Ergonomics in Design Processes: The Journey from Ergonomist toward Workspace Designer

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Abstract

The aim of this article is to study the learning processes that take place in an interactive research project, which involved university researchers as well as ergonomic practitioners. The project simultaneously developed and tested a new framework—designated Workspace Design—for intervention in workplace design processes in companies. The basic idea in Workspace Design was that ergonomists should take a new role and apply new participatory methods when involved as consultants. The course of the project was evaluated by the application of social learning theory. The goal was to find out if and why the ergonomic practitioners had learned to practice the new concept by themselves. The results confirm that learning to some extent took place with help from two different mechanisms: learning by interacting and learning by practicing. Three factors are of crucial importance to the successful transfer of a new framework to ergonomic practitioners: 1) the practitioners must take part in developing and testing the framework and the subsequent interpretation of results, 2) they must have the opportunity to practice the framework in the daily consultancy setting and then reflect on their experiences, and 3) their consultancy organization must be committed to adopt the new framework.

Keywords: Macroergonomics; Participatory ergonomics; Situated learning; Workspace design

1. INTRODUCTION

Much of the academic ergonomics community has stressed for a long period that ergonomists should take part in the design process of work systems. Karwowski (2005) forecasts that design and management of systems that satisfy human compatibility requirements will be the ergonomics discipline’s main focus in the 21st century. He envisions a proactive ergonomic design approach that drives technology (Karwowski, 2005). Macroergonomics is about the design and optimization of work systems with a focus on the interaction between technology, organization, and work system (Kleiner, 2004). Daniellou (2005) also stresses that ergonomists should take part in design processes of new work systems. He envisions an active role for ergonomists to influence the management of design projects by setting up new structures that allow the participation of future users (Daniellou, 2005).

Consequently, within macroergonomics and related disciplines, frameworks, models, and concepts have been developed to analyze and design work systems. It is recognized that ergonomics is but one discipline that must act together with engineering and management disciplines in the design process of work systems. While the ergonomic frameworks and tools for analysis and design are well developed, the capabilities and work practices of ergonomics practitioners are less studied.
Consultants have demonstrated quite well the implementation of frameworks (Hendrick, 2008; Imada & Bowman, 1992), but it is still unclear in what ways ergonomic practitioners can gain the capabilities and ways of working assumed in theoretical frameworks. One reason may be that the development of frameworks and methods almost exclusively takes place in academia. The frameworks and concepts are rich in considerations about the role of ergonomists in the design of work systems but poor in explaining how ergonomic practitioners can acquire the necessary capabilities and a new work practice based on the theoretical models and understanding. Therefore, this article focuses on the question: How can ergonomic frameworks and concepts developed in academia and implying new capabilities and work practices for ergonomic practitioners, become “transferred” to the practitioners and result in a new work practice? In our investigation of this question, we take as a point of departure the work of Schön (1983). His studies indicate that the actual work practice of professionals cannot be seen as a result of the traditional knowledge hierarchy of basic science, applied science, and technical skills (Schön, 1983). But if knowledge and capability are not “transferred” along this line, how can ergonomic practitioners learn to practice new concepts developed in academia?

In the Danish research program Workspace Design (WSD), a new framework for ergonomists has been developed. The research program also specifically addresses the question of how this framework can become a new work practice for ergonomists. The chosen strategy included an interactive research setup, where the ergonomists work alongside researchers, and a training course, where the developed concept was presented to a larger audience. The aim of this article is to reflect on this strategy and the preliminary outcomes concerning the transfer of the approach to occupational health and safety consultants and units, which in Denmark employ many ergonomists. In this way, the article can contribute to answering the question of how ergonomic frameworks and concepts developed in academia can be learned by practitioners and thereby induce new work practices.

1.1. The Roles of Ergonomists

In the academic ergonomics community, the concept of the ergonomist as an organizational change agent has become quite widespread (Hendrick, 1997). Hendrick (1997) and Kleiner (2004) pointed to this role within the framework of macroergonomics. Kleiner (2004) claims that macroergonomists are positioned uniquely to induce and manage positive change in industrial organizations, because they can work at both the human–machine interface level and the organizational intervention level.

