In Search of Innovation

Grasping the Concept of Needs

Åsa Ericson, Luleå University of Technology, Sweden
Anna Ståhlbröst, Luleå University of Technology, Sweden

Abstract: The starting position for this paper is experiences in identifying needs. The paper discusses the concept of needs and seeks to explore whether needs, as a concept, can be identified and understood in the relevant literature. The discussion is inspired by both an engineering design perspective and an interaction design perspective of needs. The discussion highlights a duality of needs, needs are partly easy to express and partly difficult, even impossible, to express. Thus, to grasp the concept as a whole, it is necessary to adapt different approaches. Needs that are difficult to express are situated in the user's context and are experienced by the user as a perceived lack of satisfying solutions. The solution is not understood or known by the user. Therefore, needs cannot be easily expressed by the user; such needs have to be found. An interpretive approach adapted by the design team and/or the needfinder to understand the user's situation and to identify such needs is suggested.

Keywords: Needs, Needfinding, Interaction Design, Engineering Design, Functional Product Development

Introduction

NEEDS + SOLUTIONS = Innovation, "…*a simple equation that leads to new thinking and novel products. But it's a formula that too few companies have grasped*" (Patnaik, 2005). The difference between needs and solutions can be considered as a basic fundamental concept in innovation, and this basic concept is simple enough (Patnaik, 2005). Simple enough, we agree; but, is it easy to grasp?

Based on experiences in research and product development projects as well as in teaching and coaching students in university courses and in research projects we have noticed that besides being confused with related concepts, e.g., problems and requirements, the concepts of needs and solutions are mixed up and confused with each other. The recognition of a need is confused with a particular solution conveying requirements and constraints for what the problem is about. To take an over-explicit example: the customer says; 'I *need* a vehicle with four wheels and some sort of steering equipment'. Taking this 'voice of the customer' (Clausing, 1994) unanalysed into the product design might give a solution that might not meet customer's needs. What, in effect, is the need? Is it a vehicle, or is it four wheels? Is it a car? The voice can be interpreted as the need to transfer something or someone from one place to another; but, depending on the context, the need may be related to some other human activity, for example, cutting the lawn. Accordingly, the design space changes and so do the solutions to meet the need.

The motivation for a focus on needs is because needs last longer than any specific solution (Patnaik and Becker, 1999). Patnaik and Becker (1999) write that the underlying needs to store computer data endure longer than the solutions of the products, e.g., punch cards, magnetic tape and 5¼" floppy disks. The need to store computer data persists, is met by new solutions and will probably outlive these solutions. If a company sees itself as a provider of a specific solution the company continues to improve that solution, but it rules out entirely new products and offerings that satisfy the need in different ways (Patnaik and Becker, 1999).

In the design of new mobile services a user-involvement strategy framed a project that was realized by a multidisciplinary design team. A needfinding process (Patnaik and Becker, 1999) initialized the project and efforts were made to translate the user needs into the product development process. Difficulties in identifying and communicating needs within the multidisciplinary team and hence difficulties in understanding needs were experienced by the team members (Stenbacka Nordström and Ericson, 2004). Consequently, some vital needs were not met in the final products.

Within the engineering design perspective, functional product development is recognized as adding value by customization, i.e., translation of customers' needs into the design of physical goods (Ericson, 2006). Needfinding has been recognized as practical in functional product development (Ericson and Larsson, 2005). In a business-to-business situation, functional products or total care products are understood as creating a new business scenario within the

Swedish manufacturing industry, insisting on close collaboration between companies in the design process of physical goods (Alonso-Rasgado, Thompson and Elfström, 2004). In the interaction between collaborating companies it is therefore necessary to separate the companies' needs and the customers' needs from each other and hence distinguish needs from related concepts.

