

# Socio-technical Process Design – the Case of Coordinated Service Delivery for Elderly People

Thomas Herrmann, Michael Prilla, Alexander Nolte

Information and Technology Management, Ruhr-University of Bochum, Bochum, Germany  
{herrmann, prilla, nolte}@iaw.rub.de

**Abstract.** The challenges of socio-technical design are demonstrated by a project of investigating the usefulness of Pen&Paper technology for ordering and coordinated service delivery. The employing and combination of a variety of methods for socio-technical design is described: surveys, ethnography, creativity techniques, walkthrough, usability testing and practical pre-tests. These methods are reflected with respect to cyclic design and support of evolutionary growth. One of the critical challenges is the practicability of combining various methods. Focusing on a socio-technical process proves to be an appropriate approach to integrate technical features with corresponding organizational measures.

**Keywords:** socio-technical design, methods, process design

## 1 Introduction: Integration of pen&paper technology and service delivery as a socio-technical process

The project Service4home [1] investigated the usefulness of Pen&Paper technology for elderly people to order services. In order to coordinate and conduct these services in a cost-efficient way, we established a service agency. Creating such a solution requires a holistic approach, which not only considers human-computer interaction aspects but also the design of the interplay between technical infrastructure and organisational processes. We thus ran Service4home as a project which takes into account various influences on work and combined different methods into an approach of socio-technical design [2].

Literature on „Socio-technical Systems Design“ such as ETHICS [3] or literature on basic principles of socio-technical design [4, 5] and socio-technical systems engineering [6] is closely oriented towards companies as organisational units, in which tasks are supposed to be conducted more efficiently through the integration of organisational and technical systems and processes. In this context, the term ‘system’ in socio-technical system design refers either to a software-system [6] or – more holistically – to an organizational unit (such as a company or a department) that will include the technical components. The term system implies on the one hand a unit – consisting of related elements – which is clearly separated from its environment [7]. On the other hand, a holistic approach attempts to see the relations within the system in the

context of the environment's influences to understand or design its behaviour in accordance with system thinking [8]. In the project Service4home however, it was not reasonable to identify an organizational unit to be designed. We rather had to include various organisations such as a housing society, the households of the renters, the neighbourhood of households, and a local subsidiary of a social welfare organisation, which took the role of a service agency throughout the course of the project. To integrate them into a single socio-technical system would have enlarged the focus in a way that would have made it impractical to carry out the project. Therefore we took the whole (service) process as a design focus, and holistically included the relevant influences which shape the activities within this process. This implies a shift from socio-technical **systems** design to socio-technical **process** design. This is methodologically reflected by e.g. using a visualization of the socio-technical process throughout the project and by applying several walkthroughs on this visualization [9]. These walkthroughs were facilitated and pursued participation and collaboration of several stakeholders to communicatively integrate a variety of perspectives. We identify structured discourses as a crucial contribution to the evolution of social systems in accordance with Luhman [10] and Habermas [11]. We used a variety of methods to inform and support the development and deployment of the socio-technical process being designed by the Service4home project.

The aim of this paper is to reflect on how different methods can be combined and arranged to support the focussing of socio-technical design on a process, and how this focus provides an orientation to select the relevant aspects which have to be taken into account. In what follows, we start by describing the socio-technical solution that we developed during the course of the project (section 2). It should be noted that the focus of design was not on the technical quality of the solution (i.e. whether the most suitable technology was chosen) but on the methodological approach. This is based upon the fact that the Pen&Paper technology we used was predefined from the beginning of this project. Then, we describe the methods used in the project (section 3) and discuss them (section 4) before we summarize our insights (section 5).