On the basis of activity analysis, researchers within the ergonomics field point to another role of the ergonomist, namely, that of organizer and facilitator. The ergonomist is seen as the actor who should organize and facilitate dialogues between the designer’s activity and the user’s activity during the design process (Béguin, 2006; Daniellou, 2006; Falzon, 2008). “The work of ergonomists rests on his/her capacity to articulate these approaches, and the ability to translate them into operational proposals and methods adapted to the singularity of a given project” (Béguin, 2006, p. 119).

In a study of the work practice of occupational health service (OHS) consultants in Denmark, Broberg and Hermund (2004) coined the concept of ergonomists as “political, reflective navigators” when they work with clients’ work system design processes. This term sums up the actual work practice of OHS consultants who try to influence sociotechnical design projects in client companies. From this role, a set of useful capabilities were elaborated (Broberg & Hermund, 2004).

1.2. Learning New Ergonomic Work Practices

All these studies have developed theoretical frameworks, concepts, and methods that prescribe a role and a set of appropriate capabilities for the ergonomist. However, almost nothing is depicted about how the ergonomic practitioners can learn the role and consequently develop a new work practice. Two Dutch studies both report on this issue based on different approaches. In a study by Swuste and Arnoldy (2003), the focus is on learning a concept already developed in research: The new work practice is learned in the classroom and real-life situations are simulated through role playing. The participants are not involved in the development of the concept, and they are not trained in implementing the concept in real life. In the second Dutch study, Commissaris, Schoenmaker, Beune, and Eikhou (2006) use the practitioners as a sort of interactive informant—the researchers adapt an existing theoretical model, based on comments by the practitioners. The focus is on integrating the knowledge and
experiences of the practitioners in the adoption of a change concept. Hence, this approach is more interactive than the approach by Swuste and Arnoldy (2003). Neither Dutch study evaluates how the ergonomists’ work practices have changed.

In this article, we contribute with experiences from the Danish Workspace Design research program using a third approach to teach ergonomic practitioners a new work practice based on a theoretical concept. The strategy adapted in this research program to transfer knowledge to ergonomic professionals is a further development of the approach taken in the two Dutch studies. The strategy consists of two separate approaches designated “learning by practicing” and “learning by interaction.” The learning by interaction approach entails the ergonomic professionals to develop and implement new work practice in cooperation with researchers. Whereas in the learning as practicing approach, the developed work practice is taught to the ergonomic professionals by researchers. In this article, we analyze and evaluate the two approaches using the theoretical framework of Wenger’s definition of learning as a social activity (Wenger, 2000), with special emphasis on the concepts of communities of practice, boundary spanners, boundary objects, and social learning systems (Wenger, 1998). Our findings suggest that a successful learning process takes place when: 1) practitioners are included in the research team and take part in the development, test, and interpretation of results when applying the new concept to a real case in a company; 2) the concept is introduced to practitioners, after which they try to practice the concept in a normal consultancy situation and afterward have the opportunity to reflect on their experiences in a “learning space” with the researchers and other practitioners; and 3) paying attention to the organizational settings of the ergonomic practitioner to make sure that a new work practice is implemented in the organization and not only by a single practitioner.

To understand the research setup, a short introduction to the WSD concept and methods and a description of the interactive research approach are presented in the next two sections.

2. THE WSD CONCEPT AND METHODS

The concept of Workspace Design derives from a wish for ergonomist to take a more active role in the early stages of design of work systems. The objective was to develop a new concept, including methods for ergonomists and consultants in the Danish occupational health service (OHS), who take part in design processes of work systems. The Danish research program Workspace Design had the remit to examine the approach and the methods in real cases in three companies. Furthermore, the approach and the methods were to be “transferred” to OHS consultants and OHS units in Denmark, thereby making it possible to develop a new work practice and a new service. The role of change agent might be appropriate; however, in the program we aimed at a more specific role for the OHS consultant, which we designated as “workspace designer.”

This role was intended for OHS consultants working with client companies engaged in technological and organizational changes. From the outset, it was not a ready-made concept. The concept gradually emerged on the basis of experiences from two intervention cases. The idea was to set up an interactive research program in which consultants in Danish OHS units participated by taking active part in the interventions and subsequent evaluation and development of the WSD concept. It was the hope that the consultants would be able to bring the concept and methods back to their OHS unit, which could then offer this new approach to clients.

