptive design process, with predefined methodology in one innovation process; it did not work but only wasted resources. This innovation process was formally planned, but when the development was to begin the turbulence in the enterprises quickly spoiled the work. Problems in production and sales stole resources from this innovation process and interrupted the formal and systematic attempts at NPD. A flexible and informal design process was later used to realize this innovation process instead.

In sum, the innovation processes in the studied enterprises needed flexibility and informality to cope with operational processes concurrently running in the enterprises, to rectify problems threatening the cash flow, to continue the interaction and communication with the supportive existing customers involved in the innovation processes, and to be able to take advantage of suddenly available resources.

An interesting finding is that Enterprise 2, which had an organic organization, used linearly structured design processes. Burns and Stalker (1961) and Engwall (2004) point out that a mechanistic organization better suits linearly structured incremental innovation processes. However, this enterprise developed software, a product category that Jonassen (2000) concludes to have design problems with low novelty and uncertainty. This meant new product's characteristics could be foreseen with great accuracy, and the NPD work could be planned in a sequential way. In Paper B, the linear processes found were called formal, but reviewing the data again, it would be more accurate to describe Enterprise 2's design processes as formally planned but informal and flexibly executed within an overall linear structure. The planning in the linearly structured design processes found in Enterprise 2 involved not only the NPD activities to be done, but also the resources needed, taking into account the resources in other innovation and operational processes. This increased the efficiency of the use of resources and minimized waste of resources.

Synergy effects in the usage of resources were gained through intertwinement between operational and product innovation processes, a bootstrapping method mainly used by Enterprises 2 and 3. The same resources were used in different processes and for different purposes, just as when sales, collection of requirements, marketing, support, and feedback about product innovation processes occurred during the same contacts with customers. Intertwinement of innovation and operational processes has also been found by Berger (1999) and Clarkson and Eckert (2005), but has not been highlighted as an approach for using resources more efficiently. Given the multifunctional responsibilities

employees had in both innovation processes and operational processes and the small organic organization, processes are not easily separated as done by different employees or departments. Enterprise 2, which was accustomed to running several product innovation processes concurrently, actively searched for synergy effects and intertwinement between different product innovation processes so several product innovation processes could use the same resources. Work done in one product innovation process that could also be used in another saved resources. This was done with the help of their form of portfolio management, planning the product innovation processes to give synergy effects in the use of resources.

Reusing existing solutions present in current products was an approach practiced by all three studied enterprises that saves on development resources. Regarding technology, the enterprises only used already known technology in their new products. It would probably be too resource demanding to develop new technology themselves. Known technology used in new novel ways probably demands fewer resources to handle than new technology, since there will be no need to develop, buy, or learn new technology. The complexity of new products was further held down, meaning fewer sources of error in NPD, which saves on resources when they do not need to be solved.

Enterprise 3 also let different innovation ideas compete for resources. Enterprise 3 had many promising innovation ideas but not the resources to realize them all. By starting the development of several ideas, they could be developed long enough that they could be evaluated properly in comparison with other innovation ideas. This helped limit the resources put on the less good innovation ideas and gave the best ideas resources for further development.

5.3.2 Bootstrapping methods for increasing resources

During the product innovation processes, bootstrapping methods were also used that increased the resources. The enterprises themselves increased their own resources by working overtime, but most extra resources came from external actors, with the focus on supportive existing customers. Examples of bootstrapping methods identified in Paper D for increasing resources in the product innovation processes are presented below, followed by a description of how the methods work:

- Only invest in NPD and realize innovation processes if supportive existing customer(s) are involved and want the new product,
- Interact and communicate with and get feedback from external actors,
- Let customers do practical innovation work for free for the enterprise,
- Have customers directly finance NPD,
- Outsource resource-stealing activities such as production and assembly.

