

# NODE IN THE ECOSYSTEM OF EMERGING DISPOSITIONS

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## ABSTRACT

This paper criticizes the narrow conceptions of user need presented in design and innovation literature. It introduces five different approaches to understand user need – bodily needs, acquisition needs, grounded needs, elusive needs and supply needs – finds them divergent, but complementary and necessary for design. In addition, the paper presents a characterization of user need that leans on an ecological approach to design being open enough to accommodate the different interpretations. Accordingly, user need should be regarded as a Node in Ecosystems of Emerging Dispositions (NEED).

**Keywords:** User need, User centered design, Ecological approach

## I. INTRODUCTION

User need is one of the most central concepts in industrial design, marketing (Kotler 1988) and product development (Ulrich and Eppinger 2000) laying the foundations for design activities. In spite of its importance there are not universally accepted definitions of user need, but the meaning of user needs varies from case to case from psycho-biological concepts such as presented by Maslow (Maslow & Lowery 1998) via consumers' explicated opinions to specific safety standards the existence of which can be completely unknown to the users themselves. In some cases the needs are derived from anticipated macro level changes in society, while other design scholars emphasize the importance of raising needs from the situated use of real products.

The tradition of industrial design has since Sullivan, Dreyfuss and many others been build around designing to fulfill users' needs. Thus, the need has become an attractive target for criticism for those who wish to challenge the prevailing design tradition. For example, Hartmund Esslinger (2003) wanted form to follow emotions, Jonathan Cagan and Craig Vogel (2002) believe in form following fantasy, Eric von Hippel (2005) wants to replace user need driven design by lead users' innovations and Utterback and colleagues (2006) believe the design communities themselves to drive the development instead of users' needs. All these points are valid, but the criticism towards user needs based design in itself, I believe, is due to a narrow conception of how the need should be understood.

## 2. OBJECTIVES, CONSTRAINTS AND METHODS

The objective of this paper is to take a step towards better understanding the concept of user need as it appears in design. The step is taken by first discussing the versatility of different approaches from which designers adopt the models for user needs. Second, ecological approach to design is introduced as a potential framework for presenting a unifying characterization of user need. Third, a characterization of user need leaning on the principles of ecological approach is presented.

A couple of constraints are adopted to focus the discussion. First, the paper sticks to the kind of user needs that appear as relevant in industrial design. People have plenty of needs, which are already very well fulfilled by available products, and they have implicit needs, which cannot be addressed by designers as the technical means are still far beyond the horizon. Further, the needs in the focus of this paper are issues having a considerable or potentially considerable impact on design, i.e. they may drive the design of a product or parts of a product, and consequently become explicitly addresses in design. These kinds of user needs are

comparable to “design drivers” (Lindholm et al.2003) or “Critical constraints” (Lawson 1997). Third, the paper approaches needs through research and product development traditions and omits the discussion about designers applying themselves as sources of user needs and references for a prospective future users even though this is not exceptional in design practice (see e.g. Goel 1995, Kotro 2003). To a certain extent the approaches below can structure this kind of introspective user research as it will introduce suitable categories for designers’ questions such as: would I reach that far with my arm; would I buy a product of this color; would I use this for reading emails in a bus; or would I need this information in my creative work? Fourth, the paper does not discuss need from psychological point of view, but only focuses on how the concept appears in design practice.

The research approach is based on overviews to ergonomics, usability, consumer decision-making, user research, innovation and product development literature and it consolidates the findings applying the principles of ecological approach to design.

### 3. VERSATILITY OF NEEDS

As the different types of user needs discussed below do not have established names they are referred to as Bodily needs, Acquisition needs, Elusive needs, Grounded needs and Supply needs.

#### 3.1 BODILY NEEDS

Industrial design is strongly rooted in ergonomics. For instance, one of the most outstanding fore runners of modern industrial design, Henry Dreyfuss (2003), became famous for anthropometrics based design and his Joe and Josephine figures are familiar to all design students. The ergonomics based design tradition has continued since but the attention has increasingly shifted towards cognitive ergonomics and usability.

Even though much of ergonomics research is case based and focused on specific contexts and tasks (and comes close to what is discussed under “grounded needs” below), there is a strong tradition separating basic research on human capabilities from applying the knowledge in design. Anthropometric data and principles of human cognition, for instance, provide designers generalized information applicable to several different design tasks. In design this data should be applied to enhance the match between humans and environment for more productive and satisfying activities.