Workspace Design was inspired by the work of Horgen (Horgen, Joroff, Porter, & Schön, 1999). In this work, the workplace with work practices is seen as embedded in four dimensions: spatial, organizational, financial, and technological (SOFT). See Figure 1.

These dimensions are interdependent and in a dynamic relationship with one another. A change in one dimension may demand changes in others as well. The staging of the Workspace Design process is aimed at creating a dynamic coherence between work and these four dimensions of the workspace. The creation and shaping of workplaces are processes influenced by the actors who populate each of the four corners. The basic idea of the concept of Workspace Design was that actors who are capable of working across the four corners are needed to facilitate and negotiate the process of workplace-making with the different actors. These facilitators stage the Workspace Design process: They are workspace designers. This is a job of creating shared visions among actors with different perspectives and competencies, overcoming resistance and political interests, setting up a collaborative design process, and facilitating meetings between actors from different corners in the SOFT model.
In addition, it is a core feature of the Workspace Design concept that staging the process is based on user participation. This entails methodologies and tools for user participation as important elements of the concept. And, finally, the concept is aimed at helping organizations create effective as well as sound workplaces, meaning healthy and safe work conditions and good ergonomics.

The methods and the role of a workspace designer were tested and further developed in two intervention cases: 1) an industrial manufacturer who was to implement new technology in an empty production hall, and 2) an office in a municipality that was to move to an open space office and implement new ways of working. We had a theoretical idea of the workspace designer’s role based on the SOFT model, and we had an existing collection of methods based on the experience gained by the WSD team members from their previous work. It was, however, during the intervention case studies that we gained experience on how to practice the role and use the methods in particular organizational and technological contexts. Based on the experience gathered from two case studies, we developed a model for a workspace designer to intervene in sociotechnical change projects (Figure 2). In this model, the workspace designer is seen as navigating concurrently at three different stages.

![Figure 1](image1.png)  
**Figure 1** The SOFT model (Horgen et al., 1999).

![Figure 2](image2.png)  
**Figure 2** The three stages on which the workspace designer operates (Broberg, 2009).
In setting the stage, the workspace designer investigates and negotiates the frames and networks surrounding the sociotechnical change project in the organization. This is typically based on meetings with management and employee representatives. Having the SOFT model in mind, the workspace designer inquires into the status of the change project by asking what in the four corners is open to alternative options and what seems to be closed. The SOFT model also points to relevant actors to be considered as participants in the intervention activities. In this phase, the workspace designer is negotiating with organizational members on the goal of the intervention, the resources to be put into the intervention, who should participate, and how insights and results from the intervention are to be transmitted and sustained in the ongoing sociotechnical change project.

The workspace designer has to gain a basic understanding of the work system in the organization or in the relevant part of the organization in question. The issue is to understand the basic features of the production system, work practices, and working conditions. It also includes getting an idea of what is being debated in the work system, and what are the current issues to be solved in the employee–management relations? Obtaining this understanding can be a concurrent process to setting the stage.

### 3. THE WSD PROGRAM AS INTERACTIVE RESEARCH

The design of the research program has been developed in the tradition of action and interactive research (Aagaard Nielsen, 2006). Interactive research was born out of the criticism of action research (AR) and claims that AR put too much emphasis on the practical changes instead of focusing on the knowledge creation process (Eklund, Pettersen, Elg, & Bolling, 2008). For example, in AR the participants seldom have an active role in the analysis of the data, the construction of new theories, or the development of new concepts (Larsson, 2006). Compared to AR, interactive research stresses more strongly the joint learning that goes on between the participants and the researchers throughout the entire research process—from the definition of the problem to the analysis and dissemination of the results (Svensson & Aagaard Nielsen, 2002). Thus, the knowledge created in an interactive research program is characterized by both practical relevance and a high scientific standard.

