MANAGING RESOURCE SCARCITY IN SMALL ENTERPRISES' DESIGN PROCESSES

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ABSTRACT
Small enterprises have scarce resources, which is the main factor hindering their innovation and design of new products. Despite this resource scarcity, some small enterprises do innovate and design new products. The research question is: how do small enterprises manage resource scarcity in their design processes? A multiple case study of three different small enterprises was used to answer the research question. The enterprises implement several approaches to use existing resources more efficiently or increase existing resources, such as reducing formality and including customers and users in the design processes, intertwining design processes, working concurrently on design and operational processes, adopting lead-user inventions, and only starting design processes when a current customer asks for or needs the potential new product. The efficiency of these approaches is found to be explained by common small enterprise characteristics. One conclusion from this study is that resource scarcity can be managed and small enterprises' specific characteristics can facilitate innovation and design if these are recognized and used as strengths.

Keywords: Resources, small enterprises, SME, design process, innovation

1 INTRODUCTION
Innovation is the most significant factor that can be used by smaller enterprises to compensate for any disadvantages caused by their small size [1]. Design processes are carried out in a context that can fruitfully be described by an innovation process. An innovation process can be divided into the phases of searching for innovative ideas, selecting the best one and implementing the idea through designing a new product for later diffusion to the market [2, 3]. There is no lack of good ideas for new products in small enterprises [4], but scarce resources usually prevent the realizations of these ideas into new products [5, 6, 7]. Resources are defined, in accordance with Wernerfelt [8], as *those tangible and intangible assets which are tied semi-permanently to the firm*. Examples of different kinds of resources are in-house knowledge, employment of skilled personnel, external contacts, efficient processes and capital. In small enterprises most available resources are put on urgent problems that must be solved to make the business run on a daily basis [9]. Developing new products in small enterprises also means high risk, much higher in comparison with larger enterprises. One reason is the inability to spread risk among different developing projects, since small enterprises have narrower markets and fewer products. A development project that turns out unsuccessful cannot easily be outweighed by other successful ones [10]. Despite the resource scarcity and high risk, some small enterprises do innovate and design new products; this study investigates how they manage the scarcity of resources in their design processes.

2 FRAME OF REFERENCE

2.1 Small enterprises
This study defines a small enterprise as an enterprise with less than 50 employees, in accordance with the definition by the European Union [11]. The small enterprises in this study have been established within their markets for several years, develop their own products (both physical products and/or services), and do most design work by themselves, financed by their own revenue.
Small enterprises are not small versions of large enterprises [12], despite that many think it is so [13]. Small enterprises have broadly similar characteristics across sectors [2, 14] and have scarce resources [6, 12, 15, 16, 17]. Size of an enterprise is an indicator of resource availably [9]. Small enterprises have behavioral advantages [6] with flexibility, low level of bureaucracy, and rapid internal communication and decision making [5, 18, 19] and do not suffer from the stiffness and bureaucracy

that are more common with larger enterprises [6]. Informality is a central theme in small enterprises and most processes are informal [20, 21]. Separate departments are often missing in small enterprises and employees have multifunctional roles, working in many different situations [20, 22].
Running a small enterprise is a complex task and the manager needs to have a broad holistic view and creativity to be able to allocate resources and run the business on a daily basis [23]. The constant occupation with operational tasks can lead to lack of strategic thinking and limited time horizon [9, 13]. Strategy is usually informal and flexible in a small enterprise [9]. Contributing to the limited time horizon is the fact that small enterprises' external environment is uncertain and turbulent [12, 24] and they have little control over this environment [25]. This high external uncertainty makes long-term strategies less useful and short-term returns more favorable than long-term returns [26, 27]. The preference for short-term returns is also connected to small enterprises being very sensitive to any disturbance in the cash flow through the enterprise; a constant cash flow is necessary for the enterprise's existence [12, 27, 28]. They find it difficult to wait long for returns on investments or sales [27, 28], and securing revenue is highly important for the cash flow [12, 29, 30].
Small firms have limited knowledge and use external contacts to overcome this [10]. Relationships with customers are an important aspect of networking [31]; vertical networking with suppliers and customers is the most common [32]. Important factors in networking in small enterprises are longitudinal relations and trust [32]. Small enterprises are usually close to their customers and users and communication is easy [6, 9, 10]. Carson [25] states that small enterprise managers often know their customers personally, and the close relationship and interaction leads to benefits including customer loyalty and higher levels of customer satisfaction. This proximity to customers and markets means easy access to accurate market information and thus better marketing decisions [33]. The main marketing technique is relationship marketing with current customers, which suits small enterprises because it is cheap, has low risks, allows direct contact with the targeted market and is highly flexible [17]. More formal marketing activities in small enterprises are rare [5, 18, 34].

