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The Socio-technical Walkthrough (STWT): a means for Knowledge Integration

Thomas Herrmann, Kai-Uwe Loser, Isa Jahnke

University of Bochum
Institute of Applied Work Science
Information and Technology Management
44780 Bochum, Germany

Emails:
thomas.herrmann@rub.de; kai-uwe.loser@rub.de; isa.jahnke@rub.de

Abstract: For the successful development of sociotechnical systems it is essential that various stakeholders are able to integrate their different knowledge and perspectives. The communication-oriented method "sociotechnical Walkthrough (STWT)" supports not only the design of sociotechnical systems but also the integration of knowledge. The STWT is a method which is flexible and has the ability to integrate different viewpoints, to document the results of this integration, and to promote the development of a sociotechnical system which follows common design principles. Using the presentation of two empirical case studies as a base, we derived a list of categories which characterize the knowledge which should be integrated when a sociotechnical system develops. Furthermore, those elements of the STWT method which have a positive effect on knowledge integration are highlighted.

1 Introduction

Sociotechnical information systems can be designed to support storage and distribution of data as a basis for knowledge sharing within an organisation. Typical examples are database systems and groupware systems used for knowledge management, collaborative learning and work, or enterprise content management. Whether these types of systems really contribute to knowledge sharing or not, depends on the corporate culture and on the degree of how well organisational and technical structures are adjusted to each other and how they are integrated. Methods, guidelines and principles (for example Eason 1988, Mumford 1995, Cherns 1976 and 1987, Bygstad 2006) which support the development of sociotechnical systems are focused on this integration.

We have combined a set of methodological elements into a concept which we call sociotechnical walkthrough (STWT). The goal of the STWT is a systematically facilitated communication process within a series of workshops to gradually specify a concept of a sociotechnical system, which step-by-step and repeatedly inspect and modify the graphically represented elements of the concept. STWT was developed, evaluated and incrementally improved in several case studies (for more examples see Herrmann et al. 2004). The main interest of these studies was to evaluate as to whether our methods contributed to a successful introduction of information technology. "Success" meant in this sense that the technical system was really supporting the cooperation and task completion in the work process, in a way which had been expected and appreciated by the involved stakeholders, and particularly by the work force. One of the "side effects" of our studies was the insight that the participatory development and introduction of systems through the STWT lead to the sharing of various types of knowledge even before the system itself was used.

This paper will explain how the developing of a sociotechnical system with the STWT can support knowledge sharing, as well as explaining the reasons for this support and how knowledge sharing can be fostered in these early phases. We assume that besides the usage of an information system, there is a continuous process of maintaining and modifying the configuration of the technical system, its content and the way of using it. This modification and maintaining happens within post implementation activities[1] which can be better performed if an intensive process of initial knowledge integration has taken place. These post implementation activities provide the opportunity for additional knowledge sharing, and these can again be intensified by appropriate methods such as the STWT.

The concept of the STWT is closely related to our notion of sociotechnical system. Starting with the historical development of this term (Emery & Trist 1960) we saw the necessity to adopt elements of newer system theory (especially Luhmann 1995; Maturana & Varela 1980) so as to achieve a better understanding of the conditions under which a social system and a technical system can be integrated. Luhmann defines a social system as a web of communication acts which develops and reproduces itself on the basis of rules which are communicatively made by itself. Therefore, – so our conclusion (Herrmann 2003) – the way of how a social system relates itself to a technical system is mainly depending on processes of communication and can mainly be observed with respect to the forms of its communicative behaviour. We presume that the degree of integration between organisational and technical structures is closely interrelated with

- the degree of communication about the technical system and the ways of using it.
- the degree of communication which is mediated by the technical system ("*by user-friendly means of communication and action in information tasks";* Coakes 2002, p.6).
- the self-descriptions (as part of our work, detailed in Kunau 2006) that result from communication acts and which are not only mirrored and found within the structure of the social system, but also within the configuration of the technical system. These self-descriptions refer in particular to the interaction with the system, and to the conventions of collaboratively using it.

[1] The continuing process of maintaining and modifying can be related to the "design-in-use" phenomenon (Fischer, 2006).