External resources could come from different kinds of external actors that the enterprises had close and trusted relations with. Enterprises 1 and 3, but not

Enterprise 2, networked during their product innovation processes with horizontal actors such as friends and other small enterprise managers, but the most central, important, and frequent external actors were the enterprises' existing customers. The studied enterprises only put considerable resources into NPD and realized innovation processes if a supportive existing customer or customers were involved and wanted the new product. This gave the possibility to tap these customers for resources needed during the product innovation processes. This was the case both in product innovation processes of new B2B and B2C products. The supportive existing customers gave the enterprises accurate market information and knowledge about new product requirements, usage, and market, but also increased resources in other ways. The involved customers were available throughout the whole product innovation process for advice, ideas, and feedback, but also to validate that the product innovation process was proceeding in the right direction. In Enterprises 2 and 3 customers also did innovation work for free for the enterprises. In Enterprise 2 customers did requirement setting, prototype testing and marketing for free in the product innovation processes. In Enterprise 3 the customers did lead-user inventions that they gave away for free to the enterprises, saving on innovation work for the enterprise if they adopted the invention and refined it as one of their own products. This had a substantial resource-increasing effect of NPD that benefited the enterprises; the customers identified customer problems but also created solutions that they gave away to the enterprise for free. Using known simpler technology with low complexity in existing products meant that customers could modify the products more easily and create lead-user inventions on their own, which is also highlighted by von Hippel (1988) to increase the amount of lead-user inventions.

Direct financing from existing customers for NPD was used by Enterprise 2 in two kinds of product innovation processes. This contributed to upholding the cash flow during the product innovation processes. This customer financing was not used in Enterprise 2's other innovation processes and was not present at all in Enterprises 1 and 3.

Enterprise 3 outsourced production and assembly to suppliers not only because it was cheaper but also because they had experienced that problems within these activities steal too many resources from the innovation activities. Outsourcing created more resources for innovation.

5.3.3 Bootstrapping methods for securing a fast payback on resources put into NPD

The two previous categories of bootstrapping methods dealt with how resources were gained to do NPD in the studied enterprises. However, product innovation is also about getting resources back through commercialization of the new products. NPD consumes a lot of resources (Smith, 2009), and to quickly get resources spent on NPD back seems especially crucial for small enterprises. Uncompensated NPD can create dips in the cash flow, which can seriously harm

the enterprise, since small enterprises are vulnerable to disturbance in the cash flow and cannot stand negative cash flow for long (Welsh and White, 1981). This justifies this third category of bootstrapping methods, used for securing fast payback from resources invested in NPD. The bootstrapping methods identified for quickly securing a payback on resources put into NPD, together with a description of how they work, are as follows:

- Use market pull only,
- Focus on solving existing customers' problems with new products,
- Only invest in NPD and realize innovation processes if supportive existing customer(s) are involved.

The studied enterprises only did market pull innovation and the market consisted of the enterprises' existing customers. A need from the market gives some guarantee that the new products can be sold and provide a payback for resources put into NPD. The enterprises further focused on solving existing customers' problems with new products, which also increases the probability that the new product can be sold. The customers want the new product because they want their problem to be solved. By only doing innovation processes with involved, supportive customers, the enterprises knew that they had a few buyers of the new product when NPD was finished. If these customers are satisfied with the new product, the probability that it can be sold to other customers increases. The studied enterprises served niche markets as normally is the case for small enterprises (Nooteboom, 1994; O'Dwyer et al., 2009). Due to the relatively limited market with specific demands for products, there is a higher probability that new products also would attract and can be sold to other customers the enterprises have.

5.3.4 The bootstrapping methods' implications for the product innovation processes

The found bootstrapping methods have several implications for the product innovation processes in the studied enterprises, as further elaborated below.

Bootstrapped product innovation processes

The number of bootstrapping methods found in the product innovation processes shows that bootstrapping is practiced not only for enterprise development in newly founded small enterprises, as previous research on bootstrapping has emphasized (for example, Bhidé, 1992; Jones and Jayawarna, 2010; Lahm and Little, 2005). Bootstrapping seems also to be extensively used during product innovation processes in small established enterprises, a thing that previous research had only indicated. Bhidé (1992), Patel et al. (2011), and Tömöry (2010) indicate that bootstrapping is abandoned when enterprises become established on the market, but the findings of this thesis show that it is highly present in small established enterprises during product innovation processes. The task of creating a new small enterprise and doing product innovation in a small established enterprise can both be argued to be highly

resource-demanding tasks in a highly resource-constrained environment. In both cases something new and complex is to be created, uncertainty is involved, and the creation must be accepted and survive on the market. In the creation of a new enterprise, resources are needed to build up operational processes such as production and sales, in order to get cash flow. Small established enterprises' operational processes take most available resources to run. Thus, when product innovation is to be done, the resources needed are lacking and bootstrapping is needed. Section 2.4.2 shared Bhidé's (1992) guidelines for bootstrapping, which focused on newly started enterprises. The findings from the studied enterprises show that these guidelines seem highly relevant for product innovation in small established enterprises as well. Bhidé's guidelines are here presented again, with their relevance for product innovation processes in small established enterprises explained after each guideline:

- *Get operational fast even if the market is small, and imitate competitors to save marketing research*. The product innovation processes are found to speed up the commercialization initially focused on a small market, i.e., the supportive existing customers that first buy the new products.
- *Focus on cash flow by a quick break-even with cash-generating activities, use cash flow from other activities for launching the new business, and use cheap marketing and selling techniques such as relationship marketing and personal selling.* Cash flow was found to be central in the product innovation processes, with a fast commercialization so as to secure a steady cash flow. Other processes in the enterprise contribute resources to the product innovation processes. Relationship marketing is used with personal selling to the supportive existing customers.
- *Customize products and add with personal service so as to offer clear advantages that solve customer's problems.* The studied enterprises focused on solving existing customers' problems with new products in their innovation processes, giving clear advantages for the customers.
- *Avoid hiring expensive, well-educated, experienced people in the business.* The enterprises mainly did the product innovation processes themselves, with the help of supportive existing customers providing needed resources for free.
- *Grow no faster than can be afforded and controlled, and invest only when there is no alternative and never in advance of needs to create space for learning and solving problems when they occur.* The studied enterprises only did product innovation processes when it benefited a sustained steady cash flow. Further, the enterprises used alternatives to financial investments in the product innovation processes by using bootstrapping methods. The enterprises did not allocate financial resources before the product innovation processes began (except for the two kinds of customer-financed product innovation processes in Enterprise 2) but invested resources only when they were needed. Learning and problem solving were highly present in the product

innovation processes, especially in the cyclical and experimental design processes found. The flexibility of the product innovation processes further created space for learning and problem solving.

- *Focus on cash and nothing else. Earn margins from day one to cover costs and finance growth.* Cash flow was a central thing in the studied enterprises' product innovation processes and were more significant than growth, profit, or competition.

The similarities in logic between Bhidé's guidelines and the logic of the found product innovation processes must be said to be striking.

Resource-efficient product innovation processes

The studied enterprises only put a considerable amount of resources into NPD if they knew with high certainty that there were customers (supportive existing customers) that would buy the new product when finished. This was to secure a payback on resources put into NPD so as to secure the cash flow but also to be able to use these customers' resources during NPD. It was also a way to avoid wasting resources on NPD; only minor NPD was done on innovation ideas if supportive existing customers were absent. The different bootstrapping methods were further used in combination, creating synergy effects that gave a "leanness" when more was created from less. No waste of resources that did not have purpose could be found in the studied enterprises' product innovation processes. In Enterprises 1 and 3 resources were put into less suitable solutions in cyclical and experimental design processes, but it should not be seen as waste, because these solutions were evaluated with the help of supportive existing customers, and new needed knowledge was created, moving the product innovation processes forward. Furthermore, the flexibility of the product innovation processes meant available resources could be seized and used within the innovation work, which further decreased the waste of resources. The studied enterprises preferred using resources that quickly and easily could be put into practical innovation work; these resources were mainly taken from the nearest environments: the enterprises themselves and supportive existing customers that provided resources for free. The product innovation processes were also designed for low transaction costs. The small organization and the closeness with trusted, supportive, existing customers meant resources were quickly put into the innovation processes from both the enterprises themselves and from the supportive existing customers. Thus, the transaction cost was low for the commercialization part of the product innovation processes, since the supportive existing customers bought the new product when NPD was finished. The resource acquisition and commercialization, with sales and cash flow, had a vertical direction. The involvement of horizontal actors in the innovation processes was modest, as van de Vrande et al. (2009) also have found. To involve horizontal actors may mean high transaction costs and demand too many resources to manage coordination and responsibility issues and to solve cultural issues (Ibid.), which may be the reason for the low involvement of horizontal

actors within the product innovation processes. All findings point to the product innovation processes being highly resource efficient in the studied small enterprises.

