

Socio-Technical Walkthrough: Designing Technology along Work Processes

Thomas Herrmann Gabriele Kunau Kai-Uwe Loser Natalja Menold
Informatics & Society
University of Dortmund, Germany

{thomas.herrmann; gabriele.kunau; kai-uwe.loser; natalja.menold}@udo.edu

ABSTRACT

How can the documentation of concepts for complex socio-technical systems, such as the adoption of groupware, be incorporated into practices of PD? Documents are important in supporting participants in their decision-making and in serving as a guidance for the ongoing project. To create such documents a mix of abstract graphical models and illustrative material can be used. There is evidence which suggests that they can be successfully employed if they are embedded into a communication process which is facilitated in a specific manner: The socio-technical walkthrough (STWT) that supports a participatory process during which concepts of such systems are (re-)considered step by step. A case study describes the challenges and benefits of the STWT paying special attention to aspects such as facilitating strategies, required preparation, training, characteristics of the diagrams, and accompanying work.

Categories and Subject Descriptors

D.2.1 [Software Engineering]: Requirements/Specifications – *Elicitation methods*.

H.5.3 [Information Interfaces and Presentation]: Group and Organization Interfaces – *computer-supported cooperative work, organizational design, theory and models*.

K.4.3 [Computers and Society]: Organizational Impacts – *Computer-supported collaborative work*.

General Terms

Design, Documentation, Human Factors.

Keywords

Participatory Design, Socio-technical Systems, Diagrams, Modeling.

1. INTRODUCTION

One of the domains where PD can show its strengths is the introduction of those technologies – groupware for example –,

which support or modify the cooperation between different roles or persons. The variety of different interactions that take place between them, dependencies, potential sequences of task completion etc. lead to a much higher complexity than is the case if the design is basically focused on human-computer interaction. Computer-based cooperation, communication and coordination do not only include the introduction of computer systems but also involves specific training efforts and the modification of organizational structures. It is therefore reasonable to consider this kind of change as the development or the adaptation of a socio-technical system.

If this development of a socio-technical system is subject to a participatory design process, it is an open question as to how the affected employees can be enabled to understand and influence how their work processes and their social interaction will change. Several techniques have been developed for the purpose of "visioning a new work practice [10]" in the context of usability engineering, such as mock-ups, storyboards or prototyping. This is clear when looking at prototyping as it focuses the participants of the design process on aspects of the screen and dialogue design but neglects the organizational aspects of work which plays a decisive role in the forthcoming working conditions. Other methods, such as story boards or scenarios are more suitable for conveying an imaginary picture of the target situation to the participating employees. One of their strengths is that they are concrete and descriptive. But this concreteness also implies a weakness: the whole set of varying possibilities of as to how a cooperative task can be carried out under the conditions of computer support is reduced to a small number of examples of task constellations and sequences and therefore, a relevant part of possible problems or benefits cannot become a subject in the participatory decision processes. It might be necessary to use more abstract diagrams to overcome this weakness. They represent models of the relationships between different roles, activities, documents, tools etc. These models can include ramifications, varying sequences and varying combinations of resources, activities and results. However, the abstractness of this kind of diagrams can lead to differing interpretations of the depicted processes and structures. This makes it very difficult to ensure that the participants agree on the same concept when using such diagrammatic models as their favored solution. In our experience this problem cannot be overcome simply by delivering documents with detailed text descriptions to explain the diagrams – it is an indispensable success factor to embed diagrams into a well facilitated communication process [4][12]. Such a communication process has to be carefully prepared and the facilitation has to be supported by some methodical and technical

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tools. We subsume these methods and tools and the appropriate procedure to the term “socio-technical walkthrough (STWT)”. It can be considered as a model-based facilitation method of communication processes in the context of participatory design.

The STWT is the result of various projects involving diagrams for user participation, user training and cooperative design. We reported first experiences in the domain of workflow-management in [16]. The methods were extended to developing cooperative processes for groupware and knowledge management in two further projects [9] and we paid special attention to user qualification for this kind of system [8]. In [12] we derived success factors for involving users in developing diagrams using a case study, where work processes were adapted with respect to off-the-shelf software. One major result of the whole effort was a detailed discussion to enable better understanding of the possible functions of diagrams in the development of cooperative systems [4].

The next section presents an abstract description of the STWT and outlines open issues. Section 3 describes a case study from which a much more concrete description how a STWT can be put into practice is derived (section 4). Section 5 compares the STWT with other relevant techniques and gives examples of its integration into broader methodological concepts.

2. STWT – CONCEPTS

The core idea of the STWT is that the concept or outline of a socio-technical system is represented by a diagrammatic model which is the outcome of a participatory design process. This model is either developed from scratch or is derived from an existing model – which usually presents the given state of the work processes – by gradually modifying its elements with respect to the technology to be introduced. A model has to be inspected step by step before it is considered as the final solution, upon which most of the participants can agree.