Therefore our approach to the sociotechnical paradigm as "*the study of the relationships and interrelationships between the social and technical parts of any systems*" (Coakes 2002, p.5), is to focus on the web of communications which keeps the relevant components together, and attempts to improve their relationships. In accordance with the sociotechnical model of Coakes (2002, p. 11) these components are people, tasks, structure and technology as seen in relation to their environment. We suggest that intervening by means of structuring communication is one of the promising approaches in supporting the development of a sociotechnical system bringing together the different perspectives of practitioners, (software-)engineers and management. The STWT can be viewed as a method of systematical intervention. We found that such a communication oriented method can support the design principles for sociotechnical systems, as for instance proposed by Cherns (1987, 1976) (cf. section 2). The specific characteristics of the STWT also proved to be able to support knowledge sharing which is achieved in the course of the exchange of perspectives.

From our point of view, establishing a sociotechnical system requires the integration of knowledge between the stakeholders. The knowledge to be integrated covers questions such as the purpose of the technical system, conventions of how it has to be used, who is responsible for maintaining it, who is allowed to do what with the system, how the domain-oriented knowledge is represented etc. Knowledge integration is extending the scope of knowledge sharing, and is therefore the pre-requisite of a learning organization, where the knowledge is not only distributed, but effectively used to perform a task and to generate new knowledge. The integration can be characterized as follows[2]: An item of knowledge can be considered as integrated amongst a group of people if it is not only accessible and available to them but can furthermore be used to:

- guide their way of collaboratively carrying out their jobs,
- influence their decision making,
- provide a basis for their communication,
- enable them to share perspectives and to discuss different views (in order to solve or prevent conflicts).

We have empirical evidence, that the STWT is especially suitable when supporting certain kinds of knowledge integration. The characteristics of STWT are described in the following section as well as the theoretical reasons why it has the potential to support knowledge integration. The third section exemplifies this theoretical potential by referring to two case studies. The fourth section summarizes the crucial factors and methodical recommendations of fostering knowledge integration in the course of STWT.

2 Socio-technical Walkthrough (STWT) - a method that supports knowledge integration in the course of socio-technical systems development

The sociotechnical Walkthrough (STWT) supports the communication process when developing a sociotechnical system, as well as supporting the formal specification of parts of it. The discourse accompanies the development and/or configuration of software systems, as well as the management of

[2] This definition is derived from the work of our colleague N. Menold (2006) who analysed different approaches of explaining knowledge integration such as: common ground (Clark 1996, p. 93), transactive memory (Moreland 1999) mutual construction of knowledge (Roschelle & Teasley 1995) and Collective Information Sampling (CIS) (Stasser & Titus 1987).

organisational change. The accompanying communication process is organised as a series of workshops and is related to a documentation which is used to serve several purposes:

- It connects the communication process with the sociotechnical system to be developed. Therefore, the documentation mainly consists of a graphical model which represents the work processes and their interactions with the information system to be constructed. The model of the sociotechnical system is represented by a set of diagrams. We recommend using a semi-formal modelling notation for a conversion of knowledge into diagrams and we have developed the modelling method "SeeMe" (Herrmann & Loser 1999) to give an example of the characteristics of such a semi-formal notation. SeeMe is comparable and compatible with many other modelling methods but has some distinctive features: explicit indicators for incompleteness and uncertainty, rough as well as complete specification of relationships, multi-perspective decomposition of elements, indication of space for free decision-making[3]. The advantage of such a semi-formal representation is that it is suitable when expressing the contingent relationships of social structures as well as the formal specifications of a technical solution.
- The graphical documentation serves as a basis for building connections between the workshops. STWT is based on a series of workshops to serve as a vehicle for organizational transition (cf. Cherns principle "*Transitional Organisation*", 1987, p. 159). In every workshop, the model of the sociotechnical system is incrementally modified and refined. For this purpose the elements are discussed step-by-step. With this process the STWT can be compared with and is partially inspired by the "Cognitive Walkthrough" (Polson et al. 1992) and the "Groupware Walkthrough" (Pinelle & Gutwin 2002). However, these two methods are mainly supporting the tasks of a single evaluator while STWT includes several participants to immediately combine evaluation with design. The walkthrough is guided by specific questions which vary from workshop to workshop. The first workshop may start with the task of reconstructing the work procedures and can be followed by another workshop asking for the needs and possibilities of supporting the work with the information technology to be introduced. Finally, the testing of a prototype can be guided by the diagrams which depict the interactive relations between work and the IT-system. The diagrams serve as a memory which builds a bridge between the workshops. It proved to be sensible to support this function by improving the layout of the diagrams between the workshops, but without altering their content.
- The graphical documentation supports the participatory character of the STWT. Since a sociotechnical system integrates the activities of different stakeholders, the concepts and the plan for this system has to mirror their different perspectives. Like Cherns (1987, p. 154) and others we assume that a sociotechnical "*design is an arena for conflict*" (Principle of "*Compatibility*"). Therefore, the bringing together of different perspectives can lead to conflicts and problems which have to be dealt within the STWT to "*support congruence*" (cf. Cherns 1987, p. 158). The continuous documentation of the incrementally developed concept provides the opportunity to express the different comments, requests for change, aspects of discussion and dissents etc. It is important that the incremental development is visible for all the participants of a workshop so that they can check whether their proposals have found their way into the documentation or not. Therefore it is also important that the modelling notation