The resources used within the studied enterprises' product innovation processes, the different bootstrapping methods, the three categories of bootstrapping methods and the result of resource-efficient product innovation illustrate how Penrose's (1959) resource theory works in product innovation processes in small enterprises. Penrose (1959) defines an enterprise as a bundle of resources that are managed to create products that can be sold on a market. For every activity the enterprise does, it must allocate resources, and this creates services (i.e., functions). The combinations of different resources create efficiency; novel combinations of different resources create innovation. The studied enterprises both created efficiency and innovation through this logic: (1) the enterprise and supportive existing customers got resources in the form of personnel, knowledge, and capital in different combinations, (2) resources from both actors are combined variously, which creates the bootstrapping methods that render functions, (3) these functions can be categorized into the three different categories of bootstrapping methods that yield resource efficiency, increased resources, and a fast payback on resources, (4) the categories together produce the overall function of resource-efficient product innovation. This is illustrated in the hierarchical scheme in four layers in figure 4 below. The different bootstrapping methods are labeled BM 1 to BM n.

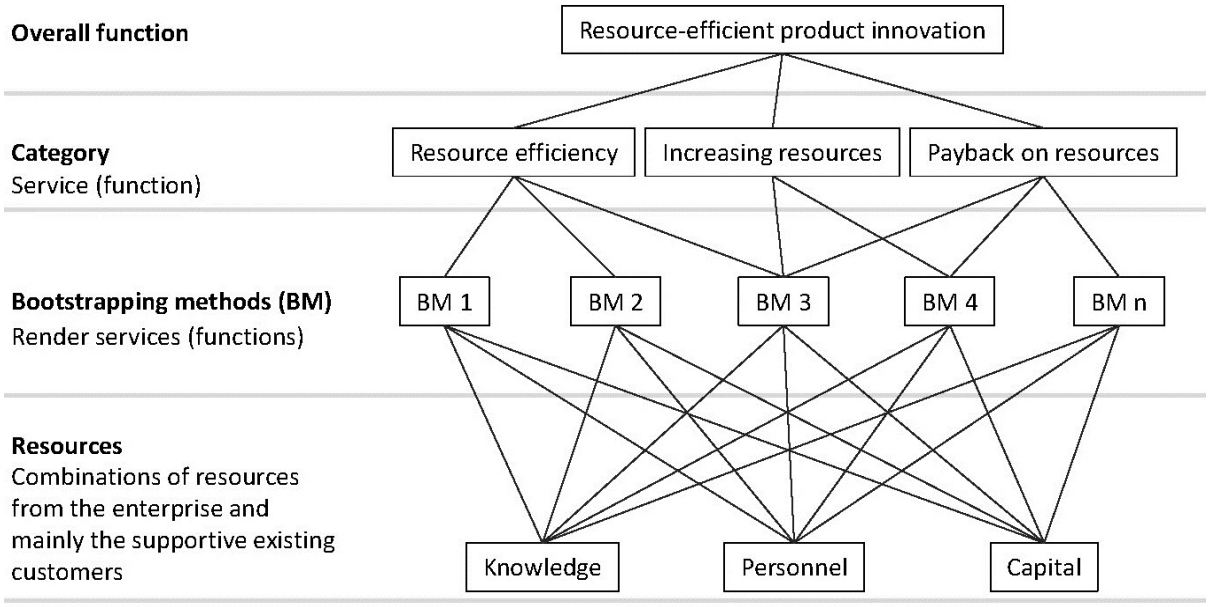

Figure 4. Resource-efficient product innovation.

From figure 4 it can be seen that some bootstrapping methods render functions in more than one bootstrapping category. An example of this is the bootstrapping methods centered on supportive existing customers: supportive existing customers render functions in all categories. The hierarchy in figure 4 on

how resource-efficient product innovation is found to be done in small enterprises is a more abstract scheme than that in section 5.2, which is more practically descriptive and includes the dimension of time. My hope is that these two schemes complement each other well and contribute to a deeper understanding of product innovation processes in small established enterprises.

