



AN APPROACH TO INCLUDE THE LIFE SITUATION OF ELDERLY PEOPLE IN PRODUCT DEVELOPMENT

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Keywords: human centred design, design guidelines, user centered design

1. Introduction

The aim of development activities must be to support the human being in his ambition for a self-determined and autonomous life. Technical systems have enormous capabilities to enable the human being to overcome his natural performance boundaries, to strengthen his resources and to expand his possibilities of action. To define the human being as measure of all things for all activities in product development it needs to be understood that the human being holds the role as user in all its facets. In reality we can observe that by several roles of the human being – as designer and as a user – various perceptions of the product can be perceived. For the designer the functionality of a product is the starting point of all activities. The user has to interpret a finished product and has to figure out the functionality for himself in the specific life context [Steffen 2000]. For the designer the comprehension of mechanisms of interpretation of the user is necessary to adapt the functionality of a product to the wishes and needs of the user in a better way. This is not only related to aspects of acceptance, but also to economical needs. To only consider capabilities like sensory, motoric and cognitive abilities (e.g. [Weißmantel and Biermann 1995], [Reinicke 2004]) is not enough. Resulting mechanisms of interpretations are limited and neglect the context of using. A holistic description of the user has to consider affective, social and cognitive aspects as well.

Research questions connected with these thoughts are the object of human-oriented research fields like psychology, social sciences or gerontology. The challenge hereby is to make the knowledge of human-oriented disciplines available for product development on the one hand and to find methods to translate this knowledge e.g. for requirements definition or product validation on the other hand. An interdisciplinary cooperation between the disciplines is essential to make findings/results from disciplines like social sciences available for product development, to build up models, which integrate the human being and the product and to express definite parameters as input for the development process. In this contribution an approach will be introduced, which explains influencing factors from social environments of the user to the use of the product. Results of an interdisciplinary project between engineers and social scientists will be explained. Based on a sociological concept a method was developed, which considers influences from life situations of the user to the user behaviour. In the following, consequences for product development will be explained in detail.

2. State of the art

In product development, two principle perspectives are used to describe the user: methods of acceptance research and methods of user participation. In the field of acceptance research a number of methods are

available, to explain resp. to predict the acceptance of a product by the user. Indeed, these models are normally only helpful for specific products or a group of products in a well-defined context. Based on information of expectations, effort and benefit of the acceptance can be measured. Most of these approaches come from business economics or information management, a conclusion of the approaches is given in [Kornmeyer 2009]. Based on the Theory of Planned Behaviour, described in [Fishbein and Ajzen 1975], a number of acceptance-models was developed. Venkatesh combined the most important models in the Unified Theory of Acceptance and the Use of Technology (UTAUT) [Venkatesh 2000]. The behaviour defined here, leads to the real use of the product. With the known acceptance models, direct and indirect influencing factors to the acceptance of a product, are known, but a conclusion to the products themselves is not possible. A prediction as well as an feasible evaluation of acceptance can be derived, but an indication, of how to change the product to get a higher acceptance cannot be derived.

Methods of user participation and user integration are used in product development to involve the user in the ideation as well as to get an early assessment of the product. The aim is to get a better understanding of wishes and needs of the user [Reinicke 2004]. Furthermore, usability and user experiences will be evaluated by using these methods [Hassenzahl 2008]. In gathering, for example, the assessment of user experiences it will not only be considered actual utilisation, but also the time before and after utilisation. Thereby, factors like education or social integration will be considered in an implicit manner [ISO 9241 2011]. Methods of measuring user experiences help to evaluate the experiences of a user with the product [Garrett 2002], but it is really difficult to interpret the results without a model to describe the human being in a holistic manner. It is necessary to bring results in the context of life situations of human being. Approaches for this are not available today.

With the above described methods the use of a product may be explained, but a holistic description on a cognitive, affective and social level is not possible. Such a description is necessary, to adapt the product to the user from several points of view and with this to ensure the acceptance of the product. A comprehensive description of deficits of the known methods for a holistic user description is explained in [Walter and Paetzold 2014].