In general, needs are important for the design of innovative products (von Hippel, 2001; Preece, Rogers and Sharp, 2002). Design and development of innovative Information and Communication Technology (ICT) products with a focus on user involvement are placed within the interaction design perspective; thus, understanding of user needs is inherent in the approach. The difficulty of grasping needs is apparent during the process of translating needs into requirements for innovative ICT products. This situation has occurred in the evaluation of mobile services in their natural environment and with real users in the context of a testbed (Ståhlbröst, 2004). Understanding of the user needs is considered to be of central concern during the whole ICT product development process, from the initiation of the project to the user evaluation of the final product (Holst and Stålhbröst, 2005). Understanding of needs is important in the design of the evaluation approach as such (Ståhlbröst, Mirijamdotter and Bergvall-Kåreborn, 2005), as well as in identifying opportunities for design of a virtual knowledge community (Holst and Ståhlbröst, 2005). These design and evaluation projects are performed in close collaboration with users, and the human activities, i.e., the users' interaction with the product to achieve a goal, are of particular interest.

Archetypically, the System Development Life Cycle (Gupta, 2000) constitutes a base for information systems design methods. This is found suitable for structured situations, but faces difficulties when it comes to handling human activity systems (Kendall and Kendeall, 2002). One significant limitation is that the method ignores the identification of needs, since it assumes that users can specify product requirements with reasonable completeness before the design begins (Vidgen, Avison, Wood, Wood-Harper, 2004; Holst and Ståhlbröst, 2005).

At first glance, the areas of functional product development and design of ICT innovations seem diverse. However, the focus on design and development of products (no matter if they are tangible, intangible or a mixture thereof) is mutual within the two stances, as is the emphasis on the concept of needs. Even though engineering design and interaction design are applied in different contexts and put forward diverse methods and theories, both perspectives grapple with needs. Positioning needs as vital implies that needs must be distinguished from related concepts, e.g., problems, solutions and requirements.

Thus, the purpose of the literature review presented in this paper is, based on the relevant literature within engineering design and interaction design, explore if the concept of needs can be identified and understood.

The disposition of this paper is as follows. Firstly, a brief presentation of our methodology will be given. In this section we will clarify the terms *customers* and *users*, which we consider essential to an understanding of the concept of needs. After this, we outline why needs should be in focus. This is followed by a presentation of a thoughtful design stance and a presentation of the interaction design approach to needs as well as the engineering design approach. In the next section we discuss the concept of needs based on the findings in the literature. Finally, conclusions and suggestions for further research are presented.

Methodology

The idea for this literature review of the concept of needs has emerged from the experience that needs are confused with related concepts. The choice of relevant literature for this study emerged from previous studies emphasising needs as a vital concept in the evaluation of innovations and functional product development. The relevant literature is also used in teaching in the areas of interest. The data found in relevant literature serves as a basis for our discussions.

The terms customer and user are used interchangeably in the literature; hence, they are also used interchangeably in this paper. However, customers can be seen as those who pay for the product and users can be considered those who actually use the product, i.e., end-users (Magnusson, 2003). The terms are equally important in the development of a product that strives to meet needs of some kind, but on different levels and depending on the product in focus. The terms customer and user are labels for different human activities; thus, there are people involved. So, when you read user and/or customer in this text, think people. Furthermore, the term product is used in a wide sense, i.e., the result of a process, service, software, hardware, processed material or a combination thereof.

Why Bother About Needs?

Maslow uses the word need to represent a whole spectrum of circumstances in the Needs Hierarchy. The scale starts with basic needs, e.g., air, water, food, shelter, followed by defence needs, e.g., safety, security. The next level is social needs, e.g., love, belongingness, and esteem needs, e.g., recognition, respect. And finally, self actualisation needs, e.g.,

beauty, goodness (Faste, 1987). Carried to the extreme, needs can be categorised as belonging to some of these levels, but before categorisation the needs have to be identified. To guide product development the needs seem to be on another abstraction level, yet developers have to identify them in the voice of the customer and translate them into the language of design.