[3] Herrmann (2006) provides a detailed description of the modelling notation.

or tool provides means to annotate open questions, informal comments, differing patterns of work according to varying perspectives etc. (Herrmann et al. 2004). The possibility of intentionally incomplete specification allows the participants of the STWT to express "*several routes to the same goal*" (Cherns 1976, p.788 multifunctional principle) or as Coakes said "*same function can be performed in different ways"* (Coakes 2002, p. 7).

- The graphical visualisation provides a basis for the interventions of the communication facilitator. By referring to the diagram he/she has a thread at hand which guides through the domain which has to be inspected, refined and modified step-by-step. The diagram gives the opportunity to visualize the results of the workshop and to document the progress being achieved by the participants' contributions. It helps to focus the discussion on the main questions to be answered and to indicate the knowledge gaps which have still to be filled.

We (detailed in Kunau 2006) analysed several methodological approaches, such as PD (Kensing et al., 1996), JAD (Crawford, 1994), scenario-based Design (Carroll, 1995) Multiview (Avison & Wood-Harper, 1990) and contextual design (Holtzblatt, 2002). This analysis builds a basis for comparing these approaches with the STWT. There are various similarities between STWT and the other methods. JAD – for example – is also based on a series of workshops and very similar. The distinctive character of the STWT is characterized by the combination of the following features:

- The STWT pursues the design task by starting with and focusing on the cooperative work procedures. Other more general areas of discussion like organizational goals or values are elaborated in this context – if necessary.
- The consequent usage of a semi-structured representation scheme which includes indicators for incompleteness and uncertainty.
- The step-by-step investigation of diagrams and its immediate intertwining with documentation.
- The integration of several perspectives of a part of a work procedure into a "large picture".
- The task of the facilitator which helps to transform contributions of workshop participants into the documentation.

All in all, the models serve as a catalyst which helps to develop a shared understanding of a newly developing or adapting sociotechnical system. It has to be asked, how strictly the discussion should be focussed onto the diagram, and which other media – beside the diagram – should be used to focus the discussion and to keep important contributions available. Also how this media – e.g. cards on a pin board – can be related to the diagrammatic presentation. A goal of the sociotechnical walkthrough (STWT) is the development of a shared understanding, which is represented by an adequate model of the targeted sociotechnical system which integrates both technical system elements and work processes. Nevertheless, the whole process starts with the discussion of a model of the current state of the work processes. This can be very helpful in developing a shared understanding between the participants about the current state of the processes and resources of their work and the requirements for improvement. On this basis the concept for designing or modifying a sociotechnical system has to be developed in a way which makes this concept part of the integrated knowledge of everyone who contributed to its success by actively taking part in the STWT's communication processes.