For all obvious analogies between STWT and the concept of cognitive walkthrough [14], there are important differences: The cognitive walkthrough is a method for usability inspection of interactive systems. The evaluator plays the role of a user and goes through every possible dialogue step of the system which can be related to the completion of typical tasks underlying the inspection. After each step the evaluator tries to derive answers to a set of prepared questions about what s/he can see on the screen. These are questions such as: “Have I achieved the desired result?”, “What are the next possible steps of dialogue?” Based on the answers the interactive system is then either improved or passes the usability evaluation. The structural similarity with the STWT is that STWT inspects (or initially develops) a model of the socio-technical system step by step and that then every step should be accompanied by questions which should be selected from a prepared set of questions in a context sensitive manner. However, it is not a single evaluator who gives the answer, but the whole group of participants and they are also able to put forth their own questions. In contrast, in the concept of “Groupware Walkthrough” [13] it is an evaluator who answers a set of questions and the walkthrough is guided by a hierarchy of tasks and sub-tasks. For the participatory concept of the STWT, it is much harder to define what a single step to be evaluated might be. Usually, each activity in the diagram can be the subject of one step. But it is an open question what the appropriate granularity of

the depicted activities should be. When defining the appropriate steps it can also be reasonable to refer to events which might occur, to the roles which have to be coordinated, to the documents or information items which are processed or to the functionalities of the system which are being used. It is also an open question what an appropriate set of questions which accompany the STWT has to look like. This set should include items such as “What is the next sensible activity?” “Which information is needed to support this activity?” “How will this activity be changed?” “Which questions have still to be answered and when?”. It seems to be appropriate to accompany each step of the presentation with at least one question. The presenter needs the answers to these questions to know whether the presented step has been understood or not and whether it is sensible to proceed.

The outcome of the STWT is a series of diagrams describing a socio-technical system. One function of these diagrams is to be a basis for the documentation. However, their main purpose is to support the communication processes of participatory design. The diagram at hand helps the facilitator to focus this communication. The contributions to the discussion of the planned socio-technical solutions can refer to parts of the diagram and thus, the context of the contribution is clearer and its diagrammatic representation helps to draw the participants’ attention to it. The diagram is a basic result either of the facilitators preparation of the communication process or it is a result of previous communication. Thus, if the contributions do not refer to the diagram, the facilitator knows that the communication has to be refocused or that the previous phases have neglected important aspects which have to be inserted into the diagram. Furthermore, changes can be discussed and presented with the model, diverging opinions can be depicted as variations of the diagram and comments can be added to the graphical model. All in all the model serves as a catalyst which helps to develop a shared understanding of a newly developed or adapted socio-technical system. It has to be asked, how strictly the discussion should be focussed to the diagram and which other media – beside the diagram – should be used to focus the discussion and to keep important contributions available and how this media – e.g. cards on a pin board – can be related to the diagrammatic presentation.

Every socio-technical system usually needs more than one model to be presented and every diagram usually needs more than one walkthrough. If a walkthrough produces a lot of changes and annotations, the affected diagram can not be immediately used for a follow-up walkthrough. A break becomes necessary during which the diagram has to be aesthetically improved; new information, which has been elicited during the walkthrough, has to be inserted and it might become necessary to gather further information. One or more walkthroughs can be conducted in a single workshop. The participatory developing of a socio-technical system usually needs a whole series of workshops. The time between the workshops has to be used to improve and to complete the models, and to add links to artefacts and information that arise during the progression of the overall project. This leads to the question of how far the models can be changed without running into the risk that the participants will no longer accept them as a result of their own contributions.

The core of the socio-technical walkthrough is the development of a model of the new target system. However, the whole process can start with the discussion of a model of the current state of the

work processes. This can be very helpful to develop a shared understanding between the participants about the current state of the processes and resources of their work and the requirements for improvement. The first walkthrough has to be prepared by using established ethnographic methods [1] for getting a detailed understanding of the field where the socio-technical system should be established or adapted. The ethnographic studies provide a basis for the decision of how the whole participatory process should start and with whom. One question still being considered is how far, and when, the participants should be made familiar with the notation of the modelling method. They should at least be able to understand the diagrams and it is helpful if they can contribute their own modelling constructs instead of leaving this task to an external modeller.

The series of walkthroughs should be concluded by ensuring that the participants agree on the consolidated models. There can be a fluent transition to the training phases which are needed to adopt the socio-technical system – especially by those who could not take part in the participatory process. “Walking through the models” can also be a suitable means of conducting training.

The STWT should be supported by specific methods and techniques. The modelling notation should include possibilities which enable users to represent roles (sometimes also concrete actors), activities, entities (such as resources, documents, artefacts), conditions, events, logical ramifications, vagueness (i.e. incompleteness, uncertainty). The modelling method has to be supported by software which combines a mode for facilitating drawing, editing tasks and presenting the diagrams. This includes hide and show mechanisms, snapshots for prepared views, insertion of comments, traceability of changes, hyperlinks to additional material. The STWT-workshops have to be supported by specific expert roles such as a facilitator, a specialist for the modelling method, occasionally a drawing expert who handles the editing tool (draftsman); and a technical expert who provides detailed information about technical possibilities and limitations.

3. CASE STUDY

In a case study based on action research we accompanied a company which plans to improve its communication processes by using information technology. The company offers logistics services and intended to support the interaction between the drivers on the road and the dispatchers in their offices and thereby improve their business processes.¹ The unit of the company that is involved in the case study is called “steel-delivery”². “Steel-delivery” is a team consisting of a team-leader who has also worked as a dispatcher, seven dispatchers working in three offices in three different towns and 17 drivers. In addition two managers

¹ The case study was funded (grant 01HT0143) in the context of “work in the e-business” – the title of a research program under which the German government supports 16 projects. One goal is to describe the effects of different forms of electronic business support on the organization of companies and work arrangements; another to develop and try out methods to shape working processes and conditions in the e-business.