The identification of customer needs in product development is important to create high-quality information channels between customers and developers of the product (Ulrich and Eppinger, 2000). Interaction with customers and experience of the use environment of the product are necessary activities for the members in the design team. This direct interaction with customers ensures that technical tradeoffs can be made correctly, innovative solutions to customer needs can be discovered and the development team may develop a deep commitment to meeting customer needs (Ulrich and Eppinger, 2000).

Focus on customer needs includes ambiguity and contradiction, for example, purchasers and users have different needs (Clausing, 1994). In a business scenario focusing on customer needs, customers are actors in the situation and they, as well as each member of the development team, have different views of the situation. All needs related to the situation do not have the same importance and different actors have different views as to which needs are important. Nevertheless, in designing something, be it a physical artefact, information system or service, the designers' perception of what to design will affect the design as such and ultimately also the success of that product.

Despite an interest and focus on customer needs, Hyysalo (2003) concludes that "*...user investigations may not guide product development, but rather tend to inform it in minor ways...*" (p. 135). In 1987 Faste writes about failures of manufacturing companies in Silicon Valley and concludes that *"The engineers involved assumed that because they personally would like to own and use such state of the art devices, everyone would. They were wrong"* (p. 422). Designers have a tendency to design what they are already familiar with, or the product they want to use themselves, often leading to a product that is too complex (Insensee, Kalinoski and Vochatzer, 2000, in Preece et al. 2002). Focus on customer needs makes the designers understand that they are designing and developing products for someone other than themselves.

Users are often not aware of, or cannot articulate, their requirements until a solution is in use (Vidgen, Avision, Wood and Wood-Harper, 2004). An example of this is given in Preece et al. (2002). Before microwave ovens were invented it was not possible to consult users about requirements. Another example is the mobile phone; users could not express requirements for how to design it before it was introduced. However, the needs, i.e., heating food and contacting people despite their mobility, could have been identified.

Needfinding is an approach to studying people to identify unmet needs and focuses on people's needs that are difficult to articulate (Patnaik and Becker, 1999). People cannot always state precisely what their needs are; they might just be able to say that they feel that something is missing. Needfinding is described as a paradoxical activity, since what is sought for is a circumstance where something is missing (Faste, 1987). Need is in itself a perceived lack of something and to be able to find and articulate what is missing the situation must be seen and recognised by someone (Faste, 1987). The needer is the person who is experiencing the need and the needfinder is the person who is observing another person's or group's needs (Faste, 1987). The needer does not know what is missing and thus it is impossible to ask the person what he or she wants. Consequently, asking people what they need is insufficient for identifying these needs (Hyysalo, 2003; Salovaara, 2004).When people become used to their problematic situation they often develop workarounds to circumvent a need (Patnaik and Becker, 1999). Doing so makes them blind to the existence of that need. When it comes to the expression of needs, one dilemma for users is that the needs are obvious after they are found, not before (Faste, 1987).

A Thoughtful Design Stance

The term design is widely used in many contexts. For our purposes we will treat design as practical and creative activities where the ultimate intent is to develop a product that supports its users to achieve their goals (Preece et al., 2002). Hence, users have to be involved in, or user needs have to be transferred into, the design process. In design literature, some have attempted to capture the whole design process in a complete model or methodology; but the design process is too complex and diverse to be fully described in a universal way (Löwgren and Stolterman, 2004). A designer who tries to use or follow design theories and models must understand their inherent limitations. A thoughtful design stance is advocated by Löwgren and Stolterman (2004), who propose that design should be seen as a conversation with a situation, i.e., a problematic situation, where the designers have to be good listeners and readers of that situation. The thoughtful design stance means that the designer relies on a reflective and critical mind, based on a thoughtful understanding of how design can serve a purpose.

The design process begins earlier than what is realised. It begins the moment a designer is assigned to a particular design task and starts to think about the environment in which he or she is supposed to act. Already in this phase, problems and solutions are created in parallel in a coevolving process (Löwgren and Stolterman, 2004). The understanding of problems and solutions as distinct concepts seems necessary in early phases of the design process.