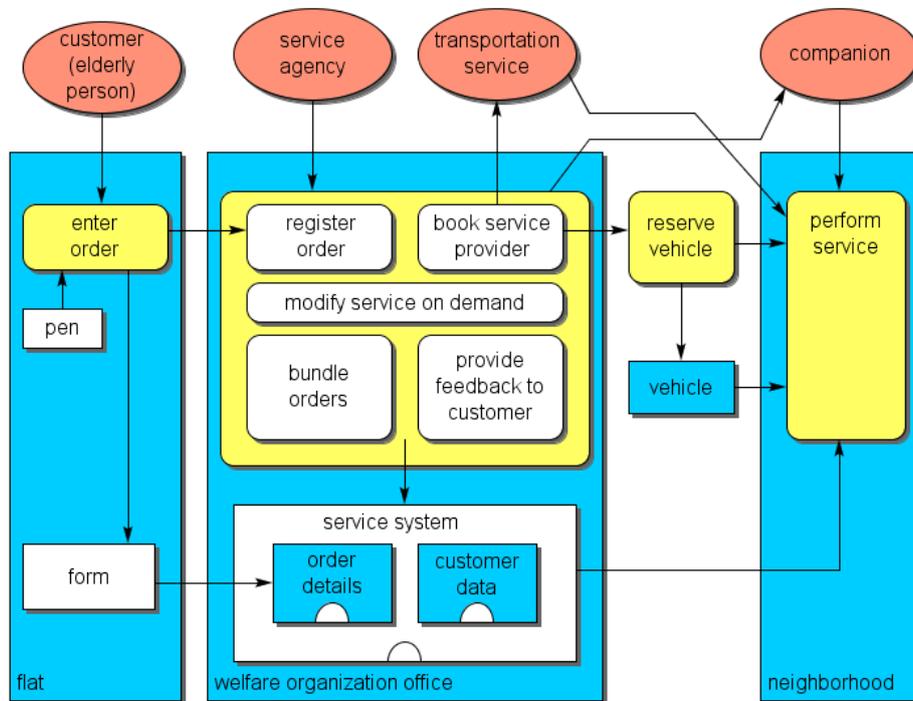
## **2 Pen&paper technology and service coordination as a socio-technical solution in a neighborhood**

Service4home was run to investigate whether Pen&Paper technology and a corresponding infrastructure are useful for people to send orders to a service agency (run by a welfare organization). We put a special emphasis on offering services for elderly people that help them to live on their own and in their homes for as long as possible. A service order is placed by filling in a (simple) paper form and using a digital pen equipped with a camera (e.g., pens by Anoto™). The pen recognizes the writing on the paper form and transmits the data to the agency. This allows for people to order services digitally without requiring the use of a computer device. The data is then included into an excel sheet which is used by the service agency to coordinate service delivery. After an order is processed successfully by the service agency, the clients are notified via telephone about when and where the service will be conducted.

The services are offered to the renters of the housing society. They include services such as home care, shopping support, cleaning and many others. By establishing a service agency as a part of a citizen center, services can be offered flexibly and on demand. This flexibility can be considered a huge competitive advantage compared to common offers, where services are available only at given times and certain rhythms during the week. Given that orders were available digitally and beforehand, the agency could also efficiently use staff capacities by bundling services (e.g. by offering a shopping companion to two or three people which wanted to visit the same shop thus reducing the cost per person).

Fig. 1 shows an example for such a service where elderly people are accompanied during their weekly shopping. The process described there includes technical components and spatial constraints. It also shows how activities are integrated into the social interactions within the neighborhood. This actual process was developed and implemented during the course of the project [12]. It includes different roles (actors) and places, which are connected by the technical infrastructure:

- A customer (elderly person), who starts the process by filling in a form at home,
- the service agency, to which the order is sent to be processed and bundled with other orders; contacts to service providers (e.g. a transportation service) and customer feedback was organized there as well,
- the neighborhood, where services such as “shopping companion” were conducted.