² name changed

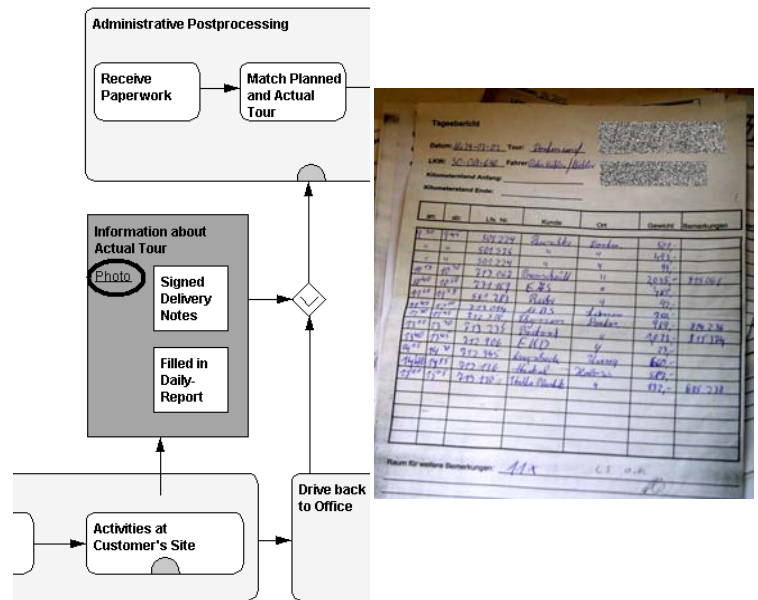


Figure 1. Interweaving Fieldwork Material into Diagrams

of the logistic-company’s head office have advisory functions for the team. They are responsible for the complete logistics of delivery of a large steel trading company that had outsourced this division: The dispatchers of “steel-delivery” receive purchase orders from the steel trading company and sort them out into delivery-tours for the drivers. The drivers load their trucks according to the pile of purchase orders they receive and are on tour for between 4 and 10 hours a day. During the tour they only communicate with the dispatchers if anything irregular happens. Early in the morning and in the evening, before and after their daily tour, the drivers come into the office to hand in the documentation of their last tour and receive the paperwork and additional information for their next tour.

The management of “steel-delivery” phrased their expectations to the new IT-system as follows:

- on time information about the status of all tours for the dispatchers
- on time information about new tours for the drivers
- integration of the drivers into the business processes
- reduction of paperwork

The overall goal of the project is to design, implement and test a technical infrastructure to support the communication between dispatchers and drivers. The working name for this IT-system was SpiW-Com³. Within this setting, our goal was to gain experience with the STWT method paying special attention to the following aspects:

- What is special about the facilitation of an STWT-workshop in comparison to “normal” facilitation?

³ SpiW is a German acronym for “Speditionen im Web” which refers to the usage of web technology within logistic companies.

- How does the usage of a software-tool for presenting and drawing diagrams influence the facilitation concept?
- How would the socio-technical models relate to other models and documents used by the software-engineers and the business process-models created by the logisticians?

Until now our intervention has consisted of three phases:

In phase 1) we used ethnographic methods to become familiar with “steel-delivery”. In addition to interviews and analysis of documents we spent a total of 9 days with dispatchers and drivers to learn about their work details. The results of these observations have been documented in our notes, on tape, as photos and in one rather large diagram. We started to organize STWT-workshops in phase 2) in order to receive feedback on our view on the status quo, and to add to the process of requirements elicitation from a socio-technical viewpoint. In phase 3) we used diagrams to allow a work-oriented validation of GUI-prototypes. In phase 4), which is about to start at the time this paper was written, we plan to use STWT-workshops for training purposes. All in all we conducted seven STWT-workshops. Due to organizational restrictions the participants were not always the same; but we usually had two participants representing the drivers and up to three representing the dispatchers. In addition the local team leader was present in almost all workshops as well as a manager from the head office and a software engineer.

In fig. 1 – 3 three diagrams taken from the three phases of our intervention, give an example of how the elements in STWT-diagrams change in accordance with the development of the technical system. All three diagrams show the handling of the so-called “daily-record” which has to be filled out by the drivers during their tour. For each customer they note the name and town, times of arrival and departure, the mileage, the identification number of the delivery note, the weight of the goods and any remarks necessary. Figure 1 shows a section of the diagram we prepared as a result of our ethnographic work. The “Filled in Daily-Report” is part of the entity "Information about Actual Tour" representing the information that is collected by the drivers