The design process is characterised by dilemmas (Löwgren and Stolterman, 2004). A dilemma has not one given solution, since it is not a problem in a logical sense. Something is a dilemma when the actors realise that all choices lead to unsatisfactory solutions (Löwgren and Stolterman, 2004). The relation between dilemmas and needs that are difficult to express because they are perceived as a lack of something (Faste, 1987) can be recognised here.

An Interaction Approach to Needs

Interaction design is explained as the design of interactive products to support people in their everyday and working life (Preece et al., 2002). Interaction design advocates a user-centered approach to development, meaning that users' concerns direct the development rather than technical concerns (Preece et al., 2002). Nevertheless, it is understood that design is about trade-offs and balancing conflicting requirements. There is a key concern about use and usability in designing interactive products; you have to know *who* is going to use them, *where* they are going to be used and *what* kind of activities people are doing when interacting with them (Preece et al., 2002; Fitzgerald, Russo and Stolterman 2002). To assure that the product will support people's activities, 'tried and tested' techniques, i.e., evaluation, are important during the design process (Preece et al., 2002; Newman and Lamming 1995).

The interaction design process involves four basic activities, (1) identifying needs and establishing requirements, (2) developing alternative designs that meet those requirements, (3) building interactive versions of the designs so that they can be communicated and assessed, and (4) evaluating what is being built throughout the process (Preece et al., 2002). The activities inform one another and are repeated. The evaluation phase provides feedback of what changes must be made or that certain requirements have not yet been met. Thus, the identification of user need and the establishment of requirements are utterly important to be able to estimate the success of the product. The terms describing the first phase – identifying needs *and* establishing requirements – indicate a twofold approach and thereby a distinction between needs and requirements. First, the design team must *identify* needs, and then *establish* requirements.

However, Preece et. al. (2002) explain user needs as *"…the range of possible requirements, including user wants and experiences"* (2002, p.35). Firstly, needs are not defined as a separate concept. Instead, needs are mixed with wants and experiences; thus, needs cannot be distinctly identified. Since needs and requirements are used as an intertwined concept, the identification of needs and the establishment of requirements seem difficult to perform. According to Benyon, Turner and Turner (2005), it is essential to develop an understanding of the user's problem situation to be able to generate requirements.

Preece et al. (2002) conclude that it is not as straightforward as it sounds to identify user needs. Identifying user needs is described by the aim of understanding *"…as much as possible about the users, their work and the context of that work, so that the system under development can support them in achieving their goals"* (Preece et al., 2002, p.202). The understanding is achieved by gathering data, interpreting or analysing the data and capturing findings that can be expressed as requirements.

Requirements are explained as *"…a statement about an intended product that specifies what it should do or how it should perform"* (Preece et al., 2002, p. 204). Thus, to express requirements an intended product has to be known to the actors. Furthermore, the focus on an intended product delimits the design space early on in the design process, hampering the design team from being open-minded for new innovative products. The requirements should be established from a sound understanding of the user needs. However, Preece et al. (2002) do not give an example of how to achieve a sound understanding. They conclude that there are several dimensions along which the user needs may vary and suggest that a good indicator of future behaviour is to look at current or past behaviour.

We have found that the interaction design approach mixes needs with requirements, wants and experiences. The approach has been criticized for largely focusing on requirements instead of needs (Holst and Ståhlbröst 2005; Vidgen, Avison, Wood, Wood-Harper 2004).

An Engineering Approach to Needs

Investigation of the user needs is indicated as the first step in a product development process (Ulrich and Eppinger, 2000), and can therefore be seen as focusing on needs. The product development process can be triggered by, for example, the development of a new technology and the final product depends on what is technically and economically feasible, on what your competitors offer, as well as on customers needs.