Especially when supporting elderly people in terms of preservation of an autonomous and self-determined life the engineer has a specific responsibility. As already explained in earlier papers, the authors developed a hierarchy of support for elderly people based on a literature review and by using knowledge from medicine and gerontology. According to this the meaning of products can be oriented on their abilities resp. rests of abilities [Paetzold and Wartzack 2012]. According to this it will be suggested:

- Motivation (animation and training): The abilities of the user shall be received and trained by the technical system. The product shall stimulate to use own capabilities and may help to tackle the daily tasks.
- Support: in difficult situation the technical system shall support the user to execute the daily tasks. The available capabilities have to be used in the best manner to ensure that these abilities are not getting lost or have to learn possibilities to compensate these abilities.
- Compensation: only if the personal capabilities of the user are not sufficient to tackle the daily life, technical systems for compensation shall be used to replace the capabilities to enable a self-determined lifestyle.

To use these hierarchy for the development of technical systems it is not sufficient to reduce the human being to his sensoric, motoric and cognitive abilities. Such a deficit-oriented approach leads to a stigmatisation of products. It rather needs holistic approaches to describe the users abilities as well as his life- and action situation [Dienel 2007], [Pelizäus-Hoffmeister and Paetzold 2012].

3. Methodology to describe the life-situation of user

In the context of a research project found by the German Ministry of Education, a conceptual based research strategy was developed in an interdisciplinary approach between social scientists and engineers. A context-integrating practice-centered methodology was generated, which includes instruments for qualitative investigation methods, based on social approaches for conduct of life and practicing theory. In terms of a sociological understanding of daily life, everyday lifestyle will be understood as an active effort of a person, which is characterised by a high degree of habituality and in the same time by a

spatial-material context. Respectively, the daily life is not implemented quasi-automatically but will be actively arranged. In most cases this process will be proceeded not high-reflexiv and in a strategical manner, but rather as a routine, which is often abstracted from consciousness.

A further fundamental aspect is given by the Practice Theory [Hassenzahl 2008]. With this perspective conduct of life is the central aspect for every technology development because it concretises the “place” on which the need of support will become manifested. It will be assumed that technical support must not interrupt habitual routines. This is necessary to hold up trained procedures in the conduct of life. Due to established structures build up over a long time new procedures normally will be refused. Such a reaction has to be understand as a kind of elemental reaction of elderly people and not necessarily as lacking willingness to deal with innovations.

By taking this argument from practiced theory seriously, the direction of product development is predefined: technical systems have to be developed, which have to be integrated without difficulties into the existing lifestyle. They have to have a high degree of practicality [Pongratz and Birken 2016]. Then again the framework for product development is pre-defined: products have to be integrated into action routines of elderly people to be accepted by the elderly people. To reach this goal it was necessary to identify a methodology and to describe practices of daily life.

To collect these data a various instruments from several qualitative methods were designed. It was used in the project to interview 23 elderly people with physical restrictions twice in their own home environment. We name the interviewee research partner to show that their expertise has a high meaning for our work. The basic idea behind the participative approach was to establish a kind of relationship between the researcher, the research partner and the research object with the goal to open and to analyse the conduct of life reflexively in a common dialog.

The data elevation occurs in the private domesticity of the research partner, wqithin the research field [13-Helga]. This enables the systematically integration of the material context. The elevation methods are based on verbal representations like interviews, the think-aloud method or reflexive dialog methods. These methods were extended by elements of field research especially by practical demonstrations, which provide a comprehensive view into particular practices. A first visit conduces to get an overall picture of the life situation of the research partner. Essential parameters of circumstances like material facilities, neighbourhood, health situation, social integration, and education were investigated based on a guideline-supported interview. Therefore, these interviews will be used to install a stable working alliance with the research partner.

In line with the second visit the tackling strategies will be in the center. Based on the faithful and emancipated working alliance, the elderly people explained with high willingness their difficulties with a number of actions in daily life. These practice-demonstrations allow the researcher to retrace and to analyse problematic details in these daily actions as a fundamental for defining idea for technical solutions. Even from the perspective of the research partners the presented practices where not compulsing well to solve critical solutions. Often these actions are coupled with considerable effort and in parts connected with high risks for the elderly people. In this respect it may be suggested that technical support based on these practices will have to have the chance of acceptance.