Resource scarcity's effect on the product innovation processes

The findings show how resource scarcity shapes the studied enterprises' product innovation processes. Resource scarcity seems to force the enterprises to involve and use the market, through involvement of supportive existing customers from the very beginning and during the whole product innovation processes. To first develop a new product and then search for customers might not work because of the lack of resources, plus commercialization would probably require more resources if no customers are ready to adopt the new product. If no supportive existing customers were present, the studied enterprises did not realize product innovation processes, nor did they put many resources into NPD. This was the case even if innovation ideas were considered very promising. Some NPD effort could be put into promising innovation ideas, but they were never fully developed into finished new products. Possible reasons for this were uncertainty about the innovation ideas' commercial value and if a new product based on the innovation idea could be commercialized fast enough to yield a fast payback on resources put into NPD. It may also be the case that the studied enterprises could not proceed with an innovation idea even if they wanted to, because of their lack of resources. Supportive existing customers have been found to give a considerable amount of resources needed in the product innovation processes, and these resources would be absent if supportive customers are not present. This is probably most pertinent regarding the resource of knowledge. Without supportive existing customers that provide deep and rich knowledge about the potential new products' requirements, usage, and market conditions, the enterprises would probably have difficulties knowing exactly what to develop to meet customer and market demands and needs. This may explain Cannon's (1985) statements regarding support from existing customers being a success factor in product innovation in small enterprises without which innovation often fails.

Unsuccessful innovation processes have been proposed to create great problems in small enterprises; Mazzarol and Reboud (2005) say that small enterprises lack buffers to handle unsuccessful innovation processes, and Nooteboom (1993) puts forward that unsuccessful innovation processes cannot easily be outweighed by other more successful innovation processes. It seems like the studied enterprises avoided unsuccessful product innovation, since no examples of product innovation processes creating new products unsuccessful on the market were found. Such products never became fully developed and launched. No supportive existing customers could be coupled with these innovation ideas, which may mean that these innovation processes lacked needed resources to

proceed. It seems that the lack of resources, which an absence of supportive existing customers in the product innovation processes gives, itself prevents these innovation processes from being realized. Scarce resources seem to hinder less suitable innovation ideas from being developed and launched, because when existing customers do not support these ideas, the right resources for NPD are missing. This, however, seems not to be related to innovation ideas being bad, not innovative, or lacking potential in a broader perspective. It seems only to mean that the innovation ideas are not suitable, for different reasons, for the enterprises' markets of existing customers, which makes them unsuitable for realizing into new products. This seems to be a powerful mechanism in product innovation processes in small established enterprises that make sure that only "the right" new products are realized, which seems to be new products that solve existing customers' problems, meet their demands, and can be developed in collaboration with supportive existing customers, can quickly be commercialized and benefit cash flow. However, as mentioned before, a "right" new product seems not to include technologically radical innovation or new products aiming at new markets.

The studied enterprises had to interact with the environment (existing customers) to get needed resources for product innovation. This corresponds directly to the resource dependence theory (Pfeffer and Salancik, 2003), which says that organizations do not possess all the needed resources themselves and need to interact with the environment to get resources. Resource dependence theory also states that those that provide the resources have power and can influence the organization and its actions. In Paper C, as well as in the above discussion, it was shown that existing customers' choice to support and give resources to NPD determined which innovation ideas were realized into new products. While existing customers seem to possess crucial resources needed for innovation to occur, they also have the power to affect which new products are realized by the enterprises. This means that the existing customers have the power to influence the enterprises and their actions, just as the resource dependence theory says. This proves the resource dependence theory and shows it is valid for product innovation, which prior research seems not to have shown.

6. Conclusions, contribution and implications

6.1 Main findings

This study has found that cash flow seems to be a central aspect of product innovation processes in small established enterprises and that the need to uphold a sustained steady cash flow is a main motive for product innovation, together with solving existing customers' problems. Small established enterprises do product innovation by solving existing customers' problems with new products, resulting in satisfied and loyal existing customers, which in turn benefits future sales and a sustained steady cash flow, securing the enterprises' survival in the long run. Further, product innovation in small established enterprises was found to be done when there is a risk for a decrease in cash flow or when the cash flow is on its way down and need to be increased. Motives for product innovation, derived from research on large enterprises, such as strategy, competition, profit, and growth, seem not to affect or be motives for product innovation in the studied small established enterprises. High novelty or a high degree of labor intensity of a product innovation process did not affect the motivation, nor were they barriers to product innovation in small established enterprises.