Ergonomics and usability have been recognized as so strong approaches to model human-machine relationships that much of ergonomics information has been given regulatory status. There are for example numerous ergonomic ISO standards for very specific purposes such as industrial laundry machines (ISO 10472-1), operator controls for earth moving machinery (ISO 10968), for lifting and carrying (ISO 11228-1), for pushing and pulling (ISO 11228-2), for visual danger signals (ISO 11428), etc. European Union has also covering directives for the design of occupational environment for safety (see <http://osha.europa.eu/legislation/directives/>).

Ergonomic standards and directives explicating user needs can be criticized, because the information is not related to any specific situation and thus its impact on motivating any specific human action may remain obscure (e.g. Miettinen and Hasu 2002). However, a design assignment typically suggests certain activities a prospective future user is assumed to complete with the future product, though all the future activities cannot be anticipated and some of the assumptions may be wrong. Designing a layout for a book is a design task, where reading can be assumed to be one of the core user behaviors – though there may be others – and ergonomic facts about visual perception turn into bodily needs. Designing a new type of toy makes the design team to consider playing and learning activities and the knowledge about developmental psychology turns into user needs. Because the ergonomic knowledge about human capabilities is based on a solid body of research and as it can be supplemented with focused measurements with validated methods, the needs are valid and generalizable. The data functions well for anticipating future needs because the human body and scientific knowledge about appropriate conditions for work change relatively slowly. Obviously the individual differences in ergonomic parameters are vast, but also something that the data models very well and allows developing robust segmentation strategies.

Standardized information is available to every-one and often applying it is mandatory or strongly recommended. Thus, differentiating design solutions based on bodily needs alone is difficult. In mature product categories the prevalent product offering typically fulfills critical bodily needs on a satisfactory level, and finding improvements that make notable differences on products is difficult.

Focusing on bodily needs may limit the designers' points view to relatively straightforward design objectives like task completion and objective performance criteria. Interaction can be seen as a goal driven activity, humans as just performers and products as nothing but tools. The dominance of usability and cognitive ergonomics as the framework for designing human-computer interaction, for instance, started to be too limiting when interactive technologies began to spread into homes and leisure applications. Subjective measurements of interaction are applied in ergonomics (see e.g. ISO 9421-11), but typically the main interest is not to study

individuals' attitudes as such, but to use them as indications of more objective qualities of use. The objectification of individual opinions and setting those to frameworks of productivity, healthy and safety, may lead to differences between individuals' experience of subjective need and what is considered an objective need. Individuals might, for instance, be more willing to compromise safety than the directives allow.

### 3.2 ACQUISITION NEEDS

Consumer decision-making and marketing studies focus on users' needs as they appear in purchase decisions and decision-making intentions. While users' needs from the point of view of ergonomics can be different from users' wishes, in marketing studies the individuals' subjective opinion is the key issue. Individuals do not always act based on their wishes because of practical restrictions and others' opinions. Thus, the links between environment, beliefs, attitudes and behavior are important in understanding acquisition needs and several models explaining these relationships such as theory of planned behavior (Ajzen 1988) or technology acceptance model (Davis 1993) have been presented.

Traditional marketing studies share the interest towards quantitative large sample studies with ergonomics. They aim at formulating objective statements about customer segments focusing on beliefs about products, attitudes concerning products and intentions related to acquiring products (review in Keinonen 1998). Thus, the basis of understanding the concept of user needs leans on users' subjective mental constructs. The opinions are always relative with respect to the individual's present situation and the alternatives that are available to her. According to satisfaction confirmation approach (Oliver 1993) needs are generated through individuals' comparison between the present and desired state of affairs. If there is a discrepancy between the two a need exists. There are two possible processes for the emergence of a need. First, there can be a negative change in the previously satisfactory state of affairs or there can be an increase in the users' perception of a reference level. The first is a common reason for replacement purchases as the negative change may be simply the consumer running out of her stock of goods, or an old product breaking down. The second mechanism explains the birth of needs for novelties. Changes on the marketplace or consumer's personal environment may have an impact on her conception of what is the desired state of affairs concerning life styles and product ownership. Thus, knowledge about available novelties may make the present product seem obsolete.

Acquisition needs are specific to the users' situation and to the alternative choices available for her. Almost by definition, the changes in product offerings, social and economical factors will change the consumers' conception of what they need, and indeed histories of needs have been written (e.g. Pantzar 2000). Thus, asking for consumers' opinions is a satisfactory approach to need identification only as far as the choices and

scenes for reference are clear enough. This is not the case with radically novel innovations and that is why innovation and product development literature expresses doubts on trusting on users' opinions (Leonard 1995).