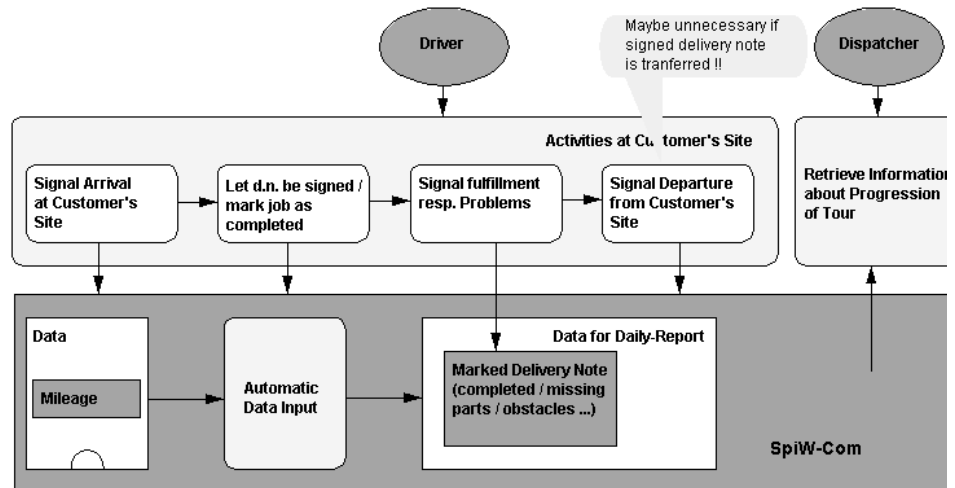


Figure 2. Envisioning New Working Processes

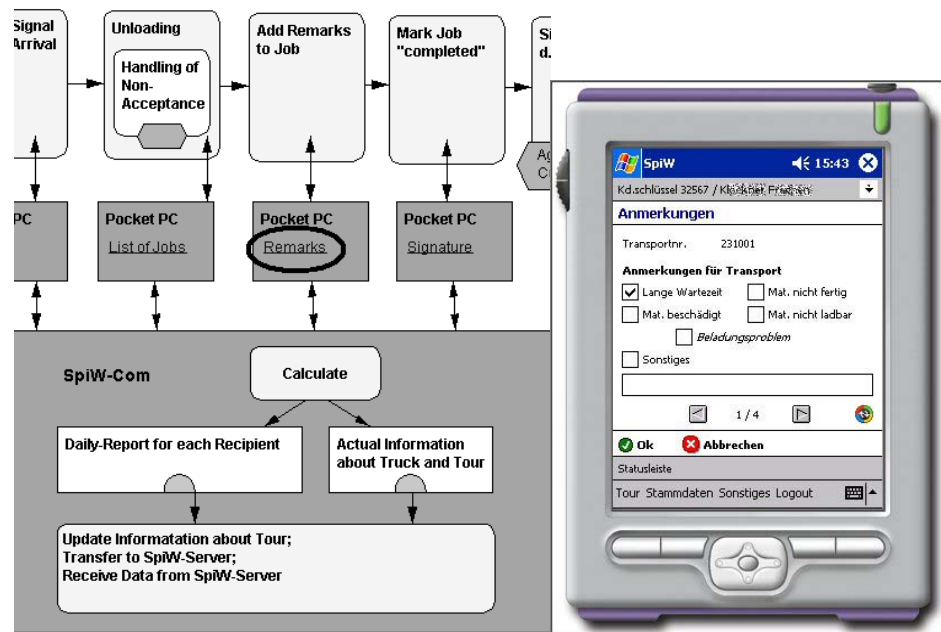


Figure 3. Interweaving Work-Processes and Prototypes

during the day, brought back to the office in the evening and further processed by the dispatchers. A photograph of a “daily record” is linked to the diagram. During the requirements elicitation in phase 2), the diagram shown in fig. 2 was created to show first ideas of how the writing of the “daily-report” could be supported by the system: SpiW-Com could automatically read data such as the mileage from the truck’s data interface; as the driver proceeds with the delivery, the system would collect the data necessary for the “daily-report” and finally the dispatcher could access the data at any time. Fig. 3 is then taken from phase 3), about six months later. The drivers working steps during the process of delivery have been refined and related to screenshots of the mobile devices. Furthermore the data collected by SpiW-Com to create the daily report are described in more detail.

4. STWT - EMPIRICAL INSIGHTS

In this section we describe our experience with aspects crucial to the STWT method in detail. This is combined with insights we gained in other field studies. Thus, we are able to derive general statements about the STWT method and to illustrate them with examples from SpiW. In 4.1 we start with the most important element, the facilitation of an STWT-workshop. From there we move on to related topics such as roles, diagrams, modelling, physical resources needed etc.

4.1 Facilitating an STWT-Workshop

To facilitate an STWT-Workshop, one of the things needed is a leading STWT-question. This question supports the participants in the communicative walkthrough of their work processes and the associated technical support. During the workshop in SpiW, where drivers and dispatchers were asked to develop requirements for the new system, the STWT was lead by the question “How can SpiW-Com support this working step?” Although the goal of the workshop was to collect requirements for the new technical system – it seems to put emphasis on the technical side, the STWT-question related the technical aspects to the work processes. Thereby the facilitator could repeatedly draw the attention to the usage of the technical system as an integral part of the work processes.

As an introduction to get everybody back onto the topic we used the large diagram representing the results of our ethnographic work during the second workshop. Then we went through the work process of the large diagram step by step repeating the question “How could SpiW-Com support this working step?” As a result of the group’s discussion, new diagrams were created that showed parts of the working process in relation to parts of the technical system. Obviously the features of the technical system were added from scratch, since there was no existing technical system that could be changed. Also the working processes were adapted as the usage of the new system made changes necessary.

The creation of a “route” – i.e. a sorted list of customers to be served by a driver during a day – was discussed during the second workshop and is a good example for the integrated discussion of technical features and work processes.

Since one of the goals of the project was to reduce paperwork, an obvious step was to put the delivery notes as entities into the technical system and say that the driver at any time of day should be informed via the system about his next tours as opposed to later that evening in the office. In the work processes without electronic communication support, the dispatchers arranged the purchase orders in piles, one pile for each truck. Although officially it is the driver’s decision as to how he organized his tour, the papers were put into an order which suggested a route for the driver. The evening before the tour, the driver leafed through the pile and maybe negotiated parts of the tour with the dispatcher

and rearranged the pile to his liking. This was quite an informal procedure with personal communication. Now the discussion was whether and how the easy and informal way of negotiating a tour between driver and dispatcher could be transferred to the new system. The result is shown in fig. 4: The dispatcher should be able to put delivery notes into the system and suggest an order in which the goods should be dispatched. The driver reads this information and rearranges the order of delivery if he wishes to do so. Only after this step has taken place, the system provides a so called “route” for further processing.

Generally speaking, questions asked during an STWT should help the participants to think about situations during their work. The examples given will then lead to the more abstract level – encompassing all of the examples – in the diagram.