Obviously, these processes require and foster intensive knowledge exchange and integration about the work procedures and the interfaces between the different tasks. Since the models of the cooperative

work processes should be so detailed that the anchor points for technical support can become distinguishable, the participants learn to know about the task of others and can compare their own view on a certain task with the viewpoints of others. It also becomes apparent which aspects of the task fulfilling are based on implicit knowledge or ad-hoc decisions and which aspects of the task or the decisions can be pre-specified by recurring to explicit or formal knowledge. A modelling method like SeeMe allows the modeller to indicate those parts of the diagrams which cannot be completely specified because of their dependency on implicit knowledge (concept of vagueness, cf. Herrmann & Loser 1999). The STWT can be considered as a sustaining attempt "*To convert tacit knowledge into explicit knowledge"* or *"…finding a way to express the inexpressible*" (Nonaka 1984, p. 99). However, the incompleteness and uncertainty symbols of SeeMe also provide a means to indicate those parts of a sociotechnical concept where the explicitness reaches its limits. It becomes also apparent which kind of process can be considered as business as usual, and what kinds of exception handling have to be taken into account. The already mentioned participatory character of the workshop concept may lead to diagrammatic documentations which not only integrate different viewpoints but also makes them comparable. With respect to knowledge integration it has to be positively noted, that the details and different proposals being contributed will be graphically represented, and are therefore visible throughout the discussions. This allows the participants to have a repetitive perception of the facts – and this repetition fosters learning and consequently the integration of knowledge. The combination of the rather abstract graphical model with more concrete and intuitive material may strengthen this effect.

Detailed visualization and step-by-step discussion have a significant positive effect on knowledge integration and on the participants' ability and willingness to use an information system. This was confirmed in an experimental study with 24 students who after having used the STWT were prepared to use a knowledge management system for collaborative learning (Carell et al. 2005).

3 Work Experiences: Two Case Studies

Case 1: Reorganisation and knowledge integration in a University Library

In a university library a new software product was introduced. The usage of the new system required a different practice for acquisition and cataloguing of books and media. We conducted 11 workshops (each of 2 to 3 hours) to support the organisational change. Prior to the project two groups were each working on either acquisition (ordering, inventorying, reminding etc.) or cataloguing (entering relevant keywords). Figure 1 gives an overview of the process.

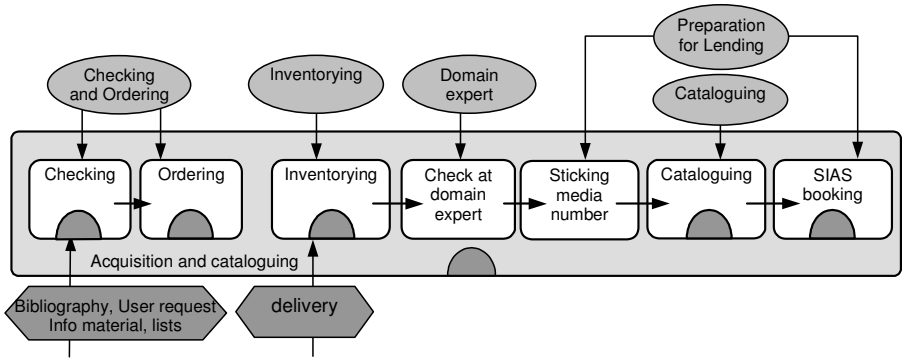

Figure 1: An Overview of the acquisition and cataloguing process

There is a radical change in the libraries as centralised catalogues are now available, where most of the books available have already been listed. For most media cataloguing is reduced to checking and accepting already entered keywords. In many cases this can already be done before a book is delivered. As a result for acquisition and cataloguing groups were integrated to enable easier distribution of the workload. During the project diagrams were developed to show how the future practice would function under use of the standard software product. During the development a STWT process was employed, discussing current practice and possible ways of achieving the goals using the new software. During this discussion a variety of knowledge was exchanged between the participants. One role was a participant who was considered to be an expert in using the software system; the others had specific experience in their own domain. As in the future all librarians will be responsible for both acquisition, as well as cataloguing, the discussions led to an in-depth exchange about various aspects of their work. This was very important as the groups did not collaborate very much and were self-contained. Both groups mutually considered the former cataloguing group as the group being more capable. The discussed aspects involved responsibilities, difficulties in practice, goals, and agreements necessary for the coordination of work.

Figure 2 shows impressions of the library project.

Figure 2: Working with sociotechnical diagrams in the library project

At a certain stage the STWT focused the following types of knowledge which was discussed and shared: the distributed tasks which are related to ordering and inventorying a book; how often are corrections to initially entered data needed, and how will these corrections later be carried out with the new software. The new software made it very complicated to make these corrections, and without even actually using the system, it became apparent that many mistakes can occur, because of the amount and variety of necessary data entries. All corrections, data entries and tasks were represented in the diagrams. These discussions were very fruitful in the cooperation between the groups, as well as for developing shared understanding and learning to use the system.