2.2 Innovation and design in small enterprises

Most research on innovation has been done on larger enterprises [34, 35, 36, 37, 38]. It is doubtful whether results from innovation studies of larger enterprises can be directly applied to small enterprises because of the different characteristics, behavior and contexts [6, 39].
Small enterprises' main beneficial characteristics in innovation are flexibility, agility in reacting and responding to changed market conditions, rapid communication and decision making within the organization [5, 18, 19] and closeness to their customers [6]. Limited access to finance [17, 40] and scarce resources are among the predominant characteristics that hinder innovation [6, 7]. Small enterprises' scale-related disadvantages mean that extra resources need to be found externally for innovation and small enterprises frequently engage in some form of external linkages with external actors in innovation [5, 9, 30]. Regarding innovation in small enterprises, there are no relevant differences between service and manufacturing firms [30]. Small enterprises usually use simpler technologies in comparison with large enterprises [33] but create new products with these technologies by using them in novel ways [41]. Small enterprises are good at serving niche markets, designing customized products and distributing their new products to the market [10].
Innovation processes in small enterprises can be seen as a continuous process with unclear start or stop points and unclear phases [18, 22] and are informal and weakly structured [7, 9, 20, 42, 43, 44]. Informality is a strength in small enterprises' innovation processes, because informal communication, coordination and decision making are efficient in a small organization setting [9, 44]. Small enterprises seldom have the resources or infrastructure to have a formal and strategic procedure for developing new products [45, 46]. There are no studies found that link product success with formal innovation processes in small enterprises [47]. There is a high degree of customer involvement, networking and employee involvement in small enterprises' innovation processes [30] and working closely with key customers during innovation is common [48].
There is a strong market pull effect in small enterprise innovation [30, 49] and small enterprises have good contact with their customers' needs [50]. Most success in small enterprise innovation is gained if new products fit closely with existing customers and users; innovation should focus on what customers want [51].
The cost for innovation has a greater impact on a small enterprise than a large enterprise [52]. Despite this, most small enterprises develop new products without external financing [27]. Small enterprises

usually finance their own innovation processes with their own revenue and use overdraft to gain sufficient finance for innovation [53]. Resources are not only needed to design the product but are also needed to be able to catch the rent of new products, so a fast diffusion and adoption of a new product on the market is important for a small enterprise [27]. Diffusion of the innovation becomes easier when there are customers that are willing to adopt the new product [54].
Studies of design processes in small enterprises are rare [34, 55]. Studies have been done by Guimarães et al. [56], Larsson [55], Millward and Lewis [38] and Lindman et al. [57]. They found that the design processes in small enterprises were informal, dynamic and iterative, highly search-oriented with cyclical loops of learning experiments. The owner-manager was usually involved together with other employees. Knowledge needed in the process was mainly gained from suppliers or other owner-managers. The small enterprises were close to their customers and external feedback from customers during the design processes was extensive, which also was found by Moultrie et al. [34]. Lack of knowledge and resources necessitated improvising and creativity in how to use existing knowledge and resources in the best ways [55, 56]. Guimarães et al. [56] and Larsson [55] found small enterprises used their own informal design methods rather than formal ones. Small enterprises rarely use formal design methods, regardless of industry [58]. Lindman et al. [57] found examples of linear and formalized design processes, but these kinds of processes were found by Millward and Lewis [38] and Franke et al. [59] to be very difficult to manage, due to small enterprises' management style, turbulent organization and lack of resources. Design processes commonly interact with other processes in small enterprises [20, 22, 60].