Most STWT-workshops start with the presentation of a diagram – either an initial one that was prepared in advance (like the one we used in the first two workshops) or one that is based on the results of the last workshop or some diagram(s) that are used to display the results of work done in between the workshops. Using such a start, enables the whole group to focus on the diagrams; however there is no automatism that they will remain there. It is the facilitator’s task to help the group to regularly refocus on the diagrams. One way of doing this is to wrap up discussions by asking “How should I draw this in the diagram?” By answering this question, the group not only comes to a conclusion but also agrees on a representation of it. Another way of using the diagrams is as a source of orientation during a workshop. While discussing the potentials of the new communication system, the participants sometimes drifted off the topic. The facilitator could use the diagram to refocus the group on the narrative line of the work processes. In the first STWT-workshop, one task was to collect information that could be provided by the system. After they had collected a few items, the participants started to give anecdotes about things that had gone wrong or happened due to lack of information. After a while, the facilitator prompted the group to derive elements from these anecdotes for the diagram from these anecdotes by saying: “We’ve just started to collect information, that would help the dispatcher: location, estimated time of return, queue time, current load, ...” While saying this she pointed to the entities on the diagram.

Having a socio-technical diagram with both, work processes and related technical support, visible, enables the group to discuss the details of one aspect – either organizational or technical – without completely forgetting about the others.

4.2 Specific Roles within the STWT

As has been thoroughly discussed in literature (e.g. [16]) the participants for a participative process have to be chosen very carefully. Here we discuss three roles that are of specific relevance to the STWT: the facilitator, the draftsman, and the technical expert.

As the STWT method is interwoven into workshops, a facilitator is indispensable and needs not only to be skilled in normal facilitation methods but also in the specifics of the STWT. It is the facilitator's job to relate statements and results of the workshop to the graphical artefact and to visualize them. For this she needs to know the details of the modelling notation.

The facilitator's responsibility for the visualization of statements and results does not necessarily mean that she has to actually draw the diagram. Within our workshops in SpiW we used two different settings: one in which the facilitator also handled the editor to modify the diagrams as needed; and one in which there was an additional person as draftsman. The advantage of having a draftsman is that the facilitator is free to concentrate on her main job which is the facilitation of the meeting. However she needs to be very unobtrusive in her interaction with the draftsman. It should seem as if the facilitator herself is drawing. The draftsman should see himself as the "long arm" of the facilitator and should only work on the diagram when the facilitator permits him to.

A technical expert should be present in STWT-Workshops and give advice or provide information on the technical component of the socio-technical system. However, the presence of a technical expert, especially if he is part of the software-engineering group, should not distract from the work processes which are the actual focus of the STWT.

4.3 Elements in a Socio-Technical Diagram

What is special about STWT-diagrams? What information do they contain? The most important part of a socio-technical model consists of the cooperative work processes in relation to a technical system supporting them. This may be supplemented by roles representing persons that potentially have rights, expectations and responsibilities for the process; and additional technical equipment and other artefacts like documents. Within the representation of the technical system two elements have to be distinguished: static items such as information screens or documents that the technical system is expected to provide and dynamic processing of data that the technical system is expected to perform automatically.

For each part of the representation it is of high relevance that incompleteness can be expressed [5][7]. Fig. 2⁴ gives an example of incompleteness in the description of the technical system. The drivers proposed that the communication system SpiW-Com should be connected to an interface (ICAN bus) which is available in most trucks, and that it should directly read data from there in order to reduce the data that was necessary for the driver to input. The mileage upon arrival at the customer's site is one example that was directly noted in the diagram. During that workshop nobody knew for sure what other kind of helpful data could be transferred via that interface, so a symbol for incompleteness was added. In general one can say that notational elements representing incompleteness can be used to ensure understanding between the members of the group in the same way as expressions of uncertainty are used in every-day conversation. If a person says "I am not sure whether I understood what you said, did you say that ...?" he prompts the other person either to confirm or to

⁴ We used the notation SeeMe for the diagrams. Details can be found in [5][7]

correct the statement. A symbol of incompleteness within a diagram can have exactly the same meaning. If, after a few workshops, still no other elements have been added to the mileage within that entity, the facilitator can use it to ask: "Do we need to be more precise at this point? Is it correct that only the mileage is needed for the calculations?"

Furthermore, comments are a very helpful element when diagrams are jointly created during a workshop. An example is shown in figure 2 where one of the comments states that a work step might turn out to be redundant. At the time of discussion this problem could not be solved, so it was noted as a comment. Comments are also helpful in situations where only keywords are collected for a topic, when there is not enough information or time available for explicit graphical modelling. At a later time, new elements can be added to the diagram according to the comments made.

4.4 Interweaving of Material

As the STWT-technique can be embedded into a larger, encompassing method, there will be other artifacts used, such as photographs, documents, prototypes etc., which are of relevance for the overall project and might be integrated into the diagrams. In SpiW, the STWT was part of a software-development project during which a requirements document and screenshots were produced. We integrated both into the diagrams using hyperlinks. Links in elements of the diagram referred directly to paragraphs within the requirements document and therefore allowed a functional or non functional requirement within the context of the work process from which it originated to be discussed. The screenshots were linked into the elements of the diagrams representing the technical system and therefore replaced diagrammatical descriptions.