The approach of interactive research is mainly used in organizational development projects where the practitioners involved are the employees and management of the organization. In this research program, the interactive research model is applied in a slightly different manner: The practice system in question is the occupational health and safety consultants involved in the interventions. The model made by Ellström, Eklund, Kock, Lindström, and Melin (1999) has been modified to illustrate this specific setup (Figure 3):

The model shown in Figure 3 depicts the knowledge creation through the interaction of two activity systems, consisting of the researchers and the consultants, respectively. Both activity systems are interlocked; they are collective learning cycles driven by the problems and issues facing the researchers and consultants when intervening in a change process. These problems and issues can be identical or overlapping, since the two activity systems can have alternating views of what constitutes the core problem in the intervention. The two learning cycles are informed by the previous experiences and knowledge of the participants—the consultants draw on their understanding of the organization and their skills as macroergonomists, whereas the researchers rely mainly on previous research experience and theoretical knowledge, which is primarily conceptual, codified explicit knowledge. This is in contrast to the local theory—the practical knowledge and assumptions—that informs the practice's learning cycle and can lead to actions in the organization. The local theory is more contextual, situated and based on experiments. Hence, local theory is difficult to make distinct because of its tacit or implicit nature (Ellström, 2008).

The shaded circle illustrates the common process of conceptualization and interpretation of the process shared by the two activity systems. In this research program, the conceptualization of the Workspace Design concept and the development of the adjacent methods took place in the Workspace Design team, where consultants and researchers worked side by side. The team worked both in companies carrying out interventions and in project meetings with the specific aim of discussing what could be learned from the interventions, as well as further developing the concept and methods.

The majority of the project meetings took place in the so-called workspace lab. The workspace lab—illustrated as the gray area in the knowledge creation model (Figure 3)—can be viewed as both a physical space and a virtual space: The physical workspace lab
is located at the university and has been designed to support the creative process and dialogue that takes place there. However, the notion “workspace lab” can also be used to describe the virtual room established in the companies during the interventions. The laboratory metaphor is both suitable and useful in this setting. Binder (2007) describes the virtual workspace lab as a collaborative space for joint exploration, taking advantage of a “controlled” environment and the possibility of “experimentation.” By calling the physical location where the joint conceptualization and interpretation takes place a “laboratory,” we emphasize the transparency of the process and the embedded wish that all team members take an active role in the experimental development of the concept and design and the subsequent interpretation of the intervention. The laboratory becomes a symbol of “the space for reflection,” which we wish to create among the members of the WSD team and which is manifested by the physical room, “Workspace Lab.”

4. EVALUATION METHODS
The bipartite strategy of “learning by interaction” and “learning by practicing” has been evaluated by the researchers in the WSD team, joined by one impartial researcher, in order to establish whether learning had taken place either on an individual or organizational level, and whether the learning has formed basis for a new work practice. For a total overview of the data on which the evaluation is based, see Table 1.

The methods chosen were semistructured interviews (Kvale, 1994) and observations of the consultants at the project meetings, the course days, and the structured events in the companies. In the case of the interventions—learning by interacting—the OHS

<table>
<thead>
<tr>
<th>No.</th>
<th>Learning by Interacting</th>
<th>Learning by Practicing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project meetings in WSD team</td>
<td>22</td>
<td>–</td>
</tr>
<tr>
<td>Workshops and other structured events in companies</td>
<td>11</td>
<td>–</td>
</tr>
<tr>
<td>Course days</td>
<td>–</td>
<td>2</td>
</tr>
<tr>
<td>Evaluation interviews</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Observations of the ergonomic practice in companies</td>
<td>19</td>
<td>5</td>
</tr>
</tbody>
</table>
TABLE 2. The Four Companies Participating in the Training Course

<table>
<thead>
<tr>
<th>Participants</th>
<th>Change project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major corporation I</td>
<td>Safety representative Safety coordinator Design of new production machinery</td>
</tr>
<tr>
<td>Major corporation II</td>
<td>Ergonomist Safety coordinator Technological changes in production lines</td>
</tr>
<tr>
<td>Consultancy firm</td>
<td>Two OHS consultants Consultancy service regarding layout of open spaced offices</td>
</tr>
<tr>
<td>Hospital</td>
<td>Project manager Safety coordinator Design of a new depot for aids for the sick and elderly</td>
</tr>
</tbody>
</table>

consultants involved in both cases, as well as the management of the consultancy firms, were interviewed.