4. Results and implications for product development

One of the central findings of the research project was the fact that a number of esential practices are identified instead of the problems. The research partners had to use smart and inventive practices to tackle the daily life. At first view both disciplines of these practices are difficult to notice for the researcher. Nevertheless, the practices provide suitable answers to individual restrictions and will be implemented simply with domestic fixtures. As a result five categories of practices are identified:

- Often specific body-techniques will be used. Elderly people develop and establish partly wilfully, partly unconscious physical tackling-routines to deal with daily challenges. An example: one of the research partners developed consciously a specific physical routine to climb stairs. She takes the stair as lope and with a specific kind of step and both hands on the handrail. She counted the stairs to get a rhythm in moving and so to reach the goal easier.

- Support by technical upgrade will only be used if the potential of the own body is insufficient. Such a support can be the frame of walking, which helps people with mobility restrictions to overcome longer distances as well as transport support in the home environment.
- Another often discovered technique was the Empowerment. A number of elderly people consciously train their abilities to hold capabilities. This can be with gymnastics in front of the television as well as climbing stairs or the training of the wbrain by using the computer.
- A further strategy: elderly people organise social support if they are not longer able to tackle daily routines or parts of this. They ask for help in the social context, for example, their children or neighbours, but they also use formal services to avoid to afflict people in their environment.
- Especially notably from researchers point of view were changes in the material environment, which are often not visible on the first view. Only step by step a number of small spatial adaptations were recognised, which help elderly people in handling the daily life. An example: the corridor of an elderly lady was complete disposed with furniture. In practical demonstration it became clear that she needs these to hold when walking. Such a “furniture walk” is not really adequate for the current considerations about unrestricted access.

4.1 Implications from the results from engineers perspective

In the analysis of the results of the context-integrating, practice centered methodology four essential findings will be derived, which are explained in the following.

4.1.1 The importance of action routines

Due to having the focus of the project on a self-determined lifestyle, for interviews only elderly people were chosen, which live in their familiar domestic environment and which are mastering their every days life autonomously. One of the most important findings from the project was that action routines have a continuously high significance for the interviewed persons. One of the reasons may be that such action routines structure the daily life. Action routines are well defined and growing over a long period of time. However, for the interviewed persons it was very significant for receiving own capabilities to follow these routines.

The observation shows that for most of the interviewed persons problematic situations exist. Nevertheless, the interviewed people have not identified these situation as critically. They normally were able to manage this situation somehow. To tackle the problematic situations, two strategies can be observed: either the domestic environment was adapted to the well-known action routines or the action routines got more and more simplified over the time the human being had reduced his field of action continuously.

Action routines are changing stealthy. In the context of observing human beings in the domestic environment, it was coupled to changes in the home. Elderly people tend to build small islands in their home environment, which are adapted to specific needs. An example: One of the interviewed persons had his haunt on the couch. Here he stacks a number of pillows to support the difficult process of getting up. In the same time a side table and a shelf were nearby to give the opportunity to stabilise. Other areas of the home environment will be used less and less.

To accept new routines or new products, which may be connected with changes in the routine, it needs for elderly people personal crises like e.g. an accident or a downfall, which makes it impossible to work in the established routines. It seems that only in such cases the human being considers new routines as well as accept new products. Elsewise new products, which support the human being put the competences of elderly people in question, their ability to manage their everyday life. Understandably this leads to an exclusion of the product.

4.1.2 Concretisation of a hierarchy of support

The surveys show that the hierarchy explained in chapter two, definitely fits to the wishes and needs of the considered user group. Regarding the question if it is desired to use technical systems as support, the most common answer was that technical systems will only be of interest if it is not possible to act alone. Only if tasks cannot longer be executed by the elderly people they fallback on technical support. It was

also shown that in the trainings-phase technical systems are not desired rather the painful executing of an action like e.g. climbing stairs will be seen as training. Some of the interviewed persons climb stairs although an elevator is available. In the survey, of the interviewed persons, the possibility to use technical systems for compensation was only a hypothetical solution. This kind of solution will only be interesting if tasks are neither executable any longer nor doable by using supporting systems.