Figure 1 shows diagrams with interwoven artifacts from our case study SpiW. The first diagram connected photos (jpg-files) as hyperlinks to entities in the diagram. Therefore we not only alleviated the effects that an abstract diagram may have on people not used to working with such abstractions; but we also provided precise examples of the current artifacts produced during the work process. Again and again we referred to such photographs when

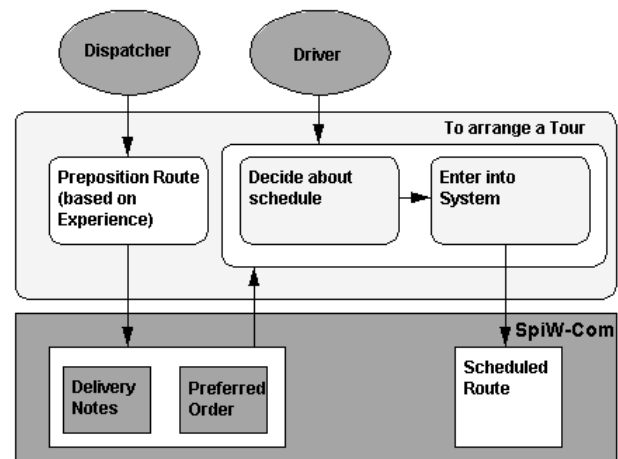


Figure 4. To Arrange a Tour with SpiW-Com

we needed to know which kind of information is created or where it is used.

For the purpose of validating the GUI prototypes for the mobile devices, we introduced entities which represented the mobile device into the diagrams, and related them to the activities in the work process and connected the appropriate screenshot(s) using hyperlinks to the jpg-file (figure 3 shows an example). This allowed us to use STWT-facilitation for the participative validation of the GUI.

Although material such as photos or screenshots of a future system can be used and evaluated without diagrams of working processes, such diagrams provide the context and orientation that is necessary when the work is carried out by more than one person.

4.5 Training of the Modeling Language

Since we use a modelling method that relies on a predefined set of elements and a well defined syntax for the relations between the elements, the participants need help in understanding the modelling method. We cannot expect everybody to be able to use formalized diagrams and can learn to handle them without any further guidance. It would be best if the participants knew the modelling notation so well that they were able to directly contribute to the model, and as we have shown in a previous case study this is also feasible [12]. If this is for any reason impossible, the participants must know the modelling notation at least so well that they are able to decide whether a verbal statement has been correctly transferred to the diagram or not.

Two options are possible and have already been used for teaching the modelling notation.

- a) Dedicated training session: gather all participants for a workshop with the sole purpose of learning the notation of the modelling method.
- b) On the job training: explain the elements of the notation and the syntax rules as they are needed during workshops.

The dedicated training sessions emphasize the importance of the diagrams and allow thorough explanations and exercises to be given to everybody; they also provide a good basis for the forthcoming workshops. While this proved to be true, it also turned out that participants become impatient when they had to spend time learning a modelling notation when they were expecting to talk about their work and a new infrastructure. Therefore in SpiW we chose to introduce the modelling method within the first 10 minutes in the first STWT-workshop, using a very simple and brief example. After that the facilitator repeatedly inserted short explanations of the modelling notation into the regular course of discussion. While this seemed to be sufficient in enabling participants to use the diagrams in the intended way, it became clear that the facilitator remained the expert for modelling and that it was she who decided how to draw the results of any discussion.

4.6 How to Start the Modeling?

What should be the first diagram and who should draw it? These are two questions that need to be decided during the preparation phase of the STWT-workshop. Is a graphical model of the actual work processes and the IT-infrastructure currently supporting

them needed, or is it a waste of time to describe a status quo that is about to be changed anyway? There are two good reasons for investing the time to document the status quo in a diagram. One it is often surprising how divergent the participants' views on the seemingly obvious are and two it is helpful to learn about the different perspectives early on, and doing this during the discussion about a diagram which should represent the status quo is a good opportunity to do so. In all our case studies, we started with a diagram representing the status quo and moved on from there. In SpiW, the researchers (also in the role of facilitators of the process) prepared a large diagram summarizing the results of the inquiry. We brought this large diagram to the first workshop, asked for feedback on our understanding and used the discussion to put forward differences between the three offices of "steel-delivery" and reach consensus on the representation of the status quo. Step by step we discussed the elements in the diagram and applied changes as required.

4.7 Material and Technical Resources

The idea that the focus of the discussion should be guided by a diagram has to be supported by the layout of the room. There needs to be one large display clearly visible to all participants on which the main diagram that is used to structure the discussion of the workshop is displayed. In SpiW we used semi-circle or u-shaped seating arrangements.

There are other purposes for which additional displays are needed: technical artifacts, diagrams with background information, and visualization of statements during the discussion. Technical artifacts being shown or displayed have to have close connection to the diagram. For a STWT it is not sufficient to present a single diagram, then change presentation equipment and then present a prototype without referring to the diagrams. When technical artifacts are available as screenshots – as was the case for SpiW – these screenshots can either be displayed on the same screen as the main diagram or on a second screen. In SpiW we only worked with one projection screen, but had the screenshots integrated into the diagram by hyperlinks, so that we could switch between the two without delay. Still the disadvantage is that the main diagram is not continuously visible and that the facilitator has to take great care in making sure that the diagram is again displayed after having discussed a technical detail. On the other hand, by switching between the two displays, the facilitator can actively support the focus of discussion in the group.

When an STWT contains a series of workshops taking place, many diagrams will be created which represent different aspects of the project. It might well be useful to put up posters with diagrams created in previous workshops to provide background information. In SpiW we provided the participants with handouts containing diagrams as well as screenshots to enable them to make personal notes. A poster with a summary of the elements of the modeling notation and an additional board to capture statements or questions outside the diagram should be available.

4.8 Work Accompanying the Workshops

Much of what is characteristic for the STWT as a method happens during participative workshops. There is however work to be done outside the workshops.