When studying needs for design purposes by asking potential users' opinions, the methodological challenge is to position the opinion formation into the future. The non-existing product has to be created and presented, which is often relatively easy by utilizing modeling and prototyping techniques. However, this is not enough if the product is related to still unknown activities and/or value and attitude systems. Consequently, for valid opinions a future projection of these should be created as well. This is often done, especially in high technology industry, by working with advanced consumer groups such as innovators, whose behavior and opinions can be expected to anticipate today what the majority will think tomorrow. However, the model does not necessarily work as the first ones being interested in novelties may do it for very different reasons than the majority (Rogers 2003, Moore 2006).

The acquisition need approach can also be criticized for being one-directional. Consumers adopt and purchase products, but do not influence on products and technologies. In spite of the criticism, the tendency to pay attention to consumers' decision-making criteria, and attitudes and values influencing those is absolutely crucial for designers to able to create pleasurable experiences with products. Designers need to understand the hedonistic needs of consumers, the ethical considerations and the social influences like peer pressure or tendency to trust of opinion leaders' choices. They need to understand their potential customers in a holistic manner as people having essentially wider repertoire of product related needs than solely practical task completion. For all of these, the tradition around acquisition needs can provide insight. Acquisition needs deal with one of the most import design objectives: once the product is available on shop shelves, customers' acute need for that specific product has to exceed the need for any other competing product and be higher than the hurdle set by the price tag.

### 3.3 GROUNDED NEEDS

The obvious shortcoming with bodily needs and acquisition needs is their lack of attention to the context of use. Without using products in real contexts for real tasks together with other products and people something very essential about what is needed will remain unnoticed. This is not only a methodological concern as it is fair to say that needs only emerge in those contexts and practices where the product becomes a part of its environment.

There are several theories modeling the human-technology relationships of in socio-technical systems, such as social construction of technology (Bijker 1995), symbolic interactionism (Blumer 1969) and activity theory (Engeström et al. 1999). These theories challenge the idea of design for the users as a one-directional process by emphasizing how the users reconfigure products and their meanings during the use, i.e. continue design after the launch. These theories do not belong to designers' tool set, but instead designers start to be familiar with more practical ethnography based user research methods and more experimental contextual approaches (Hannington 2003). These aim at exploring grounded needs in the prevailing practices trusting on observations, dialogues with users and interpretations of the data in cross-disciplinary teams. They catch the needs users are able to explicate, but also the ones that have to be interpreted based on the collected evidence.

Grounded needs are not limited to the functional ones, but can contain a very wide repertoire of issues. A good example is the one reported by Konkka (2003): a study of culture, behavior and values related to mobile communication in India taught the design organization about the following kinds of needs. (1) Environmental circumstances such as noise, humidity, and light contrasts, required robust designs. (2) Communication products' socially and economically shaped roles were different in India compared to the west as the products were considered long term investments. (3) The Indian communality led to behaviors such as "family calls", in which during one call all the members of a family spoke with all the members of another family. (4) Village connectivity was an Indian business model where one person in a village had bought a cell phone and ran a mobile phone booth for the villagers. (5) Indians had a habit of guessing the caller by voice, and not being able to recognize was considered slightly rude. (6) The Indian perception of time differed from the western business time, for example, by considering the agreed appointments pending if not confirmed. (7) The research results about the idiosyncrasies of language dealt with respective roles of English and Hindi in technical language.

Working with grounded needs is tied to existing activities, while designers look for future solutions. There are few main strategies to tackle this problem. First, in their need hunting designers should focus on reasons and drivers behind the observed behavior, because the motivations are likely to be more persistent than overt behavior when a technological change is implemented. Second, the study of present behavior can be developed towards co-development of new practices. Users can be provided with means to imagine improvements in real environments with different kinds of design representations (e.g. Iacucci et al. 2000, Brandt 2006) or they can create new patterns of use with working prototypes. Third, the studies of present practices can be turned into expeditions searching for advanced new solutions that the most advanced users have created for themselves (von Hippel 2005).

