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UTILIZATION OF SCENARIO BUILDING IN THE TECHNICAL PROCESS

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Abstract

The aim of the research behind this paper was to develop a method, which brings in the user aspects in the synthesis part of the design work and also supports the design team with creativity activities. Scenario building is a method that supports this kind of work. Based on the theory of technical systems, the approach has been to integrate the user actions to the model of the technical process and to use this user-technical process for scenario building. The user-technical process helps the designers in the product development team to receive a common picture of an intended use situation and define the sequence of interaction between user and product.

It is concluded that the user-technical process could be used for building structured scenarios. The benefit of using this type of technique for building scenarios is that the user's and the technical system's mutual and own actions and functions are clearly schematised and therefore it is possible to change combinations of actions or functions from the scenario, exchange one of the users to another individual or compare different design solutions with each other by keeping the same user sequence.

Keywords: Action, man-machine interaction, scenario, technical process, user

1 Introduction

The traditional mechanical design methodology, e.g. Hubka & Eder [1] and Pahl & Beitz [2], pays only rudimentary attention to the user. The theories mostly focus on the technical functions and the structure of the product and omit the product's relation to the user. Some of the theories, e.g. Ullman [3] and Pahl & Beitz, provide a hint on how and when in the design process some of the user aspects should be dealt with, e.g. identifying and understanding the customer and his needs.

There are many existing methods and tools for dealing with interaction between user and product. However, they are, whether quantitative or qualitative in nature, essentially designed for analysis or evaluation [4] e.g. *task analysis*, *user trials*, *performance tests* and *computer-aided design such as 3-D representation of the human body*. There is a need for methods for synthesis for user product interaction. This paper proposes an approach for such a method. The method is based on the theory of technical systems and the approach is to integrate the user actions to the model of the technical process and to use this user-technical process for scenario building.

The research method is rather empirical and the developed method has been investigated and improved during the process with help of various case studies.

2 Theoretical basis

The method presented in this paper is mainly based upon two theories – technical process from the theory of technical systems [1], [5] and scenario building [4], [6], which are briefly described below.

2.1 Theory of technical systems

The *theory of technical systems* (TTS) is a descriptive theory of the machine system or artefact [1], [5]. The technical system provides effects (actions of a material, energy and information character) through different types of functions, these effects being essential in order to produce transformations, which should convert an operand from an existing state (input) to a desired state (output) in a technical process (Figure 1). There are four basic varieties of transformations, namely changes of structure, form, location and time. The technical process is affected by humans and an active environment.

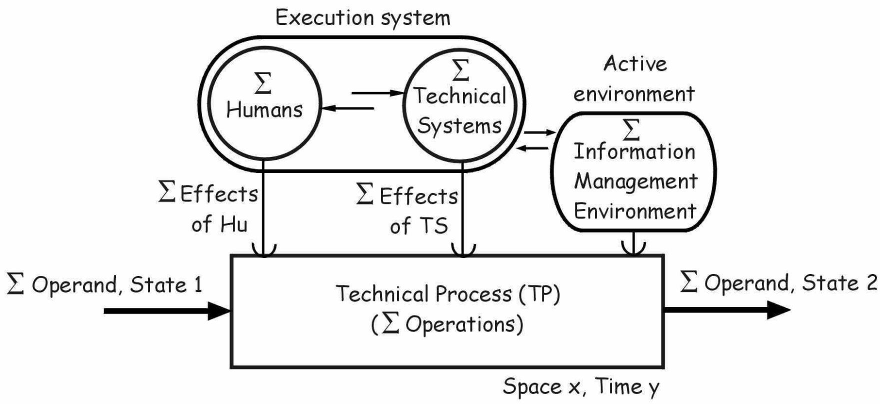

Figure 1. A general model of a transformation system [1].

2.2 Scenario technique

A scenario is a narrative description which has users, a work context and tasks that the users perform or want to perform as ingredients [6]. Scenario building derives its origin from the more conventional methods of *user profiling*, *task analysis* and *systems engineering* according to Suri & Marsh [4]. They have defined scenario as *descriptions of natural, constructed, or imagined contexts for user-product interactions*. Scenario building is ideally based upon an investigation e.g. observations or interviews with users interacting with products. According to Suri & Marsh [4], the exercise consists of three elements:

1. *A set of specific individual users*. These ought to be based on real users but do not have to be representative for the user population. The users' nature, lifestyle and incentives are defined.
2. *The individual characters' issues, tasks, and situations*. These tasks or situations could be obtained from the investigation of the users.
3. *The product to be developed*. This may be a precise design proposition or a vaguely defined concept.