Product innovation processes in the studied small established enterprises are found to be made possible by a small organic organization and closeness to existing customers. This facilitates dynamic innovation work in collaboration with existing customers, which supports the NPD. The product innovation processes are found to be highly context dependent, intertwined with operational processes, and to follow this overall scheme:

1. Focus on innovation ideas, either from the enterprise or existing customers, that have a potential to solve existing customers' problems.
2. Couple an innovation idea with one or a few existing customers that want a new product based on the idea and also support the NPD.
3. Execute NPD in close interaction and communication with these customers.
4. Quickly sell the new product to these customers.
5. Sell the new product to other customers.

Innovation ideas that solve existing customers' problems and supportive existing customers are found to be the cornerstones in product innovation processes in small established enterprises. Both seem to be needed for product innovation to occur. The focus on innovation ideas for new products that solve existing customers' problems make existing customers want the new product to be realized. This appreciation from existing customers shows the idea's commercial value, which lowers the market uncertainty and risk. The focus on solving existing customers' problems facilitates the support by one or a few existing customers during the whole product innovation process. This gives the possibility to tap these customers for resources needed in the product innovation processes, of which the resource of knowledge on new product characteristics,

usage, and market seem crucial. When NPD is finished, these supportive customers are found to buy the new product, contributing to a fast payback on consumed resources. The fast commercialization avoids or reduces dips in cash flow, which benefits the much needed steady cash flow. After this initial sale the new product is sold to other customers, further contributing to the cash flow. Technological uncertainty and risk are found to be lowered in the product innovation processes by using known technology in new ways, keeping down complexity and reusing existing solutions in new products. The product innovation processes are found to be flexible and informal so as to cope with a turbulent environment, operational processes, the involvement of supportive existing customers, and suddenly available resources. Two different kind of design process structures, *linearly structured* and *cyclical and experimental*, were found to be used within the product innovation processes. Linearly structured design processes were found to work in low-novelty situations when development activities were planned in sequence. Cyclical and experimental design processes were found to be independent of novelty and innovativeness and consequently work in every situation. In cyclical and experimental design processes the development activities were done in cyclical loops of experiments.

To manage resource scarcity during the product innovation processes, different bootstrapping methods are used in different combinations, reinforcing each other. These bootstrapping methods can be put into three different categories according to their overall functions:

- To use existing resources more efficiently,
- To increase resources,
- To secure a fast payback on resources put into NPD.

These bootstrapping methods are mainly created by the enterprises' and supportive existing customers' resources of personnel, knowledge, and capital. The extensive use of bootstrapping methods gives an alternative description and explanation for how small established enterprises perform their product innovation processes: Small established enterprises *bootstrap* their product innovation processes. The bootstrapping methods create resource efficiency and "a leanness" when much is created from less. Small enterprises' resource scarcity shapes the product innovation processes and seems to force the enterprises to involve the market of existing customers from the very beginning and throughout the whole product innovation processes. The studied small enterprises, due to their resource scarcity, favored an innovation strategy only involving new products developed with known technology and targeting existing markets. This strategy seems to avoid unsuccessful innovation but at the same time excludes technologically radical innovation and innovation targeting new markets.

6.2 Contributions

This study has several contributions. Cash flow has in previous research on product innovation in small enterprises only received minor attention, but has in this study been found to be a central aspect. It seems to explain much of the motive for innovation, the prerequisites for innovation, and how product innovation processes are performed. In addition, the chronological descriptive scheme showing how whole product innovation processes are performed in small established enterprises is a contribution, since whole product innovation processes, covering both NPD and commercialization, have not been described well in previous research. The central importance of supportive existing customers for product innovation to occur is also a contribution and raises at least two interesting propositions:

- The less resources an enterprise has, the earlier the market must be involved in the innovation process for product innovation to occur.
- Innovation ideas without supportive customers will not result in product innovation if an enterprise has scarce resources.