### 3.4 ELUSIVE NEEDS

While bodily needs, purchase needs and grounded needs address the relationships between people and goods on a rather tangible level, innovation literature recognizes much more speculative and elusive needs. Needs that finally incarnate into purchase choices or grounded behavior can be recognized as potential needs by studying social, economical, and technological trends or monitoring surprising changes in any of those areas (SET analysis, e.g. Cagan and Vogel 2002). Actual behaviors can only occur within certain circumstances where technologies and ways of life create the opportunities. These circumstances are visible before the yet inexistent products or behaviors. Consequently, design and innovation projects aiming at radical novelties and/or more distant future products have to work based on rather elusive information. It becomes necessary to discuss about users' needs, without directly referring to users, just by speculating on the impacts of anticipated macro level phenomena. Suburban living leads to commuting. Commuters spend considerable amounts of time in vehicles, many in private cars. This leads to a tendency to use the extended driving time in a meaningful manner. One way to do it is to communicate, which requires communication equipment that is safe to operate in traffic. This explains the need for usable hands free headsets.

To find this kind of elusive needs, approaches borrowed from futurologist can be applied. These include for instance analyses of social, economical and technical trends (Schwartz 1996), future tables i.e. FAR method (Rhyne 1995), Delfoi method and scenarios.

Compared to any of the previous, elusive needs are very speculative. However, design is always about creating novel interpretations and changing existing artifacts. Thus, the focus in need recognition is on items that have not been previously found, not understood well, or are rapidly changing. Studying elusive needs does not give exact answers, but gives direction and leaves a lot of room to explore with solutions, and that is why they have a meaningful role during the early phases of innovation processes.

### 3.5 SUPPLY NEED

“For us, user need is any relationship between a person and her context that may have an influence on the design of products and services. The relationship may be physical, behavioral, motivational or driven by values, interpretations and cultural codes.” (Lindholm et al. 2003)

The quotation above describes a telecommunication company's user research unit's practical approach to needs. It focuses our attention to design activity as instrumental in creating needs. I do not mean the need

generation for which companies are often criticized when they launch and market futile products. I refer to designers' request for needs to be able to do what they are taught and are paid for. Designers' have studied their textbooks which independent of the faculties where they come from – engineering, marketing or design – define user needs as the foundations of new product development. Thus, as the first step in design process the supply of need has to be secured. The design activity requires needs for the conceptual foundation on which to erect the new product.

Let us get back to the communication study above (Konkka 2003) and use it to illustrate how designers' attention to phenomena turn them into needs. Indian communality was a cultural phenomenon until interpreted by designers as a need for something. The noise in Mumbai was an environmental issue until interpreted as a need by designers. Simply, designers' attention turned those issues into needs. For phenomena to turn into needs certain qualities are required. First, they have to match with designers' preconception of what may be a fruitful foundation for design. This is influenced by organizational objectives, technology strategies and expectations, and technical opportunities forming together what can be called practice bound imaginary (Hyysalo 2004). Second, different needs are useful in different phases of a design process. In the fuzzy front-end of design, the nature of design problems is open and ill-defined. Some specific needs may have been recognized but their role and meaning is not yet necessarily known. On one hand this is a focusing problem, but on the other hand also an opportunity for creative thinking, and some design process models actually require designers to start with a list of needs that are clearly separated from the design solutions. The open nature of needs in the beginning leaves the designers the possibility to choose how to frame them and which to consider as the driving ones. Later in product development needs, solutions and ideas converge and start to meet, and articulating exactly what is needed from the product becomes possible. More specific needs are a good supply for evaluation and evolutionary development of the designs. The request of different needs in different phases of a design process corresponds to Zeisel's (1984) categories of design information: heuristic catalyst for imaging and knowledge needed for testing. Third, innovation literature strongly recommends companies to focus on new practices (e.g. Kim and Mauborgne 2005). Differentiation is possible only with finding new relevant starting points for design, and thus the industry dynamics from innovation strategies to individual projects subscribes a fresh supply of needs. Fulfilled needs are not interesting drivers of design, as they do not support differentiation and create competitive advantages.

The five different types of needs were introduced via the research and business traditions where they have been the most prevailing (Figure 1). This simplifies the reality, because in fact the traditions borrow from each other and are overlapping. Ergonomists work often in grounded needs mode and futurologists trust on similar hard quantitative statistics as market researchers. In addition, design practice itself is a melting pot of different

approaches to user needs. Designers can and do mix with different types of user needs. They consider bodily needs by measuring each others, discuss about acquisition needs by referring to hypothetical customers' preferences, approach grounded needs by informal testing of mockups, and definitely propose strong insights about the elusive future technologies and their impacts on design.