Using these three elements, a situation is built up where the intended product is seen in the context of its environment and user, and the interaction between user and product can be studied. In this way and by using his imagination, the designer becomes aware of possible problems and obtains hints for suitable solutions. Obviously, this means that the method is of some value in the synthesis part of the design work, not only providing retrospective analyses of an existing product [7]. Another distinction is that the user is more personalised in a scenario, thus providing a more intimate relation to the designer. This is believed to be more fruitful for the creative process. Scenario building also supports the increasing of a shared understanding among the design group [8].

3 User-technical process

Many products do not obtain their entire functionality without the user and other products do not function at all without assistance from a human being. Despite this fact, earlier theories, e.g. Hubka & Eder [1] and Andreasen [9] leave the user outside the system border in the synthesis part of the design work. In these theories only the technical system is investigated. In fact, the user and the technical system, in interplay with each other, together create a unified system, namely a *user-technical system*.

The interactions between the technical system and the user have to be considered and therefore a suggestion is to draw a parallel between the *user actions* and the *technical functions*, as earlier shown in Janhager [10]. Moreover, the users have feelings and thoughts. Thus, *mental activities* are introduced in the model as well, see Figure 2. The user actions and the mental activities constitute the *user process*, while the technical process consists of the technical functions. Together they compose the *user-technical process*. A time axis extends along the processes, parallel to the actions, activities and functions.

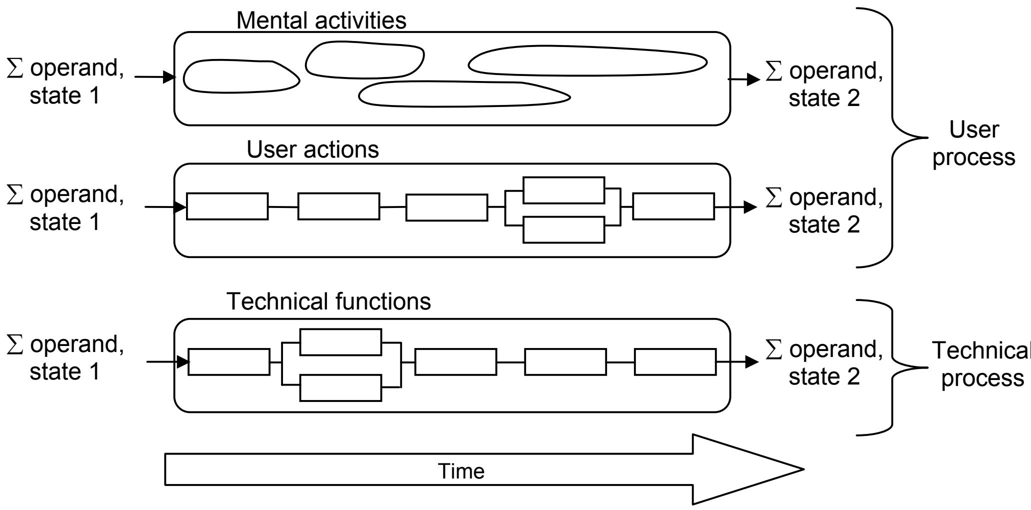

Figure 2. The user process is constituted by mental activities and user actions and the technical process by technical functions.

- *Mental activities:* In the mental activities, the user's feelings and thoughts are illustrated. It is impossible to predict what kind of emotions or attitudes the user will have in the relation to the product, but it is possible to imagine bad feelings or pleasant thoughts. A process of feelings may also be difficult to schematise, because the user experiences them more or less all the time and thoughts come and go. However, it is feasible to illustrate when the designer wants the feelings or thoughts to be initiated or when he/she believes they are going to occur.

- *User actions:* An action is a process directed towards a conscious purpose and it is subordinated to the representation of the result that must be achieved [11]. The user's intended actions, which he/she is going to perform, are described here in the user process. In a more detailed user process, it may consist of user operations[1] instead of user actions.
- *Technical functions:* A technical function is what an element (system, part, component, module, organ, feature, etc.) of a technical system actively or passively does in order to contribute to a certain purpose [5].

Like the technical process, the user process also has an operand with input and output. The user and the technical system collaborate to attain a particular goal, such as performing a task. Therefore, it is practicable and necessary to find a main function and a main action for the technical system and the user that have the same purpose. Moreover, the operand and its states should be the same for the two systems.