In Ulrich and Eppinger (2000) the word need is used to *"...label any attribute of a potential product that is desired by the customer; we do not distinguish here between a want and a need. Other terms used in industrial practice to refer to customer needs include customer attributes and customer requirements"* (p. 61). Hence, needs are not considered as a distinct concept; needs are mixed with wants, attributes and requirements. The use of needs to label attributes of potential products indicates that needs are related to a specific product in early design phases. However, Ulrich and Eppinger (2000) argue that needs are independent of the product to be developed and that specifications depend on the selected concept. A specification consists of a metric and a value and is established by the design team. Product specifications do not guide the team in how to address needs; they convey the precise description of what the product has to do.

Identifying customer needs is in itself a process and a five-step methodology is suggested, which in turn is suggested to be seen as a starting point for continuous improvement and refinement (Ulrich and Eppinger, 2000). The five steps are; (1) gather raw data from customers, (2) interpret the raw data in terms of customer needs, (3) organise the needs into a hierarchy of needs, (4) establish the relative importance of the needs and (5) reflect on the results and the process.

Step 2, the interpretation into customer needs includes a set of guidelines, for example, *"Express the need in terms of what the product has to do, not in terms of how it might do it", "Express the need as specifically as the raw data"* (Ulrich and Eppinger, 2000, p. 69). The activity in step 2 is to interpret the raw data into needs and, as presented earlier, the product specifications convey the precise description of *what the product has* to do; however, in the excerpt above, needs are suggested to be *expressed in terms of what the product has to do*. Thus, needs are translated into product specifications in step 2. Based on this interpretation, steps 3 and 4 manage product specifications, not needs. Hence, needs are not distinctly addressed in the methodology.

Gathering raw data from customers involves contact with customers and meetings with the customers in their environment. The interaction with customers helps the development team to gain an understanding of the customer's environment and point of view. This can be interpreted as needs emerge in the context; accordingly, they are contextually situated. Practical advice is 'to go with the flow', to let the customer provide interesting information and not to worry about the interview guide. The goal is to gather interesting and important data on customer needs.

In Clausing (1994) it is suggested that needs are obtained in qualitative interviews and the interviews develop and identify the needs. Furthermore, the importance of staying close to customer's own language is emphasised. The voice of the customer includes the customer's needs, requirements, desires and attributes and "*typically, each need is a short phrase*" (Clausing, 1994, p. 111). Thus, needs are mixed with related concepts and the customer must be able to express needs.

A seven-step approach to bring the voice of the customer into product development is suggested by Clausing (1994), and even though the steps are presented sequentially, there are iteration loops. The steps are as follws. (1) Plan – involves decisions about market segment and type of user. (2) Interact with customers – involves interviews and contextual inquiry. Suggested questions focus on customers' use of the product and an advice is to *"keep probing for latent needs. "If you had feature X, how would you benefit?"* (Clausing, 1994, p. 115). In the contextual inquiry, observations are made about how an existing product or a competitor's product is used in the customer's normal context and data for how to support, extend and transform the customers' activities are sought. (3) Develop an image of the customer – involves organisation of the phrases that express the customer's images in relation to the use of the product. The product development team prioritises the images by some form of voting (an example of an image is *"driving the car through a blizzard to get a mother in labor to the hospital"* p. 118). (4) Scrub the data to achieve clarity – involves clarifying of ambiguities, separation of composite thoughts and bringing all statements to the same level of abstraction when appropriate. (5) Select significant voices – needs are prioritised and grouped to keep the number of needs down. (6) Structure the needs – the objective is to further refine the statement of needs. Finally, (7) Characterise customer needs – this phase helps to concentrate the development team's effort in areas that will make the company's product competitive.

The questions asked in the contextual inquiry indicate that the customers have to understand and express their needs in relation to an existing product. It seems like possible solutions already exist; hence, limitations to new products can also exist.

Braham (1996) emphasises that in discerning the customer's voice the developers have to distinguish between customer requirements, i.e., their situation and needs, and product features, i.e., the elements of a product or what a product does to address needs. The idea that needs and product features should be treated as separate is obvious here, but needs and requirements are intertwined. However, the interaction between needs and the customer's situation are

emphasised. This can be interpreted as needs being situated in the customer's context, and requirements evolve in the interplay between needs and context.