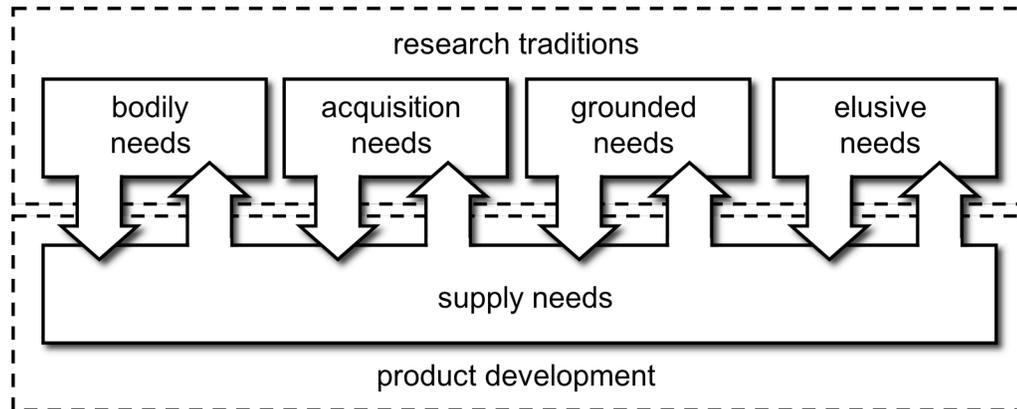


Figure 1: Five frameworks of user needs.

#### 4. ECOLOGICAL APPROACH TO DESIGN AND USER NEED

The concept of user need has been applied in design through several practices leading to a variety of interpretations. Due to their inheriting differences the interpretations are difficult to merge in spite of a certain amount of overlap. Choosing between the frameworks is also an undesirable option, as each type of need contributes to understanding something essential about the relationships between people, technology, environment and opportunities for improvements as was shown above. Consequently, if we wish to explain the concept of user need within one framework, we have to choose one that accommodates different points of view without exclusion or violent redefinitions.

One possible integrating framework is so called ecological approach to design, which in this context does not refer to ecologically sustainable design of so called green design, but to linking technological systems with social practices under one umbrella. It refers to an attitude of perceiving phenomena in human-technology systems from the point of view of relationships and interactions. According to ecological approach, environments should be understood from the point of view of the practices that they enable, and their quality refers to the development potential of the human, social, physical and technical systems as a whole. The approach emphasizes the potential of technologies to create new relevance by merging with each other, with non-technical environment and human practices creating an ecology of man made environment. Thus, the objects of design should not be understood as technical devices or even isolated interactions between humans

and products, but as broader practices. Widening the objects of design allows more comprehensive understanding about the motivations, routines and values behind human actions. It pays attention to the circumstances, where interactions take place, and where the environment enables, adjusts and restricts interaction. (Flach et al 1995, Vincente 1999, Norros et al. 2007, Kuutti et al. 2007).

Theoretically ecological approach is based on James Gibson's (1979) ecological psychology and Urie Bronfenbrenner's (1979) ecological developmental psychology. It also borrows from cultural historical activity theory (e.g. Engeström 1999) and Gibbon's and colleagues' (1994) model of an alternative way to generate scientific knowledge they call mode 2 (Norros et al. 2007). Especially, the demand for transdisciplinary concepts that they presented as characterizing mode 2 is relevant in this discussion. These kinds of concepts are needed to enable creative collaboration between several research traditions.

To explain need within the ecological approach we have to pay attention to broader concepts than just to a user, a product and an environment. Limiting to these would force us to adopt models and concepts from one or few of the perspectives discussed above and it would create a kind of competition between their superiority. Consequently, in an inclusive and non compromising attempt to create an ecological approach to user needs, it is better to pay attention to the relationships between the frameworks or systems, within which needs were described.

The discussions above suggest a set of approaches for framing user needs. Bodily needs arise from the micro level systems of using technologies in a task-oriented manner in an immediate person-product-environment interaction. Acquisition needs are studied with reference to systems of acquiring products, i.e. learning about them, forming beliefs and attitudes about them, perhaps deciding to purchase them and taking the required actions. Grounded needs emerge in specific socio-technical practices including a broader ecology of products, stakeholders, and behaviors. Elusive needs stalk within innovation practices trying to find and utilize opportunities to launch novel products and business models in an economically sustainable way. Finally, supply needs are related to design practices, which aim at defining products and planning the ways they are used. All of these systems are relevant contributions to our comprehension of user needs, and none of them is enough alone to provide an adequate foundation for user needs driven design. That is why the ecosystem capable of framing user needs should include all these systems, and potentially some others not covered in this discussion.