The technical functions may be focused on the operand's transformations. Since the user actions may be directed to the technical system or another user, it is not always possible to immediately direct the user actions to the operand. However, the user in collaboration with the technical system transforms the operand.

4 Build scenarios

By using the user-technical process, a structured scenario can be built. The foundation of the scenarios is the same as for ordinary scenarios, according to Suri & Marsh [4], i.e. individual users with issues, tasks and situations are established, and the product concept is generated with help of the user-technical process. Further reading about concept creation can be found in for example Liedholm [12]. However, the stories are structured after the format according to the user-technical process in Figure 2.

The user-technical processes for the concepts that are selected for further development, could be expanded, in other words made more detailed, before establishing the scenarios. This is due to the fact that the designer has more information about the product to be developed and it facilitates the building of scenarios. It is important to make more than one scenario [4].

The advantage of using the user-technical process for a scenario is that the concurrence between a user action and the corresponding technical function is clearly presented, i.e. the method shows visibly what the user and the technical system perform simultaneously. At the same time, it is possible to segregate a process and investigate it in isolation to see what either the user or the technical system does. Moreover, the differences in the users' acting and mental activity are visibly separated. It is also easy to exchange combinations of actions or functions from the scenarios. This makes it for example easier to compare different design solutions by keeping the same user situation and change the scenario for the different concepts.

An example of how the method could be used during the conceptual phase in product development is presented below.

[1] One or a chain of operations realise the actions. The operations are in general carried out unconsciously (automatically) [11], [13].

5 Example

To verify that the user-technical process could be used for scenario building, the method has been applied to a practical case (compare with chapter 2.2). The product to be developed is a device for helping carers to lift and transport disabled persons. An example of an existing product which fulfils this task is a patient lift, illustrated in Figure 3.

Figure 3. An example of an existing lifting device for disabled persons.

A user-technical process for the lifting device has been created and is presented in Figure 4. The product has two users, the carer and the patient, and therefore two user processes are needed.