We have found that the engineering design approach mixes needs with wants, requirements and so on. The approach has received some critique for treating needs as something already existing and waiting to be collected (Hyysalo, 2003).

Discussion

In Table 1, the views on needs, requirements and focus in user context as interpreted in the relevant literature are presented as well as other concepts which are related to the concept of needs. The findings presented in Table 1 serve as a basis of our discussion henceforth.

From our standpoint we agree with the suggested methods within both perspectives, since both focus on needs as useful, but the possibility of success seems to be at risk owing to the use of intertwined concepts of needs. What happens when the design is guided by wants and desires? The identification of needs and addressing them in early design phases are vital to the development of new and innovative products.

Tab 1: Needs, Requirements and Focus in User Context

Focus	Needs	Requirements	User context	Other concepts
Preece et al. (2002). Use and usability, users' concerns direct development	Range of possible requirements including wants, experiences	Statements about an intended product specifying what it should do or how it should perform	What kind of activities to support, who is using the product, where it is going to be used?	
Löwgren and Stolterman (2004) Designer and interaction design				Dilemmas: All choices in a problematic situation lead to unsatisfactory solutions
Patnaik and Becker (1999) Needfinding	Difficult to articulate		How people have developed work-arounds to circumvent a need	
Faste (1987) Needfinding	Something missing, obvious after they are found			Maslow Needs Hierarchy
Braham (1996)		Customers situation and needs		
Ulrich and Eppinger (2000) Design and development of physical artefacts	Label any attribute of a potential product a customer desires includes wants, requirements		The customer point of view	Product specifications: The precise description of what the product has to do. Depend on selected concept. Consist of a metric and a value.
Clausing (1994) Total Quality Development in engineering design	The Voice of the Customer expressed in a short phrase, includes requirements, desires, attributes	Included in the voice of the customer	Use of products. Search for data for how to support, extend and transform customers activities	Images: organise phrases in relation to the use of the product

In engineering design the focus is on designing physical artefacts. In the literature the product that should meet customer needs is apparent before needs are sought. To be able to express needs in terms of what the product has to do (Ulrich and Eppinger, 2000) and to ask questions about the customer's use of a product (Clausing, 1994) the starting point is to know the product. A similar situation occurs in the interactive approach, since needs are a range of possible requirements and requirements are statements about an intended product (Preece el al., 2002). Accordingly, these approaches to needs are useful for refinement of products, but have limited use for identifying needs related to new or innovative products. Needs are vital in both refinement and in innovative products. Does it matter if the data sought for and guiding the design team are needs, wants, desires, requirements or a mix thereof?

Wants and desires seem to be dependent on trends that may have changed by the time the product is launched. Marketing can be used to affect wants and desires. However, the product development company is in hands of choosy customers meeting short-term wants and desires. To be able to articulate wants and desires these have to be compared and judged in relation to the use of an existing product.

The needfinding approach emphasises needs that are difficult to articulate (Faste, 1987; Patnaik and Becker, 1999). Since needs are described with additional words, rather than merely *needs*, this indicates a distinction (taken to the extreme) of needs as either being easy to express or needs as being difficult to articulate. The words easy and difficult represent in this discussion how contextually dependent the needs are and hence the accessibility to them for user and design team respectively. Preece et al. (2002) highlighted that there are several dimensions in which needs can vary, and easy and difficult can be seen as the endpoints of a scale.

In Figure 1, the dotted line across needs represents the interface between needs which can be difficult to express, i.e., tacit needs, and needs which can be easy to express, i.e., explicit needs. Needs difficult to express are related to the search for something that is missing (Faste, 1987) and work-arounds to circumvent a need (Patnaik and Becker, 1999) can only be found in the user's context. This situation insists on an interpretive approach. It must be remembered that it is not possible to ask users what their needs are, because they cannot articulate them. Accordingly, the needfinder must gain understanding of the context, the users and what they are striving to achieve in their activities and interpret the problematic situation or the dilemma into need statements, yet not in relation to a particular solution. Need statements that are formulated in relation to a particular solution are transformed into requirements. This duality of needs is shown in Figure 1.