The latter proposition can help in evaluating the commercial value of innovation ideas in small enterprises, because an innovation idea seems to have a low commercial value if customers do not support it, but a higher value if they do. The finding that bootstrapping not only is important for newly started enterprises but is also extensively used during product innovation processes in small established enterprises is new knowledge. So is the identification of the three overall functional categories of bootstrapping methods and the many bootstrapping methods used. Several bootstrapping methods found in this research have not been brought up by previous research: the approach to only invest in NPD and realize innovation processes if existing customer(s) are involved, the intertwinement between operational and innovation processes, resource efficiency in the usage of flexible and informal product innovation processes, the reuse of existing solutions, and the use of lead-users and their inventions.

The findings on how scarce resources affect product innovation processes within small enterprises are new as well, as for example the preference for using an innovation strategy that is resource efficient, involve the market through the whole innovation process and seems to prevent unsuccessful product innovation. The finding that informal and flexible product innovation processes seem to be both purposeful and resource efficient in small established enterprises is also a contribution. The study further contributes by showing that Penrose's resource theory and the resource dependence theory are valid for product innovation processes in small established enterprises.

6.3 Limitations and further research

This study is qualitative, with a limited number of cases and units of study. These limitations make statistical generalizations not possible. To enable statistical

generalizations from this study, the findings and conclusions must be tested in a quantitative way, which is an opportunity for further research. Furthermore, it is unknown if the results are valid for enterprises other than small established ones. It would be interesting to test the findings on other kinds of small enterprises or organizations. A central finding in this study is the proposed importance of a steady cash flow in product innovation in small established enterprises. This definitely deserves further research. Furthermore, this study concluded that competitive advantage, profit, and growth do not seem to motivate product innovation in small established enterprises, but it is possible this is a result of product innovation processes being done over a longer time. This has not been covered by the data and needs further longitudinal studies to determine if that is the case.

6.4 Managerial implications

This study adds knowledge and advice on how efficient and effective product innovation in small established enterprises can be done. Prescriptive product innovation process models exist in the literature, but they mainly target large enterprises with characteristics and prerequisites other than those of small established enterprises. Since most prescriptive literature on product innovation prescribes formal and systematic innovation processes, in the meaning of using a predefined structured methodology for product innovation (Kahn et al., 2006), the findings in this study on the great benefits of using a flexible and informal product innovation process in small enterprises are strikingly different. This may mean that what the literature describes as "best practice" for innovation may be a "poor practice" for small enterprises. Small established enterprises have distinct characteristics, including a small organic organization, informality, flexibility, fast communication, quick coordination and decision making, closeness to customers, scarce resources, and a vulnerable cash flow, which together seem to set constraints on how product innovation processes can be done. However, all these characteristics seem to be possible to use as advantageous assets for efficient and effective product innovation.

This study has shown that a focus on solving existing customers' problems with new products seems to be a successful approach. This means support from existing customers can be gained through the whole product innovation process, which lowers the market uncertainty and risk, provides needed resources, and facilitates the fast and easy commercialization that benefits a sustained steady cash flow. The product innovation processes will further benefit if relations to existing customers are close and trusted. Without close and trusted relations with existing customers, accurate feedback and the possibility to use existing customers' resources in the innovation processes would probably be more difficult. If close and trusted relations with existing customers are lacking, efforts may be put into building these.

Cyclical and experimental design processes seem to be suitable in all situations, independent of novelty, innovativeness, and experience. They may be a good first

choice of design process to use within product innovation processes. During the whole product innovation processes, bootstrapping methods can be used to manage scarce resources. Further, this study has shown the benefits of using known technology with low complexity in new products, which not only results in less resource-demanding product innovation processes, but also increases the probability for customers to modify existing products and create lead-user inventions that can be adopted by the enterprises and realized in new products. This practice results in NPD work being done for free. The overall chronological scheme (see section 6.1) found in the product innovation processes of the studied small established enterprises is both resource efficient and successful for product innovation. This scheme may be a useful reference model for small established enterprises in product innovation and may be a starting point for the development of a prescriptive model for product innovation processes in small established enterprises.

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