The STWT supported the exchange of information within the group by focusing discussions on the work processes and helped to maker sure that nothing important was left out. In this manner STWT guided peoples' ways of collaboratively carrying out their jobs. Interviews after the project showed that the personal exchange has enabled a detailed impression of the work of the different groups and that knowledge integration has actually happened. The participants learned about the topics and tasks of other groups and about their point of view. This was the most valuable outcome of the project for most of the participants. The interviews showed that – as not all the aspects of the others work were

known – they then found a basis for communication during this project, and that the external representation was used to guide the discussions. (Loser 2005) The STWT provided a basis for their communication and enabled them to share their different perspectives.

Case Study 2: *A Logistic Enterprise goes Web* (spiw.com[4])

A second case study (as part of our group, detailed in Kunau 2006) gave us the opportunity to apply various methodical steps, which also contribute to knowledge integration, during the STWT more deliberately. The project behind the *steel-delivery* case had been set the goal of designing a mobile communication system which supports truck drivers and their dispatchers in a German logistics company. The system was intended as a gradual replacement for the paper-based procedures, not only between drivers and dispatchers, but also between the logistics company, their customers and the recipients of the goods. For the drivers the new system took the form of a mobile device (PocketPC) which was added to the equipment in their trucks; the dispatchers received an add-on to their office software. It was necessary to integrate the technical design into the planning of new work-procedures that make expedient use of the mobile communication system. A participatory project was established which included representatives of the following groups: drivers, dispatchers, local management, head office management, and software-engineers. They each represented different perspectives with respect to their interests, tasks, expertise, and power relations. The relations of power between drivers and dispatchers were of special interest: Although the dispatchers are seen hierarchically above the drivers, both of them have a decisive influence upon the sequence in which recipients can be addressed during a tour. It should also be noticed that the dispatchers' workload would significantly be reduced if the new system was working well, and that the driver has to be motivated to enter additional data into the mobile device in order to make the whole system work well.

The STWT used in this project comprised of a series of 10 workshops (each of 2-3 hours) where 25 semi-structured diagrams were developed, to make different positions visible but without being overloaded with information as it could occur if the completeness of specifications was formally required.

During the workshops drivers and dispatchers got the chance to on one hand learn about the others' workplace, work-processes and specific problems and on the other hand were able to see how the other contributed to the overall business processes. The diagrams were a means of capturing the multiple facets of the discussion. The knowledge exchange was mainly covering the characteristics of the work procedures, the way the new software should be used and the new ways of coordinating the work.

[4] SPIW is a German acronym for "Speditionen im Web" which refers to the usage of web technology within logistics companies.

We give an example of the work procedures. Fig. 3 is part of a larger diagram and illustrates the drivers' activities when unloading their trucks at the customers' site. The description of this work-procedure changed during the course of the project. Activities lost or gained importance as the software system was developed; and accordingly activities were then eliminated (e.g. *Open transportation belts* and *Repack material, Fig. 3),* added, or modified. The activity *Fasten transportation belts* was changed into the more general task of *Make sure truck is in a roadworthy state.* To explicitly represent this task in the diagram proved to be highly relevant for the understanding of the process even though this task is not supported by any interaction with the system. The participants had discussed as to whether or not the departure from the recipient's site could be automatically signalled as soon as the delivery note had been marked as signed. However they then decided that the task of *Make sure truck is in a roadworthy state* could be so time-consuming that it was worth noting it. Due to this decision, it is important that all drivers know that signalling the departure is really the last task they have to carry out at a recipient's site. This example illustrates that knowledge integration also involves topics which are not directly related to the technical system going to be introduced, furthermore it demonstrates that the transition from implicit to explicit knowledge was possible with respect to the question: "When is a job at the customer's site completed?" However, there are cases where the experience of the participants could not be made explicit, e.g. the condition under which a driver has to repack the material on the truck before he leaves the customer's site (empty hexagon in fig.3).