The presentation of any diagram – especially any larger one – needs to be prepared carefully. A large diagram unthoughtfully presented can become a source of confusion and distraction rather than being a guiding artefact. Therefore, the facilitator has to plan to deliberately present the diagram step by step.

Another decision the facilitator needs to make is about the scope of the diagrams: should a few large ones or lots of smaller ones be used? For the workshops in SpiW we used both alternatives. At the beginning we presented an overview of the relevant work processes and the associated information flows, using one large diagram. Later on when we designed aspects of the future socio-technical system, we only used small ones which represented one work step and the supporting technical features. The reason for this was the amount of editing done with the group. When presenting the overview of the status quo, some additions and corrections were made, but the basic structure of the diagram remained unchanged. But when discussing the characteristics of a future system, a diagram is bound to be changed many times. This is much easier to handle using smaller diagrams rather than a large one.

In this context it is also worthwhile noting that the facilitator should try to be one step ahead and envision the topics that might come up, and have to be drawn in diagrams. He has to make sure that he has adequate constructs of the modeling language to represent them.

A diagram that has been created during a workshop is usually not very clearly structured and bears marks of the discussion during its development process. While it is important that such a diagram is part of a protocol enabling the group to remember their line of argument, the diagram needs to be redrawn for any future use.

This task – which we call “aesthetical improvement” – needs to be done between workshops. The goal is to create a presentation that captures the viewpoints and decisions of the workshop in such a way that it can be used to communicate them either as input for the next workshop, or even for other groups involved in the overall project. In our work with “steel-delivery” we used diagrams that were results of workshops with the projects’ steering committee; the diagrams were also used by the software engineers to derive technical “workflows”, for such usage it is important that the diagrams are optimized towards readability. On the other hand the group should be able to recognize that the new, “aesthetically improved” diagram is related to the outcome of the last workshop. Another issue adds to this problem: In section 4.4 we described how different artifacts of the design process are interwoven into the socio-technical diagrams. This is a typical task that has to be performed in-between workshops, which is bound to change the appearance of a diagram. In our case study “steel-delivery” we radically changed diagrams between workshops. We did this because of the pace in which the project moved. The steering committee made decisions, and the software-engineers provided prototypes; both needed to be incorporated into the diagrams. To alleviate this problem, we started an STWT-Workshop by presenting the diagrams from the last workshop and explaining how the new one was derived from the old one.

5. APPLICABILITY OF THE STWT

5.1 STWT as an Alternative to other Methods

In this paper we are not able to extensively compare the STWT with other techniques available; we therefore selected four techniques which share similar purposes with STWT. In its basic design JAD is very similar to the STWT, because the descriptive artifacts play a major role in the method. For similar purposes many scenario methods exist. Contextual Design is practically relevant as a technique for requirements elicitation and is based on ethnography and feedback of models.

JAD

Based on the insight that direct communication between stakeholders is much more efficient than bilateral interviews organized by software-engineers, the JAD – joint application design – concept was developed and extensively deployed by IBM in the 1980’s [3]: In a series of facilitated workshops a so-called workbook is continuously updated. This workbook is in so far comparable to the diagrams in the STWT as it serves as a coordinating artifact for the design process and is kept visible during all workshops. JAD however does not call for specific diagrammatic representations which we consider helpful, if not indispensable for the facilitation of a group discussion about future computer supported cooperative work. Whereas JAD takes a very broad view on system development, including company goals and values, the STWT focuses on the detailed discussion of cooperative work processes and provides detailed techniques for this task. The STWT does not end when the design is completed but continues on through the development into the training phase of a project. STWT and JAD both emphasize the importance of a facilitator. But while JAD suggests that a charismatic leader will be most successful, STWT relies on the competence of the participants and the skills of a facilitator who is able to support the group process.

Scenario-based Techniques

Scenario-based techniques are also used for similar purposes as the STWT. Usually scenario-based techniques focus on instances of a process, based on text (e.g. [2]). On the one hand focusing on a story basically leads to a close link of the text artifact to practice. However on the other hand, the complexity of the field is only mirrored by many varying scenarios. The interrelationship between a series of scenarios is generally hard to comprehend, as variations of the work process are not visible and an overview of the whole process is missing. Therefore further techniques are needed. For example CARD [15] extends scenario-based analysis with cards representing artifacts and tasks in the domain. The cards are laid out and related to each other on a table. The focus of CARD is the tool which is developed. In comparison to CARD the STWT takes a deeper look into organizational processes with a strong relation to software systems. In STWT a single tool becomes embedded into the processes, and is linked with other (existing) tools which provide other needed functionality.

Contextual Design

Contextual Design – CD – [10] is an influential method of requirements elicitation. As in our case study, the analysis begins with a detailed ethnography, then in CD the developer/analyst derives several types of diagrams. To validate them, these

diagrams are discussed in workshops. After performing these steps with other customers a general view on a domain is derived to develop COTS-products. In CD a potential learning process of the analyzed organizations plays a minor role. With STWT users can actively reflect on their organization and discuss possible organizational change. The organizational development has the same priority as the development of the requirements for software products.

5.2 Applications

STWT for Requirements Elicitation

In the SpiW case STWT had to especially facilitate discussion on changes of the work processes. Like in MUST [11], in advance of the process, a strategic discussion is needed and a shared vision has to be created for the project. In these discussions mainly those units of the organization have to be identified which should be in the focus of the innovation. The detailed analysis with an STWT is then used in these units to elicit the requirements.