The learning by practicing approach was evaluated by interviews and observations in two of the participating companies: 1) the project involving design of a new depot for aids for the sick and elderly (see Table 2) were evaluated by interviews with the two course participants, the affected employees as well as visits to the depot before and after the changes; and 2) group interviews were carried out in the corporation working with technological changes in production lines (see Table 2).

In the data analysis, we have identified data that indicate that learning had taken place. For instance:

- The consultants themselves state that they have learned something.
- The consultants report that they applied the framework in other projects.
- The management states that the concept and methods have spread inside the organization.
- The management states that the concept and methods will be used in their consultancy services.
- Other stakeholders evaluate the consultant’s new work practice and its effect.
- We observe the consultants using new methods.

5. LEARNING THE PRACTICE BY INTERACTING

The strategy of learning by interaction was established by two interventions that were carried out as part of the WSD program. In both cases, OHS consultants were part of the team that designed and carried out the interventions. In this manner, the WSD concept was tested and simultaneously further developed, using an interactive research methodology.

The first intervention took place in an industrial company embarking on a change of production technology, going from outdated, labor-intensive batch production with numerous ergonomic problems to a state-of-the-art, highly automated continuous production, partly with the aim of eliminating the majority of the ergonomic problems. The OHS consultant normally associated with the company was included in the WSD team, and he instigated the negotiation with the management. In this way, he became a key player in “setting the stage” (Figure 2). To ensure the WSD team’s awareness of the production and the work practice at the company—the so-called work system stage (Figure 2)—a screening of the work environment was carried out by the OHS consultant and a researcher. The researcher chose to approach the screening by following the flow of the production, so that both knowledge of the production and the associated ergonomic problems came to light. This approach is inspired by the walk-through method (Horgen et al. 1999), which is a combination of an interview and a guided tour, where the employees systematically walk you through the production while explaining the different elements. The OHS consultant was not accustomed to this approach, and he was surprised at how many new things he also learned about the production just by talking with the employees and following the production flow. This OHS consultant was a novice in the field of macroergonomics and WSD and was not familiar with the more creative methods used. Consequently, he took a less active role in the “intervention stage” (Figure 2) and drew on the experience of the other members of the WSD team. Later in the intervention, we carried out what is called a future workplace assessment. In this event, the OHS consultant was asked to take the central role of facilitating the discussion about the future working environment. The OHS consultant was instructed in the method by the rest of the WSD team, and he also took part in writing the “script” for the workshop. The OHS consultant rose to
the occasion, became the prime mover of the event, and was able to orchestrate a visually supported dialogue between the different stakeholder groups—employees, management, and engineers—about the working environment of the future workplace. In this way, the OHS consultant used WSD methods to address the ergonomic considerations in an open forum and in this process developed the skills required for staging a WSD process. Thus, in the first part of the intervention, the OHS consultant worked as a novice workspace designer alongside the researchers learning the methods inspired by participatory design (Horgen et al., 1999). In the second part, the OHS consultant worked more independently as a workspace designer.

The second WSD case involved a department in a city council that was undergoing major change, consisting of 1) a reorganization where several smaller departments merge into one, and 2) a physical move from small one- or two-man offices to a newly refurbished office building with an open-plan layout. In this case, too, the OHS consultant normally associated with the council joined the WSD team. However, in this case, the OHS consultant had previously worked with similar creative methods and was used to taking a more holistic approach to ergonomic consultancy, which prompted the OHS consultant to play a more active role, especially in the design and the carrying out of the intervention. Thus, the OHS consultant 1) negotiated the WSD team’s access to the change process with the management; 2) designed the intervention alongside the WSD team, thereby ensuring the tailoring of the methods to the specific context of the department, which was well known to the OHS consultant; and 3) functioned as a facilitator at several events. She also played an active role in composing written material, such as booklets describing and interpreting the intervention. Subsequently, the OHS consultant presented the WSD methods at different occasions internally in the city council with the aim of selling the WSD as a consultancy service to other departments undergoing similar changes.