Empirical Insights

Sociotechnical systems theory stresses that technical and organisational development goes hand in hand, and we argued that knowledge integration is also essential to make this process successful. Both cases show that various stakeholders even though they have different points of view, interests and experiences which imply implicit knowledge, were able to participate in a design process. The documentation of the outcome of STWT-Workshops uses graphical models which serve as shared

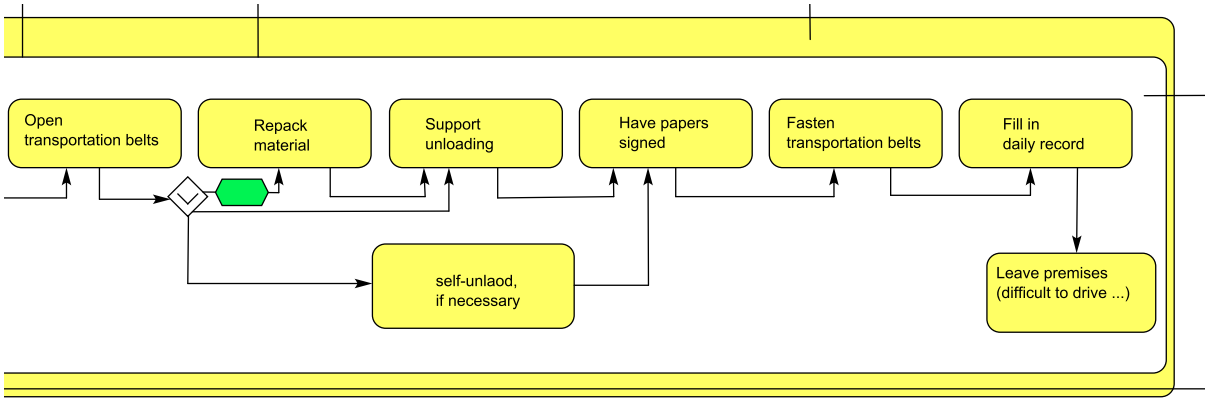

Figure 3: Work-Procedures

objects that are available to all groups for reference and interpretation. Besides the positive outcome from the projects point of view, the participants valued the discussions guided by the STWT as a means of communication, for example, participants focussed on their shared objects and not on the facilitator. The dominance of the diagrams as a focus for the discourse can even lead to a type of social

interaction where participants pay less attention to their hierarchical degrees and the influence of power and authority (cf. Cherns 1987, p. 157).

The diagrams evolving from the second case study were carefully analyzed (by our group, detailed in Kunau 2006) so as to identify the varying categories of content which were considered as important by the participants for the development of a new sociotechnical solution. An ex-post comparison with the first case study revealed that these categories could also be related to the content of the diagrams which were discussed in the workshops in the library. The categories have to be considered as an outcome of explorative qualitative research which is related to grounded theory (Strauss & Corbin 1998) and action research (Avison et al. 1999). Both case studies showed that participants confirmed in interviews or questionnaires that the participants considered the contents of the diagrams as helpful information when structuring and conducting their future work.

The following categories describe clusters of content which participants contributed to the discussion and to the documentation, and which was therefore a basis for the knowledge exchange during the STWT:

- Cooperatively performed work procedures, as they are perceived or assumed by different stakeholders, including management and the workforce. This topic deals with the question whether certain tasks or activities are relevant for the process which is under consideration, and whether they have been appropriately described

  For example, the relevance of the task *Make sure truck is in a roadworthy state* and its relationship to other tasks. In the library orders are often a handed over when they come to different state of process. The person who orders a book may not be the same as that who inventories it and so on, however detailed information is important to be able to carry out the tasks.

- The relations between work-related activities and software functions – in here we discussed, whether or not, and how, certain tasks could be supported by the IT-system

  For example, in the steel delivery case a decisive point was the indication as to where and when the pocket PC should be used. The library case was even deferred as became obvious during the discussions that the system placed too many obstacles in the way of task performance. It diagrams showed that in several cases simple data correction is very difficult and involves several work steps.

- Agreements concerning coordination of primary task – showing who is in charge of which task and how tasks are dependant upon each other.

  For example, it has to be agreed that the driver is responsible for sorting a tour (i.e. an unordered list of recipients) to choose a route (i.e. a list giving the chronological order in which he will deliver the goods). Another agreement was that additional consultation with the dispatchers should be reduced to a minimum.