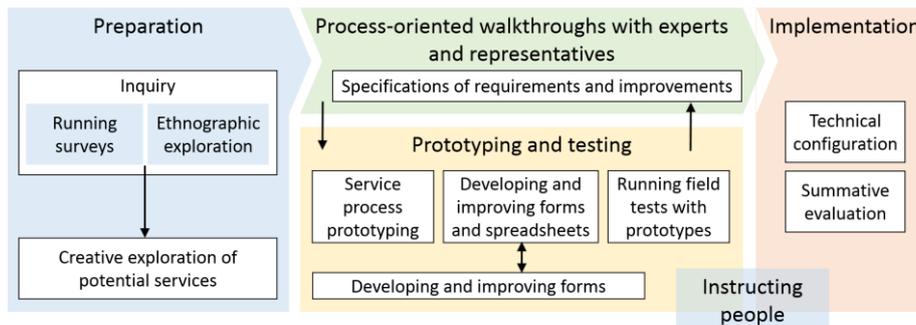


**Fig. 1.** Roles, activities, components of the solution by the example of a combined service for transportation and shopping support (“Shopping companion”, modelled using SeeMe [13]).

### 3 Methodology and course of the project

The usability and acceptance of a new process like the one described before depends on various aspects, such as the quality of the paper forms and the perceived quality of the cooperating partners (e.g., services providers) and other helpers (e.g., voluntary shopping companions).

Methods that aim at designing and implementing such solutions need to enable designers to get an understanding of these aspects and to tailor solutions to them. Literature however, mostly focusses on the description of frameworks for such designs rather than providing guidance on the application of concrete methods. Support can be found in approaches such as Contextual Design [14], which describes different ap-



proaches for empirical work and documentation of insights in the design process.

**Fig. 2.** Procedure of the design project

According to the needs described above, Service4home included multiple methodological steps, which were partly overlapping (c.f. Fig. 2). These steps required suitable methodological support. In what follows we describe these steps. It should be noted that they do not follow a certain process but were chosen based upon the necessities within the project (e.g., insights needed and requirements to be fulfilled).

### **3.1 Explorative data gathering**

In the beginning of the project empirical investigations covering the application context and constraints were run. These investigations included a survey as well as ethnographic methods (c.f. Fig. 2 left).

To analyze the potential demand for services, we ran a survey covering 10% of the renters in the neighborhood where the services were to be offered in (n=120 households). The survey consisted of questions on the demographic background, willingness and potential to pay for services, assessment of value perceived by certain services and questions on the acceptance of the Pen&Paper technology. The results of the survey were used as a basis for choosing appropriate services and for designing concrete service processes. For example, according to the results, the acceptance of Pen&Paper technology was above 50% across all age groups.

A complementary exploration was conducted as an ethnographic study to collect qualitative data and to identify specific constraints within the neighborhood. This was conducted by talking with elderly people about their habits, exploring the area, working with the people in the citizen center etc. Results were included into the design of the services, contrasting them with the ideas and visions of project staff. The ethnographic study included observations as well as conversations with renters of the area. For example, from a conversation with an elderly lady it became obvious that despite some physical problems she regularly went to the office of the welfare organization to help others – providing help also manifested as a major prerequisite of taking help in the study. Based upon the results of the ethnographic study we developed stories that guided the further course of the project. We deliberately chose a pragmatic approach to ethnography, which brought forward many insights and ideas but also allowed for (partial) incompleteness. Results from both the survey and the ethnography served as a basis for preparing the creativity techniques described in the following section.

### **3.2 Exploration of potential solutions with creativity techniques**

After the inquiry phase a workshop was conducted (c.f. Fig. 2 bottom left), in which new ideas for services were developed [4]. From a collection of ideas provided in the workshop, the participants chose services they perceived to be well suited for the renters of the neighborhood and that could be supported by Pen&Paper technology.