4.1.3 Technical support based on the hierarchy of support

Considering the user's point of view the explained hierarchy of support can be extended. Motivating activities as well as training activities normally take place before the real activities and may be seen independent from the action routines. Supporting activities are directly connected to activities in the daily action routines. Therefore, technical support in this stage has to be integrated and defined depending on the concretised activities. Compensational activities replace typical user activities; action routines will be replaced/leaved. This gives, on the one hand more freedom for designing, the product must fulfil a defined functionality, but on the other hand the user context is not as rigid as for the supporting level. Otherwise the use may be based on critical events for the user connected with a irretrievable loss of capability. The following explanation of results is summarized in Figure 1.

TRAINING	SUPPORT			COMPENSATION
empowerment	enhancement	mobile support	context	replacement
product to sustain competences and capabilities	product to represent action routines resp. parts of this	product to complement parts of action routines	create an environment, which allows action routines	product to take over action routines resp. parts of this
needs knowledge about motoric, sensoric and cognitive abilities	needs knowledge about action routines, functions of the actions routines and parts of this, constraints of action routines, variances of action routines			needs knowledge about performance and function restrictions
functionality based on competences which have to be trained	functionality based on necessity of action routines as a complement to competences and abilities of the user			functionality based on action routines which gets impossible

Figure 1. Concretisation of the hierarchy of support

Technical systems for training

The training situation will be supported by technical systems in understanding of empowerment. The aim is to receive necessary competences and capabilities not only to use the action routines but also for the well-being of the user. Thereby knowledge about action routines is not necessary in detail. The design of technical systems concerning the functionality is nearly free but it needs an understanding of the principle capabilities as well as typical performance restrictions. It also needs knowledge of mechanisms to build up competences for human beings. Such preconditions require a strong cooperation between product development and human oriented disciplines like medicine, gerontology or psychology. Technical systems to support training should pick up aspects of "Joy of use", to create positive experiences for the user.

Technical systems for supporting

Support for executing actions must be strongly oriented on the action routines of the user and need to be easily and with low effort integrated in this action routines. The acceptance only can be ensured if the support fits with the action routines of the user. According to this, the functionality of the technical system must be part of the functionality of the action routine.. A detailed analysis shows that three kinds of supporting techniques are thinkable:

- Enhancement describe technical support systems, which are directly connected to the body of the user, e.g. hearing aid or glasses. Such systems have to be connected with the body, several interfaces between the user and the technical system result. These interfaces can be detailed by using approaches of ergonomics. The technical support can get more complex, based on sensors, which supervise specific functions of the body. During the activities the user must not take care of the technical system. As recently as the action is closed, the supporting system will be removed. In the consequence, the user has to engage with the technical system in a strong manner. On the one hand the technical system has to be robust and on the other hand. flexible enough to deal with variances in the actions. In ideal conditions the user does not think about the technical support in his actions.
- Mobile support describe systems, which are not strongly connected with the user as well as the environment, n for example frame of walking. Mobile supporting systems give the user more free space in his action routines. He can use his own competences, but if it is necessary, the technical system will support the limited functionality. Only in specific situations as well as under extreme boundaries the technical system is considered to support. According to this the spatial and/or the temporal availability is limited.
- Changes in the context of the user environment will be supported by technical systems, which are integrated in the environment, here in the domestic environment, e.g. grab handles in the bathroom. Such supporting systems are normally not as flexible as the before described approaches but in the domestic environment these approaches are very effective. It needs also an intensive analysis of action routines, the integration in this routines depends on the functionality which has to be supported.

Technical systems for compensating

Technical systems to compensate functionalities in activities intervene in action routines or parts of this. Flashpoint for the necessity to compensate are personal crises or drastic disruption like an accident or a disease. This is necessary if the user is no longer able to work in the action routines in a proven manner. Such situations lead to more or less significant changes in the way of life, the user has to adapt and to convert his behaviour. Usually this is connected with a loss of life quality. Technical systems to support in this stage of life will be more accepted when they can be easily integrated in known routines as well as when they reactivate parts of actions routines. Nevertheless, technical systems to compensate can be nearly free and independent from action routines. The concerned functionalities must be completely taken over by the technical system.