- The agreements concerning the usage of a software system – there are choices to be made before using a software system and these need to be negotiated.

  For example how should the truck drivers use the system when they are not able to successfully complete a delivery? Also this happens when standard software is introduced such as in the library case: What are our categories for this field in this form?

- The usage of additional technical systems – Not only the software system, which is being newly introduced as a background for a new sociotechnical solution has to be taken into accoung, but also the existing technology and the effects it might have on its usage have to be considered.

  For example in the steel delivery case the truck drivers had to agree that the mobile phone would only be used in exceptional cases, e.g. in an emergency situation. In the library, for dissertation thesis the work with the database system is accompanied by tasks regarding the digital publishing of the work and these tasks needed to be synchronized.

- The meta-level comments concerning the project – STWT workshops prompt contributions which cannot be expressed by a modelling notation in a process description, but are related to its elements.

  For example in both cases notes were taken to clarify the current state of the projects, where to continue at the next session or themes that need deeper discussion. This could include both, material needed for the STWT procedure and/or broader context information about the work environment.

4 Conclusion: Supporting knowledge integration in the course of developing socio-technical systems

As described in section 2, STWT has distinctive features, which differ to other approaches in the domain of sociotechnical design. These features are mainly the focus on concrete work-procedures, the usage of a semi-structured modelling notation, the handling of incomplete specifications the step-by-step principle of inspecting the details, the intertwining of communication and documentation, and the integration of varying perspectives in one picture. In this section we emphasize those aspects of the STWT-case studies which – from an analytical point of view – are relevant for the success of knowledge integration:

a) Continuously combining communication processes and graphical documentations in order to support the development of a sociotechnical system
b) Interweaving fieldwork material (e.g. photos, screenshots, prototypes) with diagrams of working processes
c) Combining the discussion of contingency and freedom of decisions with the appropriate level of deterministic specification

Ad a) In a STWT the contributions made in a discussion are immediately documented using diagrams (instead of delegating the writing of the minutes to a single person who may represent a specific perspective (e.g. software-engineers). The STWT combines communication processes and graphical documentations, even though this may appear awkward or over-disciplining. However, it has proved as reasonable and helpful to make the documentation of the communication progress a task which accompanies the discourse about the new system immediately. The visual presence of the anticipated features of the sociotechnical system is crucial as well as the option to add further details and

comments if necessary. The less ephemerally the presentations of details are, the higher the chance is that they will become an integrated part of the participant's knowledge.

Ad b) Using a modelling method such as SeeMe, which is limited to the use of three basic symbols, is on one hand easy to learn but on the other hand leads to relatively abstract presentations. This level of abstraction requires a certain amount of effort when the participants are asked to compare the models with their real life experiences. To make this comparison more feasible we provide additional material for the recipients such as photos of persons or of forms, with screenshots of prototypes, etc. As far as is possible, this material is linked to the more abstract models of the work processes. These links increased the participants' attention, as they were then able to imagine how their future tools would look like, and it became easier for them to comment on the quality of the screenshots once they were directly linked to the sequence of tasks that had to be carried out. The material supports the connection of the participants concrete work experience and the newly acquired knowledge.

Ad c) Many people are not used to expressing their perception of work procedures in a formal way. Formalisation can be an obstacle on the way to articulating and to acquiring knowledge. Furthermore, it can result in misleading representations of the real world. A typical example is the over-specification of activity sequences, if one specific order of task processing is determined with a model instead of a multiplicity of possible sequences. In our experience, agreements or specifications are not very easily accepted or kept in mind, if they are more formal or more restrictive than is necessary. However, it is adequate to formally represent aspects of a sociotechnical system if they are based on a formal structure. Therefore, a modelling method for sociotechnical systems must be able to represent both, contingent as well as highly determined structures and processes.

From interviews – which were conducted after the workshop series by our group member Menold (2006) – we became aware of the fact that not every aspect of the sociotechnical models is equally accepted, and therefore did not become integrated into the groups' knowledge. Therefore, further research is necessary so as to understand how the exchange of knowledge and its integration takes place during workshops to design sociotechnical systems and how the methods can be improved and become more reliable. There also has to be a better understanding of the effect of different kinds of diagrammatic representations and the ways to refer to the representations during an STWT.

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