At the left in Figure 1, needs are situated in the user's context and their identification requires an interpretive approach. An interpretive approach is challenging, since the needfinder has to rely on a reflective and critical mind (Löwgren and Stolterman, 2004). The user's point of view has to be considered valid and worthy of respect, yet the design team is not governed in all respects by the user. Needs can also be easy to express and can thus be apparent in the design context, as indicated by the right side of Figure 1. On this side the focus for the needfinder and/or the design team is to translate need statements into requirements and possible solutions.

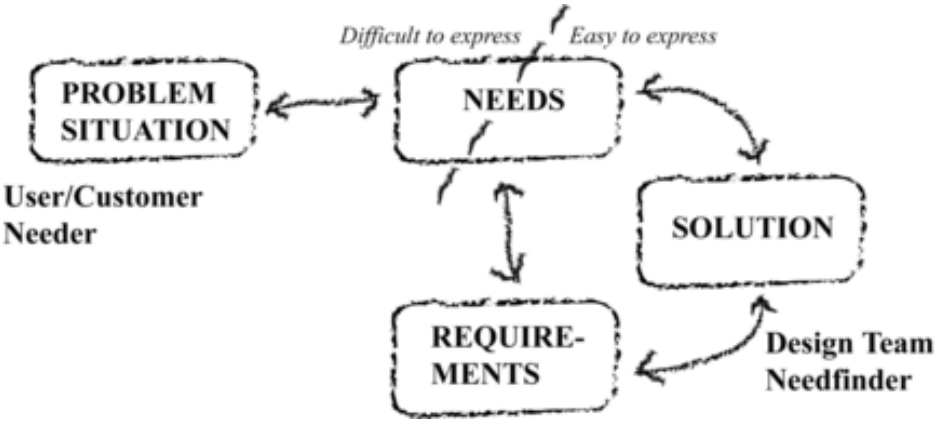

Fig. 1: The Duality of Needs

Conclusion

We have experienced difficulties in different ways in identifying needs to guide design activities. This experience has lead to this study, of which the purpose has been to explore if the concept of needs could be identified and understood in relevant literature. The identification of needs as utterly important is advocated in the literature. However, the concept of needs could not be clearly comprehended. A study of the concept of needs in the literature from the two design perspectives, engineering and interaction, shows that the needs are mixed up with or not distinguished from requirements, wants, desires or experiences. Thus, it can be concluded that needs are not treated as a distinct concept in the literature upon which this study is based.

One consequence of using the intertwined concept of needs is that the methods suggested in the literature seem to present limitations for the design and development of new innovative products. The search for needs related to a product in mind or mixing need with statements about an intended product delimits the design space in early phases.

Needs may vary along several dimensions; we have opened a window to a specific point of those dimensions. There are some things that we have not considered. In the literature, needs are also discussed as basic needs, latent needs and so forth. We have focused on needs as both easy and difficult to express. One suggestion for further work is to explore basic needs, latent needs, etc. In our discussion we have suggested that the design team and/or needfinder interprets a problematic situation or a dilemma into need statements. Further research, even though quite philosophical, might start with the question: are such needs invented?

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About the Authors

Åsa Ericson

Åsa Ericson is currently a Ph.D student at the Division of Computer Aided Design, Luleå University of Technology, Sweden. She finished a Master of Science in Informatics and Systems science at the university in June 2002. Her research interest is in the areas of Engineering Design with an emphasis on need-driven product development.

Anna Ståhlbröst

Anna Ståhlbröst is currently a PhD student in Social Informatics at the Division of Information Systems Sciences. Her research interests are methods for creating and evaluating innovative technology. She especially focuses on developing methods that identifies and takes user needs into consideration in different design situations. The research has a strong relation to a Living Lab organisation in which most of her studies occur.