The duration of the workshop was three and a half hours. In the beginning, the moderator asked the participants (organizers of the services, software developers, welfare organization staff and researchers) to answer the question “*Why is it helpful for elderly people to be integrated into a network of people (professionally, voluntary, personally related)?*” individually. The answers were written on paper cards. Then, groups of three people used these cards as a basis to answer the question “*Which offerings for and by elderly people can be derived from the collection of ideas?*”. The resulting ideas were collected digitally before they were compacted and associated with new ideas that came in during this process. After that, the groups of three were merged to groups of six before all groups came together in order to exchange ideas. During this transition phase ideas were sharpened and concretized.

The workshop featured different means to facilitate ideation and creative thinking:

- Questions such as “*Which kind of support would be helpful for elderly people*” and the questions mentioned above,
- Randomly chosen pictures of elderly people in different life situations,
- A loop of presentation slides with results from the inquiry phase, including insights on interest and demands for services as well as leisure activities of elderly people,
- Stories created by one of the researchers that was part of the ethnographic study,
- A provocation: people were asked to envision the wishes of an elderly person, who could afford anything due to her being famous.

From a large number of resulting ideas, we prioritized those ideas that were perceived by the participants as valuable for the later services processes.

We also used brainstorming techniques afterwards to concretize the process on which the socio-technical process was to be based. We identified six fields of action, which needed to be designed in more detail afterwards: Preparing a service, transferring order data, communicating about a service, processing and coordinating orders, conducting the service, and following up on the service conducted. Based upon these fields a basic process representation was created and discussed. For the discussion we used guiding questions such as “*Which steps need to be regarded?*”, “*Which data is needed?*”, and “*For which areas of work can the digital pen be supportive?*”. A detailed description of this procedure can be found in [15] and [16].

### **3.3 Participatory design with the socio-technical walkthrough**

One of the main challenges we faced during the course of the project was to choose a reasonable set of participants for the workshops and to organize their participation [4, 17]. Participation was a key aspect to identify potentials and barriers of technology usage and to adapt the socio-technical solution accordingly. As target groups and potential participants we identified elderly people, welfare staff and management, potential staff of the service agency, representatives of the housing society, external service providers and technology developers. For these groups we used different ways of integrating them into the project [1]: service providers, welfare and housing society staff and management as well as developers were directly integrated into modelling walkthrough workshops (c.f. Fig. 2 top middle) and the prototyping of service pro-

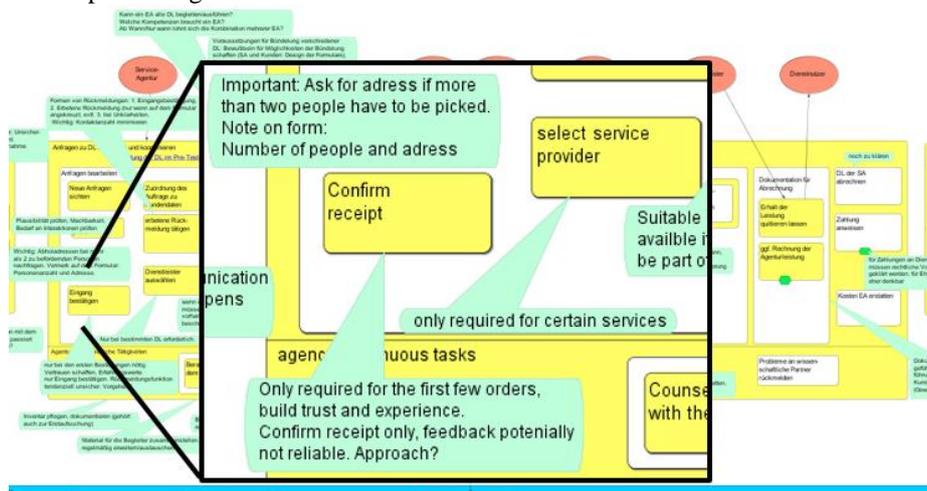
cesses (c.f. Fig. 2 bottom middle). Elderly people were indirectly involved in order to get their feedback on the quality of service processes and their fit to daily needs. Elderly people were also integrated by discussing marketing material with them, in which the services offered and the procedure for their delivery was described alongside paper forms that were designed to order the services [18].