2.3 Dealing with resource scarcity in small enterprises' design processes

From the above description of common small enterprise characteristics and innovation and design processes, some ways of managing resource scarcity in design processes can be derived. These approaches are connected to such resources as knowledge, efficiency in design processes and finance. Approaches described in the literature for dealing with this resource scarcity are:

- Networking to gain resources that the enterprise does not have in house; a flexible and quick way to gain knowledge [5, 9, 30].
- Use relationship marketing with customers, which is cheap, has low risks, allows direct contact with the targeted market, and is highly flexible [17].
- Continual creativity on how to use existing resources in the best way [55, 56].
- Use flexible and informal design processes [9, 44].
- Tie customers to the design processes to obtain easier diffusion of the new product [27, 54].
- Trying to reduce the time for returns on investments in design [27].

3 RESEARCH QUESTION

Existing research on small enterprise characteristics and innovation treats the creation of new products, the design process, on a more general managerial level. Research on small enterprises' design processes is scarce. Several scholars state that small enterprises have scarce resources [6, 12, 15, 16, 17] but how this affects design processes in small enterprises and how small enterprises deal with this is only covered to a limited extent. This knowledge gap justifies this study. Consequently, the exploratory research question is: *How do small enterprises manage resource scarcity in their design processes?*

4 RESEARCH METHODS

4.1 A case study approach

To answer the research question a qualitative multi-case study approach [61] is used. This study has an exploratory research question and examines design processes that are complex, with unclear boundaries [62, 63] that are affected by and dependent on their contexts [2, 3, 64]. Case study methodology is appropriate when the units of study are not fully understood [65], complex and hard to isolate from their real-life context [61]. Thus, case study methodology suits this study well. Further, innovation and design processes in small enterprises urgently require study as a process and not only as input-output [37, 66].

4.2 Case selection

Small enterprises with their own products and design activities were recruited for this study. Three enterprises in Sweden that fulfilled these demands were chosen due to their difference in the number of new or improved products launched. Table 1 briefly describes the three studied enterprises.

Table 1. Some characteristics of the three enterprises in the study

	Enterprise 1	**Enterprise 2**	**Enterprise 3**
Type	Manufacturer B2B,	Software/Service B2B,	Manufacturer B2B and B2C
Employees	23	9	25
New products or product improvements launched per year	Approximately one	Many	Several
Customers	One big, many small	Many small	Many small
Closeness and interaction with current customers	Quite close and regular interaction and communication	Very close and daily interaction and communication	Very close and daily interaction and communication

4.3 Research Process

Innovation and design activities, as well as the context, were observed in Enterprises 1 and 2 over a period of five months, four days a week, and documented in field diaries. Numerous interruptions arose and much of the research time at the enterprises consisted of waiting for design activities to occur, but this waiting approach made it possible to study design activities when they occurred in their natural environment. Semi-structured interviews were carried out with persons involved in the design activities. A basic interview guide was used; innovation and design processes were first covered on a general level and then questions about specific design processes were asked and described by the interviewees. In Enterprise 1 five interviews were conducted, in Enterprise 2, six interviews. In addition to these interviews many innovation and design issues were discussed informally with interviewees and others at the enterprises or in the enterprises' external environment. The answers described given during the interviews were cross-checked during the observations. The studies of Enterprises 1 and 2 were performed prior to the study of Enterprise 3. Since Enterprise 3 had a substantial amount of secondary data available about the enterprise and its design processes, that study differed from the other two. Examples of the secondary data included brochures, newspaper articles, the enterprise's own newspaper, extensive website information and different manuals. Neither Enterprise 1 nor 2 had much secondary data. Secondary data from small enterprises is often rare or unavailable [67]. This secondary data from Enterprise 3 made it possible to get a good understanding of their design processes.

A visit was paid to Enterprise 3 with a two-and-a-half-hour semi-structured interview with the product development manager, a 15-minute informal meeting with the owner of the enterprise, and a short guided walk around the enterprise premises. The findings from the studies already conducted of Enterprises 1 and 2 made it possible to fine-tune questions and to focus more upon the most relevant and interesting areas in small enterprises' design processes. All findings were later compiled, analyzed and checked for accuracy with the enterprises.