A specific need in such ecology can be seen as a node visible from one or several of the frameworks and providing development potential. In this node treads from different subsystem meet and create new dispositions, so that those who notice the change and have capabilities to act accordingly, can improve the quality of the ecosystem. As discussed above, time is critical variable changing the configurations of many of

the systems. So, for relevance, attention should be directed to the fresh needs, i.e. the nodes that are emerging – or re-emerging in new locations. Thus, instead of choosing between bodily, acquisition, grounded, elusive or supply needs we should design taking advantage of appearing relationships in the multitude of human-technology systems. This can be reframe it the following way: User need equals to a Node in Ecosystems of Emerging Dispositions (NEED), where a node in ecosystem refers to particular relationships in human-technology systems and emerging dispositions to new phenomena, knowledge or opportunities in the context of current interpretation (see figure 2).

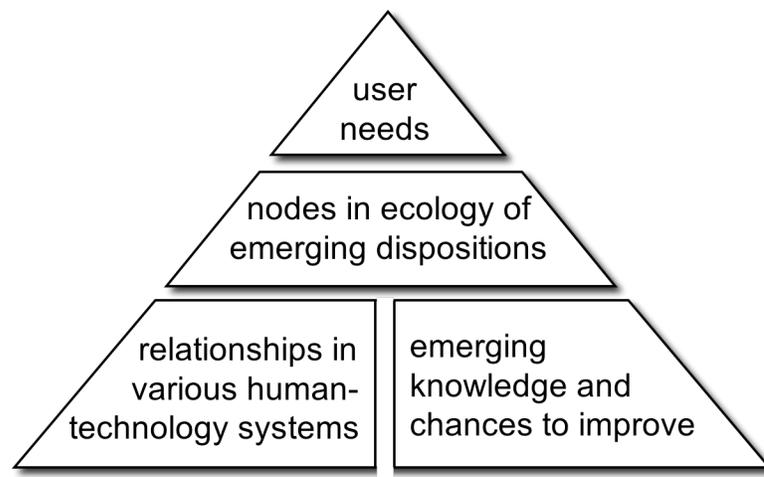


Figure 2: Elements of user need in design context

## 5. DISCUSSION

Several approaches to user needs have been introduced, but fixing the concept in any one of these alone, like is often done and which has motivated this paper, gives too limited an idea about the design for user need. Ecological approach to design was consulted to provide an inclusive and non-compromising framework to propose a transdisciplinary interpretation of user need as a Node in Ecosystem of Emerging Dispositions. However, the interpretation is rather an opening to further discussion than a final research result and can be challenged with a number of arguments, some of which are discussed below.

*The discussion is based on five angles to user needs. Can't there be more?*

There can be others, but the number and exact nature of those is not relevant from the point of view the presented argumentation. The five views are enough to show the amount and variety of needs, their

incompatibility and relevance. If additional types of needs are found, which is more likely than not, they do not necessarily influence on the definition or on its justifications.

*Is the NEED interpretation too generic referring to any design requirements especially because a user as a person is not referred to or it does not address the good for the user?*

A user exists in the description through the reference to human-technology systems, from which the needs, if relevant to design, always arise. In addition, the above-mentioned approaches do not necessarily assume the user to have an active role in need recognition. This is the case, for instance, with ergonomic standards defining user requirements about, which the users are ignorant or do not agree with. Users' needs in product development, in a value free interpretation, do neither need to define something that is objectively good for users. For example the acquisition need framework conveniently deals with people needing unhealthy and dangerous products.

*Is there empirical evidence to suggest that on one hand anything more focused could not frame user needs, or on the other hand that all the needs would be covered with the description?*

No, there is none. The description has not been validated by empirical research.

*Does the NEED interpretation have any practical relevance?*

NEED addresses user needs as being essentially dependent on relationships of phenomena in complicated human-technology systems and changing dynamically over time allowing opportunities for product development. By doing that NEED contradicts the simplified statements about user needs rising from any single angle, typically from acquisition need. Considering user needs only as something people can explicate, as something that can be measured in ergonomics laboratory or something that only takes place as situated action lead to dangerously limiting views of designers' possibilities to improve human-technology relationships. By paying attention to this, NEED advocates the versatility of research angles, design methods and approaches to be used in the design for user needs.

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