4.1.4 Interaction between user and product

Integrating a product into the daily life of a user is connected to the capabilities, resp. the requirements of a product. This leads to another dimension for the interpretation of technique for elderly people. With this dimension, not only the varying complexity of the technical system is addressed but also the intensity of integration in the user's privacy. To describe this phenomenon three levels are identified:

- User-effected interaction: such product have no active elements at one's disposal to recognise the users behaviour or to react. These products support the users only by their presence, e.g. to hold up the body or to hold on.
- Product-supported interaction: such products have active components at one's disposal, e.g. motorisation or in simple cases possibilities to adjust to the body. If it is necessary, these components can be activated. The user only triggers the impulse for support. To use such a functionality the technical system needs some kind of sensor to register the situation. In easier cases, the user themselves fulfil these function of sensor. The reaction on the stimuli is controlled by the user.
- Product-user-integration: such products not only have the active components at one's disposal but also the actoric to react. Sensors help to detect the user situations as well as the environment, based on the resulting information actors will support the user in his activities to fulfil a function in his activities. The control of the situation lays in the technical system. Such an intensive kind

of integration is already coupled with compensation: The product helps the user to overlook the situation.

Coupled with such a subdivision is the intensity with which the technical system is integrated in activities of the user. It defines how strong the user has to engage to the technical system. The subdivision is a kind of hierarchy. By choosing the approach of integration between user and product the fitting accuracy can be adjusted to the needs of the user. With it connected is the degree of dependency of the user from the product. This leads inevitably to considerations of how strong the technical system will intervene resp. will be integrated in the action routines. As stronger the integrations as pronounced the loss of autonomy of the user about his action decision.

4.1.5 The influence of moral concepts to the user behaviour

From the interviewed persons some products would be considered as reasonable in principle. For the own use, the products were rejected with the argument "It's not worth it". The interviewed person thought that they would not live long enough to have such an expensive purchase. Otherwise, products were rejected with the argument "I don't need this not just yet". Products which fulfil well-known functions but are presented in an unfamiliar form also were rejected (e.g. robot vacuum cleaner) although they may be helpful in solving a problematic situation. To overcome one's inhibitions to use products with similar functionalities is comparatively high. The handling of familiar products is preferred especially if this handling is connected to action routines.

Especially in connection with products for elderly people, the meaning of safety and reliability is strong emphasised by the engineer. In the interviews, it was conspicuous that this aspect seemed to have only a minor relevance for the elderly people. Even as innovative concepts as exoskeletons were discussed aspects of safety or reliability were not picked out as a central topic. Optical Reasons or the argument "I don't need this because I'm able to do this myself" leads by the majority to rejection. It was not clear to differ in the argumentation whether a product will be seen as safe per se or safety and reliability do not play a role in the decision of using.

5. Next steps in research

One of the next steps is to make the gathered findings available for product development. Based on the findings and the structuring of the results, procedures to comprehend important action routines in the daily life have to be defined. Function-oriented descriptions of activities in the domestic environment, like e.g. cooking, personal hygiene or cleaning the flat, which are detailed prepared in catalogues, can be used as basic. In combination with the results of this project, a number of generalised problem situations can be identified. Exemplarily named may be "stand up in several situations", working overhead, or act and stabilize the body at the same time. Such catalogued combinations of action routines with problem situations provide a basis for ideation or for concretising requirements.

Another connected point to support the development process will be seen in the definition of support-matrices. In the matrices the hierarchy of support will be coupled with the level of interaction between product and user (see Figure 3). For such matrices selected problem situations can be analysed more detailed. On the same time, the dependencies between hierarchy of support and the level of interaction can be considered. For example, gaps in the matrix are a suggestive for potential of a need of support. In further steps, it is necessary to complement the matrix with an approach to assess the found solutions based on a clustering of elderly people depending on their life situation.