The data about the design processes in the different enterprises were later mapped in sequence on an abstract level and approaches to the use of resources were identified.

5 FINDINGS

5.1 The design processes in Enterprise 1

The development of new products is generally rare in Enterprise 1. Approximately one new product or improved product is developed and launched each year. Still, the enterprise has many good ideas suitable for new products, but the ideas are usually not explored, mainly due to lack of resources. The

enterprise has a history of abandoning design processes because of lack of resources and/or lack of customers to buy the product in the end. Occasionally the enterprise does develop and design new products when their main customer explicitly asks for a specific new or improved product.
The design processes are mainly done by one or two persons within the enterprise. Sometimes a mechanical engineering design consultant is involved for detail design. The design processes are executed in a cyclical, nonlinear way with prototyping, by trial and error, with regular feedback from the customer and others inside or outside the enterprise's trusted informal network. The design process is a learning process by the ones designing the new product, with the problem and solution space explored concurrently. The process is informal and dynamic and flexible to cope with other operational tasks that need to be handled on a daily basis. The mix of design and operational work requires that the ones responsible for the design processes sometimes work on operational tasks and design tasks concurrently. When operational tasks take their full attention, the designers use the time spent on operational tasks for the incubation of ideas, so they gain new ideas and a fresh eye for the design problem when they resume working on the design process. The design processes are executed without a formal planning and documentation procedure and no deep analysis of the design problem is done before starting to find solutions. The enterprise once did try to plan a design process in a formal and structured way, but this approach did not work because of the flexibility needed in the turbulent internal and external environment of the enterprise. Many unforeseen, urgent problems happened, in manufacturing or in the customer use of the products, that quickly spoiled the plan for the design process. Feedback from customers and other trusted people inside or outside the enterprises is used to evaluate the process and keep it on track. During the design processes there is continual creativity on how to use existing scarce resources, such as lack of knowledge, personnel, time, and finance, more efficiently.
It is not common but lead-user inventions as described by von Hippel [68] do exist. The customers and users modify the enterprise's products on their own, and the enterprise sometimes adopts these inventions to make product improvements. No totally new products have been created from lead-user inventions. A lot of effort is put into reusing existing solutions in new products to save development efforts.

5.2 The design processes in Enterprise 2

Enterprise 2 develops new products and new versions of current products and executes several different design processes concurrently. The enterprise only starts to develop a new product if there is a current customer that requests it. Particular customers also often finance the development of new products directly. Enterprise 2 develops both their main software product and related customer-specific software products. There is an abundance of good ideas for new products in the enterprise and a form of portfolio management is practiced. The main idea with this form of portfolio management is not to spread risk among different projects, as is stated to be central in portfolio management literature [69], but to search for synergy effects between design processes and tasks to save resources and to package customer-specific projects with solutions reusable in other design processes. The novelty value of the new products is relatively low, which means that the development work and the final characteristics of the new products can be accurately determined in advance. Low novelty is a characteristic of design problems in software design because the constraints of language and systems make the problems more structured and less ill-defined [70]. This low novelty is the main enabler for this kind of portfolio management and means that larger design processes can be formally planned. Smaller design processes are not planned in a formal way.
Most other aspects of the design are informal in the enterprises. During the design processes an intense communication is held with the customers and users to get feedback on the processes; frequently, customers themselves are deeply involved in the design processes and do design work for free for the enterprise. Those involved in the design processes have additional responsibilities to handle daily. The external and internal environments are turbulent, with many unforeseen things happening on a daily basis, such as user or technical problems with the current products. This mix of design work and operational work means people sometimes do operational tasks and design tasks concurrently. Time spent on operational tasks allows for the incubation of new ideas for the design problem when they resume the design process. Creativity is used in determining how to use existing scarce resources more efficiently. The enterprise also intertwines their design processes with their other operational processes, to gain synergy effects on the usage of resources. An example of this is when sales,

collection of requirements, marketing, support and feedback on design processes usually are done during contact with customers and users.