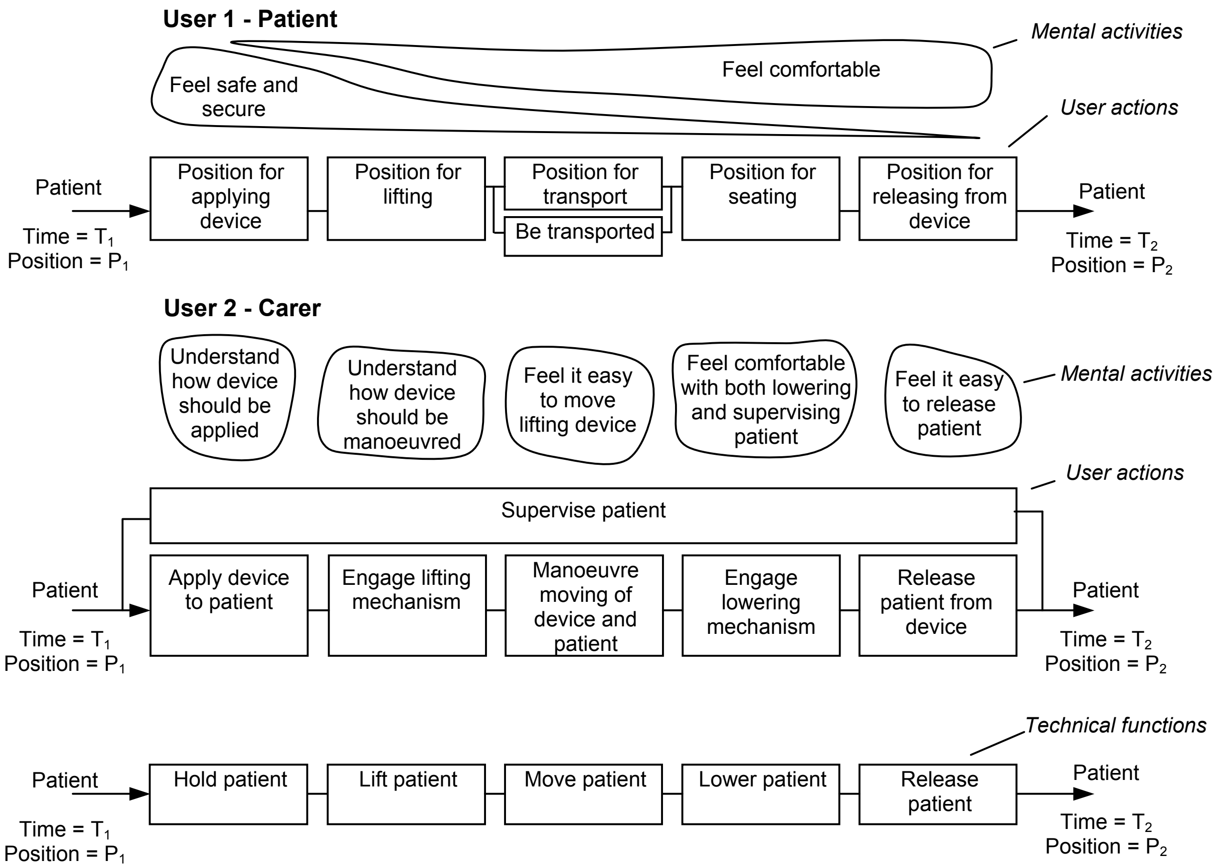

Figure 4. The two user processes for patient and carer, and the technical process for the lifting device. The operand is constituted by the patient, the in-state is T_1 and P_1 and out-state is T_2 and P_2.

5.1 Scenario

- **Product:** From the user-technical process and a function/means tree (see Liedholm 1999) several concepts are generated and some are selected for further development. This example is established on a concept which contains a lifting table, which the patient should lean over during lifting, transport and lowering. The belt is buckled around the patient's waist and the belt is hooked onto the lifting table. There are two handles on the table which the patient can hold onto during lifting and seating, as shown in Figure 5.

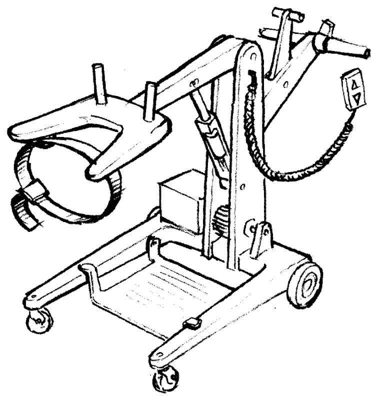

Figure 5. The concept that provides the base for the scenario.

A structured scenario was created to find new viewpoints in the use situation, which could influence the performance of the lifting device.

- **Users:**

- *Carer*: Erica is 22 years old and works part-time at an old people's home. Erica does not really like the job but needs the money to support her studies. She thinks the work demands too much responsibility and effort.
- *Patient*: Maria, 79 years, is seriously disabled and is physically weak, especially in her arms. She has no trust for Erica as she thinks that the carer is too young and irresponsible.

- **Situation:** Erica wants to go home. She is tired since she has been working the whole day. She is going to help Maria change places, from an armchair to her bed. It is very difficult to get near the chair with the lifting device. Maria is wearing several layers of clothes, which makes Erica uncertain about how tightly she ought to buckle the belt.

  Maria is in a bad mood because she neither likes nor trusts Erica. She asks for Charlotte, another carer. The scenario is illustrated in Figure 6.