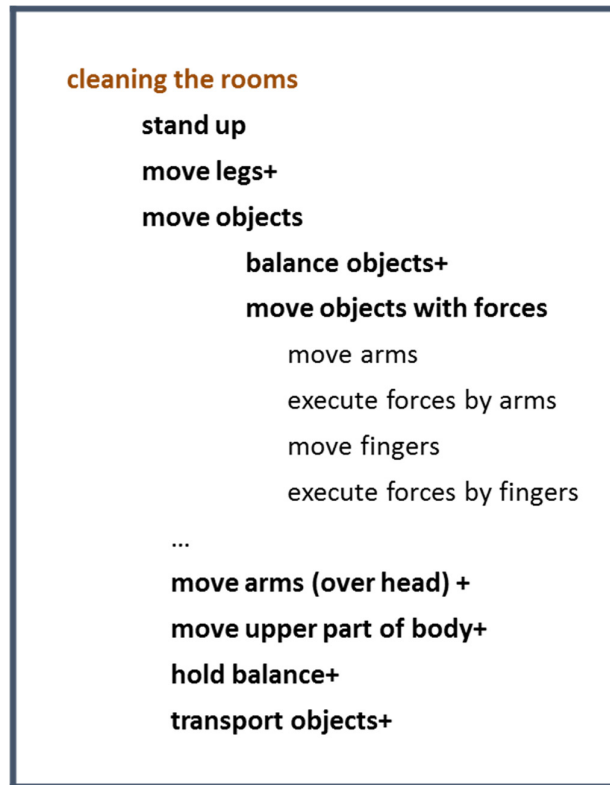


Figure 2. Example for function-oriented catalogue of activities in action routines

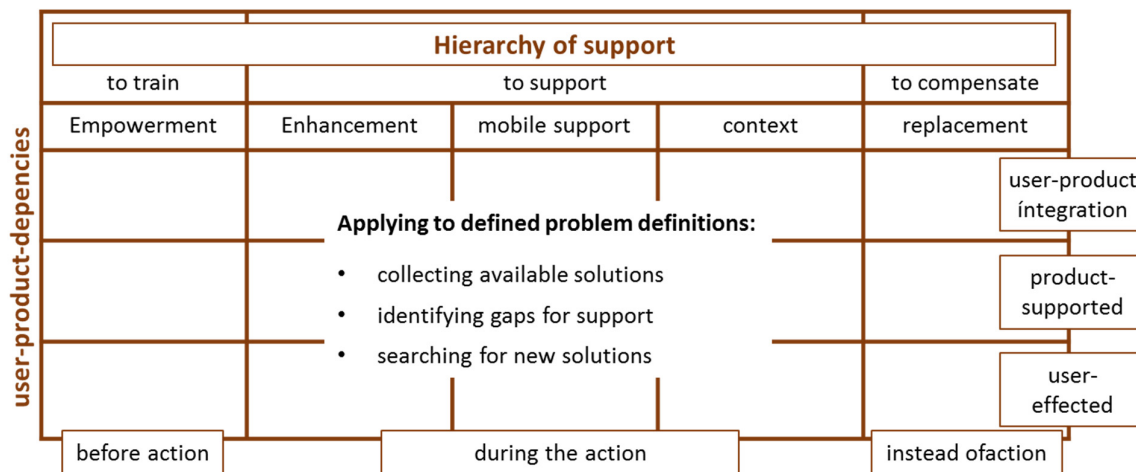


Figure 3. Support-matrix to identify potential for technical solutions

For most elderly people it is obviously important to preserve their autonomy as long as possible. The hierarchy for support can be used as a measurement instrument to determine the useful degree of technical support. It is essential to have „only as much support as necessary and as less as possible“ . Often the engineers argue with the aspect of comfort in explaining the usefulness of technical systems in daily life. One of the most important results of this project was that comfort is not important for elderly people; comfort plays a role or an underlying role at the needed moment. Much more clearly articulated is the thought of training. Hereabout the engineer has a high responsibility adverse the user. At times the engineer can be compared to a playing child. New technologies will be included in products independent of ask for the benefit of the user. In context of development for elderly people , it is often

better to have less than more functionalities. Too much support leads to limitations in the capabilities of the user. To use a technical system or activities, which can execute by the user – also below difficulties – seems to be needless from the user's point of view.

Products to support the daily life have to be integrated into action routines of the user. If they are not able to do this, the acceptance is limited. Such an approach implies that the engineer knows typical action routines and is able to interpret these not only in physical manner but also with social background. The analysis from a social point of view, the transformation and the interpretation into physical functions will be an important part of the requirement analysis. Action routines only will be broken up by personal crises. Only in such cases products are needed to compensate loss of capabilities. This is like a paradigm change. It needs an inversion of problem finding in product development.

The best solutions for products seem to be such solutions, which are adaptable over the time, which can be fitted to changes in the boundary/environmental conditions and constraints. This seems to be an important aspect for future products for elderly people to be able to increase the acceptance. The produced support can be adapted to the needs depending on the hierarchy of support, arguments like „its not worth it“ decrease the importance.

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