Approximately once a month, the WSD team and the OHS consultants involved in the cases met at a project meeting. These meetings functioned as a space for joint reflection, where the participants could discuss and further develop the WSD concept and its methods.

The evaluation of the first case showed that the work practice had not been embedded in the consultancy firm after a few months, and 2) the consultancy firm apparently viewed their participation in the research program more as a work task like any other and not as a possibility to learn a new approach to ergonomic consultancy work. The consultant involved in the WSD team also left the company to be able to work with a more holistic approach to ergonomics in line with the WSD concept. However, the company has since shown some commitment toward the project. They have held a workshop for consultants and clients about the new concept. At this occasion, it became clear that several of the firm’s clients were interested in this kind of consultancy service.

The OHS consultant in the second case has partly succeeded in incorporating the concept and methods in her consulting firm’s service portfolio.

I need to describe this at our website as a new consultancy service. I will open for more light versions of the workspace design approach because some people gets a little bit nervous when I tell them about the process we had in the case of the open-plan office design. It was apparent that she had learned a great deal from participating in the WSD team, and she tested some of the methods in her own work.

I have previously worked with the practical layout of workspaces. However, I learned a lot of the more abstract layout design games that included organizational aspects too. The emphasis on visualization techniques was also new to me.

In so doing, she also initiated her colleagues into the concept. However, our interviews with her and the management of the consulting firm indicate that although the consultancy firm had been inspired by some of the more creative, visually based methods developed in the research program, and they have used these methods in different projects, it is more doubtful whether we succeeded in including some of the more basis principles behind the WSD concept in the local theories (Figure 3) of the company. Thus, no serious organizational action has yet taken place, and the WSD concept in its totality has not yet been included in the company’s approach to ergonomic consultancy. Still, it is too early to make a definitive evaluation of this matter.
6. LEARNING THE PRACTICE BY INTERACTING

When the WSD concept had matured and been developed during the interactive research interventions, the WSD team sought new ways of “transferring” the new work practice to a larger audience. The WSD team offered a training course to ergonomic professionals, such as OHS consultants. The course was advertised in various media and the response was overwhelming.

Four companies were chosen to participate, based on submitted applications describing a future change project in the company (see Table 2). Each company participated with two representatives. Two companies were major corporations from the private sector with their own internal OHS advisors. One company was an OHS consultancy firm. The two last participants were from a Danish hospital, a safety coordinator, and a project manager. The course was designed as a combination of traditional education and contemporary training in which the participants take a more active role. In advance of the course, participants were asked to fill out a booklet preparing them for the course. The booklet consisted of three elements: 1) a page where the participants should summarize their experience with project engineering and the planning of large change processes; 2) a so-called workbook (Horgen et al., 1999) in which the participants should photograph six different motifs that depict central problems of the workplace; and 3) subsequently comment on the pictures using a color code (red indicating problems, green indicating good solutions, and yellow pointing out areas in need of special attention).

The last element of the booklet was inspired by the SOFT model (Horgen et al., 1999; Figure 1). The participants used the SOFT model to analyze their projects, for instance, in order to identify the key stakeholders occupying the four corners.

The first day of the course focused on design, alternating between group work and presentations by the WSD team about the theoretical foundation of the WSD concept as well as reports from the two interventions (Figure 4). In the group work sessions, the representatives from one company worked with
representatives from another company, forming two groups. The group work was facilitated by members of the WSD team, and the organization of the group work was inspired by WSD methods, such as design games, which emphasized creative, visually based means of communication (Seim, 2007). In the first part of the group work, participants presented and explained their project, using the booklet they had filled out. In the afternoon of the first day, the participants helped each other design a plan for their company project built up around WSD methods that were tailored to their company’s specific context.

In the month between the two course days, the participants carried out the plan, working in practice with the WSD methods in their own real-life projects. The main purpose of the second course day for the participants was to report and discuss their experiences with the methods and jointly plan the further steps to be taken in the different projects. This plan allowed the participants time for reflection. Their thoughts and reflections were written down on postcards, which the participants wrote to themselves. For instance, they could write about their experiences using WSD or how they planned to use WSD methods in the future. The postcards were sent to the participants approximately 1 month after the course. This was done to remind the participants about the thoughts they had at the end of the course; this was to emphasize the idea that the learning that took place during the training course was supposed to manifest itself in the daily work of the participants.