The indirect involvement of elderly people into the design of the processes proved to be helpful, as it enabled them to assess the results of process design after each phase of design and deployment: This enabled them to look at the processes from the angle of potential clients and to add a perspective that was decisive for the development of the processes – this perspective was not provided by any of the other participants (developers, experts, researchers). Foci of the feedback given by the elderly involved can be found in transparency of prices and value proposition (“*What do I get for my money?*”) and reliability regarding the services ordered (e.g. expressing the need of approval after orders via telephone). The implementation of this feedback into the processes was supported by researchers, who acted as representatives of the elderly people during workshops. The researchers intervened when they thought it was necessary from the perspective of the elderly people.

### 3.4 Usability test and field tests of the prototypes

The design of the paper forms was evaluated in intensive usability tests with elderly people (c.f. Fig. 2 bottom middle). These tests showed a lot of minor problems handling the forms (e.g. for filling in the date, we had provided boxes for each digit that were not recognized by some participants in the test), which resulted from the fact that using a paper form provides less restrictions than filling in a web form. During evaluation, the participants were asked to perform sample tasks (service orders) with the forms and to fill in all data needed to order the service. This was done in two iterations.

The improved forms were used to run a field pretest of the prototyped service processes (c.f. Fig. 2 bottom middle). In order to do this we created Excel sheets containing data that represent service offerings. Furthermore, we trained the staff of the service agency with respect to the process of coordinating services. This was done by a test that was run for three months with four households. For this time period, data was not sent electronically but the forms were collected from the households manually. These visits also offered researchers the opportunity to talk to and interview participants of the pretest and to identify difficulties and barriers when ordering services. The forms were then transferred manually to the corresponding sheets by the staff of the service agency, which in turn offered possibilities to observe and discuss problems in data processing and service coordination.



**Fig. 3.** Comments containing improvement needs in the process model of the service (including zoomed part).

### **3.5 Deriving improvements in a walkthrough**

To connect insights and other results from the pretest closely to the design of the service process, we analyzed the process again using the approach of the socio-technical walkthrough (STWT) [9, 16]. A Walkthrough [19] is done in a step-by-step process following a documentation – in our case the documentation came in the form of a process model. The socio-technical walkthrough promotes the discussion with respect to the details of a process model (i.e. process steps) by using guiding questions. We used questions such as “*Where did we encounter problems?*” or “*Which tasks need to be adapted?*” as the basis for discussion. The walkthrough was conducted in a workshop in which all participants of the pretest served as workshop participants (c.f. Fig. 2 top middle). Researchers brought in the results from the discussions and feedback given by agency staff and elderly people – thus representing them as discussed above (c.f. section 3.3). While discussing the process model step by step comments were added to the process model. These comments served as a basis for re-design after the workshop. Whenever it appeared feasible and reasonable the process model was altered right away. Fig. 3 shows a part of the process model, illustrating the amount of comments created. After the workshop the comments were processed and included into a new process design. One of the results from this procedure was to set priorities in service delivery and to reduce the amount of options in service orders. This included the number of different services to be offered as well as service details such as the number of supermarkets for which the shopping companion service was offered.

### **3.6 Establishing organizational processes and evaluation**

In parallel to the analysis of the pretest, the technical components were designed and implemented (servers, data transmission, processing via Excel sheets, c.f. Fig. 2 right). We found that the technical challenges were far less complex in comparison to the establishment of the organizational procedures in the socio-technical process. Such establishment is referred to by Baxter & Sommerville [6] as „Change Process”, which accompanies the technical development. In Service4home this included choosing and training agency staff as well as integrating suitable service providers and voluntary helpers (e.g. shopping companions). Recruiting elderly people who are willing to pay for the services offered by the agency proved to be a challenge. For this the abovementioned marketing material can be considered crucial. In addition building trust also was an important factor. As an example, all members of agency staff were provided with a special ID to show when they arrived at the different households. Elderly people were mostly recruited via personal conversations during information events run by the welfare organization. Testimonials provided by clients of the agency (e.g. those who were part of the pretest) also were helpful. In addition we also made sure to only record a minimal amount of personal. As an example data on special

needs of clients was asked for each time when filling in forms again in order not to store them as standing data of clients.