Kensing et al. [11] also proposed to sustain the vision with organizational discussions, presentations etc. during the whole process. Key players need to be convinced of the project's goals. In our experience this is a key factor. You need several people, who share the vision of a project, who stay involved and push the project forward. The STWT itself needs to be interwoven with the technical development process. Early prototypes can help to further clarify requirements and can be used during STWT. At the same time feedback is instantly generated for the prototypes. Finally the results of the STWT can be translated into technically oriented design documents such as use case diagrams, or class diagrams.

For using STWT as part of a MUST project, we want to discuss briefly how STWT follows MUST's principles, which reflect tradition and experience in participatory design. Kensing et al. [11], propose the following principles: Participation, close links to project management, design as a communication process, combining ethnography and intervention, co-development of IT, work-organization and qualification, and sustainability. We think that all of them are appropriately represented in STWT. In particular we thought about how ethnography can be used to create a basis for discussion (see section 4.1). The main focus of STWT is to facilitate communication between users, designers and other relevant participants. As explained, STWT is dedicated to the co-development of IT, work-organization, and qualification. The difference between MUST and the STWT can be related to the usage of a notation that affords the discussion and design of all three areas in relation to one type of single artifact. Participants can easily switch between topics and link solutions in any area. Kensing et al. strongly argue against the use of formalisms during this process. However our experience shows something very different. Using appropriate formalisms in a careful way with users is possible and leads to positive effects. We used STWT in several domains, and, of course, there are differences between persons or groups, but in all domains an appropriate understanding of the diagrams was reached. With regard to requirements elicitation, we suggest that STWT should be considered as part of the portfolio of techniques as an alternative to the scenario-based and prototyping techniques.

Agreements for Coordination with STWT

The deployment of Groupware, Knowledge Management Systems or other types of cooperation-based software does not automatically enforce any rules for their usage. It is therefore necessary to explicitly agree on certain topics to coordinate a successful cooperation. Examples of this are deadlines for task completion, places to put results, format of results and many more. A STWT can help to reach the needed coordinative agreements. We currently use this domain for an in depth analysis of the effects of STWT based on experiments.

STWT to Support the Adoption of COTS

The introduction and adoption of commercial-of-the-shelf software products usually involves a careful analysis of the possibilities of the product, and a transformation into the organizational structures where it is to be applied. This means that an alignment has to be created between software and organization – with respect to the software's functionality – and is a domain where the STWT can be applied. First, the STWT can be used in selecting an appropriate software solution, for example, in addition to classical "feature lists", the STWT can be used to test functionality in detail by walking through the work process. After the selection, an adaptation of parts of the organization is needed, to enable a coherent socio-technical system to be built. Several decisions then have to be made: which parts of a system are used for which tasks, who is responsible for these (sometimes new) tasks, what should users know about (the usage of) the system, etc. These details can be checked and discussed within a STWT. Some of these decisions involve extensions of the functionality, workarounds to avoid problems and the use of functionality, which was the developers had not intended etc. Two instances of the use of STWT for introducing COTS can be found in [8][12].

STWT as a Training Method

We propose to use STWT as a method of training users. The usual way of conducting user training is by walking through the interface with a scenario and an example data set. One problem is that the relation between the task and technical artefacts is hidden then. Another problem is that options and variants of the work process are invisible. It is rather unclear to participants as to which situations, and which functionality is being used, who is affected by each task, and what the alternatives are etc. These problems can be avoided by using a diagram as an overview. Usage scenarios can follow the structure of the diagram and a scenario is used as a basis for walking through the steps of the STWT. The alternatives will be visible in the diagram, and can be mentioned, and the diagram will be able to give an impression of how different the variants are. The tasks in the diagram can be linked for example with screenshots or forms as they are offered by the interface. We applied this kind of training sessions in various projects (for details see [8]).

6. CONCLUSION

The paper presents the socio-technical walkthrough as a method which could be derived from experience gained in various projects, in the context of software design and development, requirements analysis, software adoption and user training. The core idea of the STWT is that the concept of a socio-technical system is represented by a diagrammatic model. During the STWT, participants walk step by step through the current or envisioned practice to discuss the details of the modelled interplay

between technical and organizational issues. The modelling notation of the STWT should make the relevant aspects of socio-technical systems visible and combine formal and informal aspects. The way in which the models are embedded into a participatory, facilitated communication process is of great importance. The preparation and guidance of this process requires deliberate decisions being made, which may vary from case to case:

- The participants either have to be trained to become familiar with the modeling technique or a set of simple notation elements and simple introduction examples have to be chosen for the start of the STWT.
- An initial model has to be prepared based on an ethnographic study or a strategy which guides the development of a model from scratch during the first STWT-session.
- A set of questions has to be prepared from which the facilitator can choose when asking the participants for their feedback while walking through the steps.
- An appropriate granularity for the walkthrough has to be determined.
- We have to continuously check that the graphical models have been understood by the participants and reflect their point of view. This especially applies to changes, add-ons and improvements which are made between workshops.
- Other kinds of descriptive artifacts, such as photos, prototypes, examples for forms or paper documents, have to be selected, introduced into the communication process and linked with the diagrams.
- When the final versions of the models of the socio-technical system have been achieved, it has to be ensured that a majority of the participants will be acting as promoters of the ongoing project which is based on the modeled solution.
- The facilitator should have a strategy as to how the interplay between narrative phases, the perception of illustrative material and the refocusing of the abstract level of the diagrams can be guided.

Further research will be based on experiments and hypotheses which help to reliably identify the success factors of the STWT. Furthermore we are interested in the following question. How can the diagrams become a sustainable self-documentation (of the socio-technical system) which can continuously be used for training, adjustment, and in discussing the potentials for improvement?

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