The training course took place in the workspace lab. Once again, the lab functioned as a physical and mental space for reflection and experimentation; here, the course participants could learn, plan, and discuss the WSD concept and methods in a setting separate from their own organization.

The evaluating interviews carried out in the hospital case showed that the participants had not only been able to design and execute a WSD-inspired change process, but they had also been able to tailor the methods to the context in which they were applied. They were able to design an intervention with a series of events, among them two workshops in which they staged a meeting between the architect, employees, and management of the aid depot. They facilitated these meetings using the visually based method of WSD. They also visited the aid depot to familiarize themselves with the work procedures. These actions show that the course participants had learned the basic principles behind the WSD concept, and they were able to work on all three stages at which a workspace designer operates (Figure 2). Afterward, they also expressed the wish to apply the methods in other projects, and they included their own descriptions of the WSD methods in the hospital’s OHS handbook. This indicates a change in the local theory toward inclusion of their own version of the WSD concept and methods. Both the employees and other stakeholders involved in the change process expressed satisfaction with the new approach taken in the design of the aid depot.

The group interview with the participants from the corporation working with production lines revealed that the course participants had not been able to apply the WSD method in their own company. The employees have thus not been involved in the redesign of their workplace. Several ergonomic problems were identified after the implementation of the new production line. The participants had met numerous barriers, when they tried to involve the employees in the project using WSD method. Their own analysis of the sequence of events was that the main barrier was the organizational culture in the corporation, which is characterized by a technical rational approach to change projects in which the predominating actors were engineers in the technical department. This case clearly demonstrates the importance of the phase of “setting the stage” (Figure 2), when all involved parties have to be committed to the approach to the change project.

7. ANALYSIS OF THE LEARNING PROCESSES

Both ways of “transferring” the WSD concept and methods from academia to ergonomic professionals are in line with Lave and Wenger’s (1991) theory of learning by participation in situated practice. In this section, our results are analyzed and discussed using the terminology first introduced by Lave and Wenger.

7.1. The WSD Team as a Community of Practice

In the approach used in the WSD cases—learning by interacting—the WSD team gradually formed a heterogeneous community of practice (Wenger, 2000). When the WSD team was initially formed, the situation could be described as a meeting between different
communities of practice; but as the team members worked together in developing the concept and methods, the process of establishing a community began. The researchers’ and the consultants’ sense of belonging to the community developed concurrently with the development of a common intention, their engagement in the project, and the mutual repertoire. The common intentions behind the project were maintained and simultaneously developed during the project meetings, where everybody contributes with information and takes an active part in discussions and decision making. The feeling of engagement toward the community increases over time, concurrently with the development of WSD methods and our mutual success stories.

In the WSD community, OHS consultants were engaged in testing and developing the WSD concept, side by side with the researchers in the two cases. Thus, learning was entwined with participation, and the OHS consultants became full members of the community of practice, not by learning about the practice but by actively participating in it. The community defined what constituted legitimate practice (Fenwick, 2006); thus, the researcher and the OHS consultants shaped the practice together. In this way, the legitimate practice comprising the WSD concept and its methods was based on both theoretical research and the practical ergonomic knowledge of the OHS consultants. However, the development of the WSD team community was not completely symmetrical; from the start, the setup favored academia. The consultants had more to learn from the researchers than the other way around. It was the knowledge of the researchers that constituted the basis on which the WSD concept was built. During the interventions, the consultants moved from the periphery of the community to become full members of the community. This process demonstrates the asymmetrical relationship between the researchers and the consultants. However, the intention had never been a symmetrical relationship between the researchers and the consultants. The interactive research model emphasizes different—and clearly defined—roles for the researchers and the practitioners (Ellström et al., 1999). While the researchers were responsible for project management and the research process, the practitioners were responsible for their own learning and the devolvement of the framework back to their home organization. In retrospect, sufficient time was not spent on the role definition phase in this project.