The services proved to be quite successful: The five most active clients ordered 77 service in the first nine months of the service agency. The Pen&Paper technology was also used cooperatively. For example we were told that two clients, who wanted to use the shopping companion service together, talked on the telephone when filling in the forms to ensure that they would be able to go shopping together.

#### **4 Reflection: Relevance of the methods for socio-technical redesign**

The literature describes a variety of methods, e.g. with respect to usability design, ethnography, interviewing techniques, participator design (cf. [6]) which can be employed to develop complex socio-technical solutions. However, the challenge is to go beyond analytical and technical considerations, to extend design to the realm of organizing work processes and their continuous evolution, and to find an appropriate focus and extend of details to be taken into account.

With respect to the **qualitative exploration** of the social aspects it became obvious, that the magnitude of potentially relevant details cannot be taken into account in accordance with ethnographical standards. A manageable focus of ethnographical gathering of data can be to challenge pre-assumptions being made about the context of a solution. For example we erroneously supposed that groups of people can meet somewhere to be picked up by a taxi although there was no shelter available where people could wait e.g. during bad weather. In this context it is most important to identify potential for social conflicts which can potentially compromise a socio-technical solution. To inform redesign activities it is important to repeatedly collect stories about how a technical system is used as well as rumors about the success or failures. We gained valuable data by working with people at the citizen center at the beginning of the evaluation. This should have taken place earlier to inform in the first phases of design.

**Creativity techniques** support the emergence of a variety of helpful and innovative ideas. Via brainstorming potentially important details of the newly designed collaboration process could be anticipated. Involving experts such as caregivers into brainstorming was not only relevant with respect to the experience and background they could bring to the table. Involving different participants from different backgrounds also stimulate creativity. It was expected that not every innovative idea was brought into reality in the first design cycle. The early phases of combining creativity and development of requirements should consequently rather be used to establish an idea pool which is continuously maintained and to which one can go back to inform continuous redesign. Since creativity techniques produce a variety of ideas, they help to overcome sticking with the first draft for a solution. However, it has to be taken into account that practitioners and analytically oriented experts may have a critical attitude towards creativity techniques.

Improving and adapting a socio-technical solution by inspecting the process model proved reasonable since the approx. 115 modeled activities had to be discussed with respect to several questions. It turned out that it is a challenge to motivate participating experts to actively take part in these repeated walkthroughs. It was necessary to prepare the workshops carefully and to avoid long phases of documenting results of the discussion. The participants should always perceive that their active involvement is solicited and helpful. It was reasonable to intertwine walkthroughs with phases of brainstorming to collect proposals of how the recognized problems can be overcome. Walking through the draft of a organizational work process helped to derive requirements for the socio-technical solutions. It also helped to realize how technical features and social measures had to be related to each other.

Offering and supporting **participation** was highly relevant to achieve acceptance for the project. It turned out to be inappropriate to directly include elderly people in the discussion since the caretakers did not want to disclose their experience if their clients are present. Therefore we included representatives of the elderly who were familiar with their needs and we also took the results of the ethnographical analyses into account. We knew that these representatives might have a biased view. But we also expected that the evaluation of the field test provides correcting information if necessary. When starting the project we thought that the biggest barrier to be overcome would be the acceptance of the technology and the services by the elderly people. In contrast, we faced the highest skepticism by the people who worked in the welfare organization and whom we asked to run the coordination agency. They were skeptical about the possibilities for informal communication if the orders were submitted electronically. This kind of skepticism did not become obvious during the walkthrough workshops since the participants felt obliged to behave supportive with respect to the group dynamics. The problems rather surfaced when members of project took over some tasks at the service agency. Similar to action research they had the opportunity to get a more direct impression of how people think and act. Concluding, it is reasonable to combine participatory approaches taking place in workshops with action research activities where members of a project directly interact with people that are part of a socio-technical process. This is useful to detect potential conflicts as early as possible.