5.3 The design processes in Enterprise 3

Enterprise 3 has a strong tradition of design and innovation and several design processes are executed concurrently. There is an abundance of promising ideas for new products. The design processes are executed by two to three persons who also have other responsibilities in the enterprise and must do other operational tasks. Therefore, those responsible for the design work sometimes work on operational and design tasks concurrently. As with Enterprises 1 and 2, time spent on operational tasks is used for the incubation of new ideas for the design problem. Both the internal and external environments are turbulent with many unforeseen occurrences, such as customer problems with the enterprise's products. The enterprise conducts an intense interaction and communication with its customers and users during the design processes and has many lead-users who design new products or modifications of the enterprise's products that they give away for free to the enterprise. Sometimes lead-user inventions become new products. Promising ideas for new products are often tested through some design and development work. The enterprise finds it hard to evaluate ideas for new products without testing them through some design and development work. The design processes are informal, flexible and unstructured and done in a cyclical, experimental way by trial and error, exploring the problem and solution spaces concurrently. The design processes are executed without a formal planning and documentation procedure and no deep analysis of the design problem is done before starting to find solutions. During the design processes that are executed concurrently the different ideas are compared; the most promising ones survive and become new products in the end. Those ideas that become new products solve problems that current customers have. The design processes are open for feedback from customers, users and others inside the enterprise or in the enterprise's external network. Enterprise 3 actively invites feedback on their design processes to be sure that they are on the right track with the ideas and new products. Efforts are made to reuse existing solutions in the new products' design. There is a continual creativity on how to use existing scarce resources, such as knowledge, personnel, and time, more efficiently in the design processes. The enterprise intertwines their design processes with their operational processes to gain synergy effects on the usage of resources. An example of this is when sales, collection of requirements, marketing, support and feedback on design processes usually are done during contact with customers and users.

6 ANALYSIS AND DISCUSSION

The three enterprises have similarities in their design processes but also interesting differences. All enterprises had an abundance of promising good ideas for new products but also scarce supplies of knowledge, personnel, time and capital. The enterprises had approaches for managing their scarcity of resources in their design processes. These approaches can be divided into approaches for using existing scarce resources more efficiently and approaches that increased the resources. Table 2 and 3 shows those approaches that deal with resource scarcity. A dot in the table means that the approach is used in the particular enterprise.

Table 2. Approaches to increase resources in the design processes

Approaches to increase resources	Enterprise 1	Enterprise 2	Enterprise 3
Targeting current customer(s) that need or demand the potential new product from the very beginning of the design process	●	●	●
Intense interaction, communication and feedback from the targeted customer(s)	●	●	●
Intense interaction, communication and feedback from potential users		●	●
Interaction, communication and feedback from others in the enterprise's network	●		●
Customers doing design work for the enterprise for free		●	
Adopting lead-user inventions	●		●

Table 3. Approaches to use existing resources more efficiently in the design processes

Approaches to use existing resources more efficiently	**Enterprise 1**	**Enterprise 2**	**Enterprise 3**
Informal and flexible design processes	●	●	●
Formally planned design processes		●	
Concurrent work on both operational and design tasks	●	●	●
Time doing operational tasks used for incubation of ideas and solutions in the design processes	●	●	●
Synergy effects (intertwinement) between operational processes and design processes to use the same resources		●	●
Synergy effects (intertwinement) between different design processes to use the same resources		●	
Reusing existing solutions in the design processes	●	●	●
Continual creativity on how to use existing scarce resources most efficiently	●	●	●

Some of these approaches are connected to each other or a consequence of each other, as is discussed below.