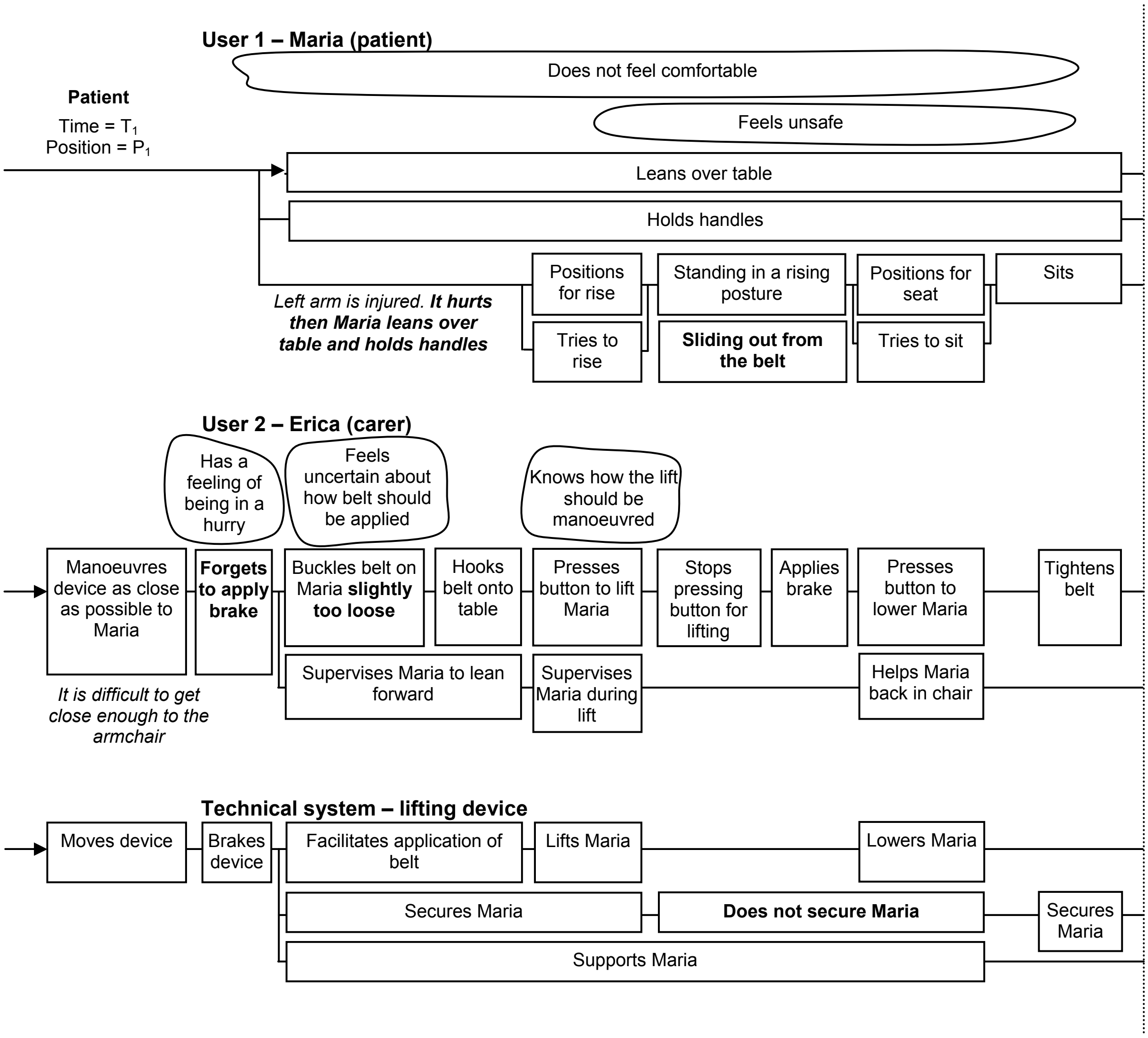

Figure 6. The figure shows the first part of the scenario. The following sequence (not shown in the figure) describes how Erica makes a second attempt to lift Maria.

One benefit by creating scenarios is to find defects and new demands on the product. The requirements and findings, which were obtained from the first part of the scenario, are presented below:

- It should be possible to get close to patients with the device.
- The lifting device should exhort or force the carer to apply the brake while applying the belt and lifting and lowering the patient.
- Provide help or restrictions for the carer to show when he/she has tightened the belt sufficiently.
- There should be no risk of the patient sliding out of the belt during transfer, lifting or seating.
- The device with belt should support patients who have almost no strength at all.
- It should not be necessary for the patient to hold onto the handles. The handles should primarily be a means for convenience.

5.2 Conclusion

This paper has showed that the technical process could be supplemented with the user process and together they constitute a user-technical process. This model is a better description of many products as they often co-operation with its user. Thus the designers ought to design a user-technical system and just not a technical system.

The user-technical process is valuable in the early stages of the design process, when the understanding for the design issue and the use situation should be established. The designer could describe an intended use situation and define the sequence of interaction between user and product.

With support from the user-technical process it is useful to create structured scenarios arranged in the same they as the processes. The benefit of building scenarios in this way is that the user's and the technical system's mutual and own actions and functions are clearly schematised. The different activities are clearly described in every moment of time. This makes it easy to focus on just one part: the technical system or the user. The detached mental processes also help the designer to separate the user's thoughts from his or her actually acting. Moreover, it is possible to change combinations of actions or functions from the scenario, for example exchange one of the users to another individual or compare different design solutions with each other by keeping the same user sequence. The clear presentation of actions and functions also makes this type of scenarios useful for verifying use sequences in different situations for products.

Acknowledgments

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