**Usability**-Testing as well as practical **pretests** in the systems environment were indispensable for the success of the project. They helped to detect mistakes early on and promote focusing on realistic goals. The problem of pretest is that they influence the participants' first impression of the socio-technical concept and therefore sustain opinions about it. This opinion can be negative since pretests usually help to make deficits apparent and take place while not every question is sufficiently answered. For example, questions about the costs for the services could not be answered during the pretest. This vagueness led to an uncertainty which was communicated between potential clients and proved as an obstacle when marketing started.

When the new processes of ordering and coordinating services were eventually established a **gradual deployment** of the solution was necessary. Accordingly, the potential users had the possibility to become familiar with the Pen&Paper technology by testing it at the citizen center before they ordered it for their household. During the

test they were assisted to perform real ordering of services by filling in a form. Offering the possibility of such a type of testing in the citizen center implied the need to have two types of forms: one where the name of the user had to be filled in explicitly and another where this was avoided since each form was assigned to an household. Furthermore, a gradual introduction of the new technique included that it could have been tested at home before the payment of a fee for every usage had been started.

It is necessary to combine such a gradual introduction of new socio-technical processes with the need of continuous adaptation and evolutionary redesign of the solution. The possibilities for adaptation have to be taken into account in advance for instance by applying principles of meta-design [20]. This includes underdesign – an approach which avoids the specification and determination of details which restrict the flexibility of the usage processes. Only those aspects which ensure the compliance with legal norms and similar restriction have to be fixed by technical features so that they cannot be bypassed. An example of meta-design in our project was to avoid programming the digital pens in a way that every special form had its own software. By contrast, the pens we used more abstract variables to program the pens. Consequently, we were able to change forms without changing the digital pens' software.

## **5 Conclusion and summary**

Conducting the project Service4home we faced the challenge to create a socio-technical solution where we had to set up a service agency that coordinates services for elderly people. In order to do so, the support of different service providers and volunteers had to be acquired. Our experience from using different methods during the project provides initial insights on how to support socio-technical design being focused on a process (rather than a system).

The centerpiece of our methodological approach (c.f. Fig. 2 top middle) are facilitated discourses within walkthroughs which repeatedly refer to models of the designed process. As a preparation we conducted interviews and surveys as well as ethnographic data gathering in order to cover the details and constraints that can and will potentially influence the socio-technical process. To our understanding, designing a socio-technical process requires a cyclic approach that involves multiple phases of prototyping, testing, and (re-)design or adaptation. Pretests in the real future field proved to be especially helpful as they create insights – which supplement the views of the walkthrough participants – on additional and changing requirements and before finally implementing the process. Therefore, we suggest that design and deployment consequently are organized step-by-step in cycles which include informing and orienting actors towards a future solution (c.f. Fig. 2 middle).

It is reasonable to accompany the cycles by socio-technical walkthroughs which employ the linear structure of processes to decide step-by-step how the experience with the prototypical solution is translated into improved design. This allows for systematically analyzing the current state of the solution, anticipating potential flaws and identifying details that have to be adapted. This systematic linear approach should however be accompanied by phases of creative divergence. Approaches that foster

creativity such as brainstorming support divergence and allow for new ideas to be created or factors to be collected that have to be considered when designing a socio-technical process [21]. Linear walkthroughs consequently serve as a convergence phase that accompanies these divergent phases in order to shape the socio-technical process and prepare its delivery.