6.1 Approaches to increase resources in the design processes

The closeness the studied enterprises have with their customers and users results in a network of trusted external contacts with which communication is easy, which is common for small enterprises [6, 9, 10, 31]. This closeness with trusted actors gives the enterprises accurate market information [33]. Furthermore, networking and communication with customers is cheap, has low risks, allows direct contact with the targeted market, and is highly flexible [17], which suits small enterprises well that are accustomed to being flexible [5, 18, 19] because of their turbulent environment [12, 24]. This informal communication matches the informality of their innovation and design processes [38, 55, 56, 57]. But networking and closeness and communication with customers and users are not only about gaining valuable knowledge needed in the design processes but also increasing resources. The studied enterprises did not start an innovation process unless a clearly defined current customer needed or demanded the products, an approach suggested by Ledwith and O'Dwyer [47]. This approach has several resource-increasing benefits. In Enterprises 2 and 3 not only the customer, but also users, are interested in and want the product to be developed. This, together with the friendly and close contact and communication, means that these customers and users are available through the whole design process to ask for advice, ideas and feedback but also to validate that the design process proceeds in the right direction. Thus, more formal marketing research is not necessary, which saves resources in the form of time, capital and knowledge about formal marketing research, because the enterprise gets qualitative marketing knowledge directly from the targeted customer. The customers are deeply involved in the design processes, which for Enterprises 2 and 3 means customers did design work for free for the enterprises. In Enterprise 2 the customer did design work for free in the design processes and in Enterprise 3 the customers created lead-user inventions that they gave away for free, saving on design work for the enterprise if they adopted the invention as one of their own products. Enterprise 1 also had lead-users but not as frequently as Enterprise 3, and the adoption of the inventions was more limited.

To work closely with targeted current customers and users also has benefits in the later part of the innovation process, when diffusion to the market takes place. Because the targeted customers are already present and were involved in the design process, co-developed the product, and have a feel for and need for the product, diffusion and adoption become fast and easy. As stated by Mazzarol and Reboud [27], resources are needed not only in the development of the product but also in the diffusion and adoption of the new product on the market. The approaches used by the enterprises in this study decrease resources needed for diffusion and adoption of the new products, which matches the findings by Mazzarol and Reboud [54]. The speed of product adoption is important [27], mainly due to the small enterprise's sensitivity to disturbance in the cash flow [12, 27, 28]. Small enterprises often use

overdraft when designing new products and this affect the cash flow negatively [53], which in turn makes fast returns on investment crucial.
Enterprises 1 and 3 networked with people other than their customers and users to gain additional feedback, knowledge and ideas. This kind of networking, typically present in small enterprises' innovation processes [5, 9, 30], was not practiced in Enterprise 2, which only communicated with customers and users during their design processes. Freel [32] states that vertical networking is the most important kind of networking in innovation in small enterprises, which indirectly means that networking with people other than customers and users can be of minor importance. This latter point is supported by the findings in Enterprise 2.

6.1 Approaches to use existing resources more efficiently

The approaches to use existing resources more efficiently relate to how the enterprises work in their design and operational processes. More efficient processes also save resources in the form of available time and needed personnel. The studied enterprises had informal and flexible design processes in practice. Aranda [44] and Handjimanolis [9] state that informality is a strength in small enterprises' innovation processes and that this would be valid for the design process as well. Bolinao [45] and Mosey et al. [46] further state that small enterprises seldom have a formal and strategic procedure for developing new products. Enterprise 2 distinguished itself by their formal planning of larger design processes, yet the processes were executed in a flexible and informal way. This planning was facilitated by the fact that the enterprise creates software, which has low-novelty design problems [70]. This low novelty means that the final product can be determined with great certainty in advance. Because most characteristics and properties were known in advance, the process to design the product was easier to foresee and plan. Still, the design process in Enterprise 2 was flexible and informal. High flexibility was needed because the studied small enterprises work in a turbulent external environment, which is common for small enterprises [12, 24]. Flexibility is needed because small enterprises have little control over this turbulent environment [25] and must cope with it with the natural flexibility that small organizations have [5, 18, 19]. The turbulence was caused by the many urgent things that arose that must be dealt with on a daily basis, such as trouble in manufacturing or a customer's or user's problems with the enterprise's current products. Unsolved manufacturing problems would quickly affect the cash flow negatively, an undesirable risk because small enterprises are very sensitive to disturbance and dips in the cash flow [12, 27, 28]. The customers' and users' problems with current products must also be solved quickly, because good relations with current customers secure the cash flow. From the above discussion we can conclude that flexibility is not only beneficial to the design process but naturally results from a turbulent environment and cash-flow issues.
The informality in the design processes was striking. The natural setting for design in small enterprises is a small organization. Decisions are taken quickly and communication is easy and efficient [5, 18, 19]. Formality, written rules and documentation are less necessary, because most important things in the design processes are easily shared and understood in a small organization. Formal approaches seem not to yield any advantages, but only create unnecessary work for small enterprises. Larger enterprises can benefit because of their lack of flexibility, internal communication problems and need to communicate decisions throughout the organization. As Bolinao [45] and Mosey et al. [46] state, the small enterprise infrastructure, without separate departments and many different decision makers, does not fit with formal approaches in innovation. We can conclude that lowering the degree of formality and using informal and flexible design processes saves resources in small enterprises' design processes.
Other approaches include ways of executing design processes that are connected to the operational processes, mainly due to the designers having other responsibilities in the enterprises connected to the daily operational work. Multifunctional roles by employees are common in small enterprises [20, 22] and design processes commonly interact with other processes in small enterprises [20, 22, 60], as was also the case in the studied enterprises. In all three enterprises employees sometimes concurrently worked on both design and operational tasks to use existing resources more efficiently. Time spent on urgent operational work was indirectly used to incubate ideas and solutions and to bring a fresh eye for the design problem and solution space to the design work. This also increased the efficiency of resource usage, because non-design time was indirectly used for the design processes.
Quite similar to concurrent work on both operational and design tasks is the approach of creating synergy effects through intertwinement between operational and design processes used by Enterprises