## 6 References

1. Prilla, M., Herrmann, T.: Gestaltung von AAL-Lösungen als sozio-technische Systeme: Selbstgesteuerte Alltagsunterstützung. *i-com. Zeitschrift für interaktive und kooperative Medien.* (2012).
2. Mumford, E.: The story of socio-technical design: reflections on its successes, failures and potential. *Information Systems Journal.* 16, 317–342 (2006).
3. Mumford, E.: *Effective Systems Design and Requirements and Analysis - the ETHICS approach.* Macmillan Press LTD, Houndsmill, Basingstoke, Hampshire and London (1995).
4. Carell, A., Herrmann, T.: Interaction and Collaboration Modes for Integration Inspiring Information into Technology-Enhanced Creativity Workshops. In: *Proceedings of the 43rd Hawaii International Conference on System Science (HICCS 43)* (2010).
5. Cherns, A.: Principles of Sociotechnical Design Revisited. *Human Relations.* 40, 153–162 (1987).
6. Baxter, G., Sommerville, I.: Socio-technical systems: From design methods to systems engineering. *Interacting with Computers.* 23, 4–17 (2011).
7. Bertalanffy, L. von: *General system theory: Foundations, development, applications.* Braziller. New York (1968).
8. Alter, S.: Desperately seeking systems thinking in the information systems discipline. *ICIS 2004 Proceedings.* 61 (2004).
9. Herrmann, T.: Systems Design with the Socio-Technical Walkthrough. In: Whitworth, B. and de Moor, A. (eds.) *Handbook of Research on Socio-Technical Design and Social Networking Systems.* Information Science Reference (2009).
10. Luhmann, N.: *Soziale Systeme. Grundriß einer allgemeinen Theorie.* Suhrkamp Verlag, Frankfurt (1993).
11. HABERMAS, J.: *Theorie des kommunikativen Handelns. Band 1. Handlungsrationalität und gesellschaftliche Rationalisierung.* Suhrkamp, Frankfurt (1981).
12. Prilla, M., Rascher, I., Skrotzki, R.: Digitale Stift-Technologie zur Vermittlung von Dienstleistungen: Auswahl und Anpassung geeigneter Dienstleistungsprozesse. In: *Proceedings AAL-Kongress 2011* (2011).
13. Herrmann, T.: SeeMe in a nutshell - the semi-structured, socio-technical Modeling Method. (2006).
14. Beyer, H., Holtzblatt, K.: *Contextual design: defining customer-centered systems.* Morgan Kaufmann (1998).
15. Herrmann, T., Nolte, A., Prilla, M.: Awareness support for combining individual and collaborative process design in co-located meetings. *Computer Supported Cooperative Work (CSCW).* 22, 241–270 (2013).

16. Herrmann, T.: Kreatives Prozessdesign - Konzepte und Methoden zur Integration von Prozessorganisation, Technik und Arbeitsgestaltung. Springer, Berlin Heidelberg (2012).
17. Prilla, M., Nolte, A.: Fostering self-direction in participatory process design. In: Bodker, K., Bratteteig, T., Loi, D., and Robertson, T. (eds.) Proceedings of the eleventh conference on Participatory Design 2010, pp. 227–230. ACM New York (2010).
18. Turnwald, M., Frerichs, A., Prilla, M.: Usability Testing für und mit Senioren. In: Brau, H., Lehmann, A., Petrovic, K., and Schroeder, M.C. (eds.) Tagungsband Usability Professionals 2011. pp. 216–220. German UPA e. V., Stuttgart (2011).
19. Yourdon, E.: Structured walkthroughs. Yourdon Press Upper Saddle River, NJ, USA (1989).
20. Fischer, G., Herrmann, T.: Socio-Technical Systems: A Meta-Design Perspective. International Journal for Sociotechnology and Knowledge Development. 3, 1–33 (2011).
21. Herrmann, T.: Design Heuristics for Computer Supported Collaborative Creativity. In: System Sciences, 2009. HICSS'09. 42nd Hawaii International Conference on. pp. 1–10 (2009).