2 and 3. The difference is that here the resources were used for a different purpose, just as when sales, collection of requirements, marketing, support and feedback on design processes occurred during contact with customers and users.
Enterprise 2, which was accustomed to running several design processes concurrently, actively searched for synergy effects and intertwinement between these design processes so several design processes could use the same resources. Work done in one design process that also could be used in another saved resources in the form of personnel and time. This was done with the help of their form of portfolio management when the design processes were planned to get synergy effects. The main enabler for this approach was the low novelty of the enterprise's products. Reusing existing solutions was an approach practiced by all three studied small enterprises, because it also saved resources in the form of knowledge, personnel and time. In general there was a continual creativity on how to use existing scarce resources in the most efficient way in the examined enterprises' design processes, a finding that matches Larsson [55] and Guimarães et al. [56].

7 CONCLUSIONS

This study identifies several different approaches to how small enterprises manage resource scarcity in their design processes. Some of these approaches are interrelated or a consequence of each other. These approaches are used both for increasing resources and to use existing resources more efficiently. Small enterprises focus on current customers' needs and problems when starting innovation and design processes if they suffer from scarce resources. This focus saves resources and permits getting qualitative knowledge, marketing information, feedback and ideas from both customers and users during the whole design process. Executing the design processes in close interaction and communication with the targeted customers and users results in several benefits, as they do design work for free or create lead-user inventions that can be adopted by the small enterprise to implement in new or improved products. Customers and users also provide feedback on whether the design process is on the right track. Furthermore, co-development of new products with customers means that the customers care more about the product, enabling fast and easy diffusion and adoption of the new product at the end of the innovation process.
The study also shows that informal and flexible design processes are resource efficient in small enterprises. Formal design processes are seen to be inefficient because the need for and value of formality is low in a small enterprise. It is possible to plan design processes in a formal way for low-novelty products, but the execution of these design processes still requires flexibility and informality to cope with the turbulent environment common in small enterprises.
Small enterprises are creative about how to use existing scarce resources in the most efficient way, and they try to reuse existing solutions in new products to save resources. These enterprises also intertwine design processes with each other and with operational processes, to get synergy effects of the usage of resources. Employees in small enterprises sometimes work concurrently on design and operational tasks to use existing resources more efficiently. The study also shows that time doing operational work in a small enterprise is used indirectly for incubation of ideas and solutions in design processes.
In conclusion, this study shows that innovation and design are not a problem in small enterprises; resource scarcity can be handled; and small enterprises' specific characteristics facilitate innovation and design if these characteristics, such as flexibility, informality, rapid communication, rapid decision making, and closeness to customers and users are recognized and used as strengths.

8 LIMITATIONS AND FURTHER RESEARCH

Broader generalizations of the findings of this study are difficult due to the limited number of cases studied. Testing the findings in a quantitative way would allow for generalization and increase the validity.

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