7.2. The OHS Consultants as Boundary Spanners

The consultants belonged to (at least) two different communities of practice: the WSD team and their own organization. In Wenger’s optic, the boundaries of communities are particularly important to ensuring learning. Boundaries are areas where perspectives meet and new possibilities and radical new insights arise. When members of a community interact with another community, they are exposed to a different type of competence, which results in reconfiguration of the relation between experience and competence (Wenger, 2000). The consultants’ membership in the OHS consultant community gave new dimensions to the repertoire of the WSD team community. But it also gave the consultants an important role as boundary spanners, functioning as brokers between the communities. Thereby, experiences from the consultancy world could inform the knowledge creation inside the WSD team, and the knowledge created by the WSD team could be made accessible to the OHS consultancies.

7.3. The Training Course as a Social Learning System

In the case of the WSD training course—learning by practicing—a more conventional way of learning was adopted in the presentations, but the notion of situated learning was manifested in the emphasis on group work and the implementation of the concept in practice by the participants. At the two course days, the WSD team’s community of practice met other communities—the course participants—thereby forming a social learning system. According to Wenger “the learning and innovation potential of a social learning system lies in its configuration of strong core practices and active boundary processes” (Wenger, 1998, p. 245). The core practice—in this case, the WSD concept and methods—had already been configured and tested by the WSD team. The participants’ own project, where they planned and carried out a WSD project in their own context and were supervised by the WSD team, constituted active boundary processes. Specifically, the movement to and from the mental reflection room in the workspace lab and the real-life context of their own change project (Figure 4) demonstrated these active boundary processes; in the workspace lab, they were able to reflect on the usefulness of the WSD
concept in their own context. In this manner, we had designed the training course to underpin situated learning.

7.4. The Course Material as Boundary Objects

The material used in the course—the preparation booklet, the game board used in group work, and so forth—was designed to facilitate the dialogue between the participants and the WSD team. Thereby, these objects became boundary objects supporting the learning process across the boundary between the communities. In our experience, visually based tools work very well as boundary objects because of the equalizing effect of visually grounded communication (Seim, 2007). An example of this is the group work where the dialogue was structured using a game board depicting the SOFT model.

8. DISCUSSION

The starting point of this study was the question of how ergonomic frameworks and concepts developed in academia can be learned by practitioners and thereby induce new work practices.

The WSD research program attempts to take the learning approach a step further, than the previously mentioned Dutch studies, by focusing on 1) the interactive development of the concept and methods, 2) the situated learning of the concept, and 3) identification and evaluation of a changed work practice. Our findings suggest that two phases should be distinguished in learning a work practice based on a new framework. In the first phase, when even the researchers are not able to formulate the framework explicitly, the idea of learning by interacting is a useful way for practitioners to gradually learn to know the framework. In the other phase, when the framework is more mature, our findings suggest that it can be learned by learning by practicing.

Commissaris et al. (2006) conclude that the involvement of ergonomists is crucial if a new framework is to become applicable to ergonomics practice. Our findings suggest that a specific sort of involvement is beneficial: the active participation of ergonomic practitioners in the phase of development and trial of the new framework. This invokes for the practitioner a situated learning approach and offers at the same time reflection with the researchers regarding practice. In the city council case, we have strong indications that the OHS consultant learned to practice the Workspace Design framework. After her participation in the program, she was able to practice the framework in her own assignments. Once the Workspace Design framework was developed and tested, we tried to see whether it could be learned in a training course for ergonomic practitioners. This approach was very successful for one out of four training teams. The hospital training team had the freedom to test the Workspace Design framework in their organization, and they were very skillful in doing so. However, in the case of the industrial manufacturer, the training team had difficulties in applying the framework to their organization. This case clearly demonstrates that the success of a training course depends not only on individual learning but also on the capability of the practitioner’s organization to adapt to a new framework and the practitioner’s ability to persuade the organization to do so. The participants themselves named the organizational culture to be the main barrier to applying the new work practice. As mentioned earlier, this culture is dominated by a technical-rational approach to changes, with engineers as the primary change agents. To root the new work practice in this specific organization, another strategy might have proved more successful; a representative of the engineers from the technical department could have attended the training course together with the safety coordinator. In this manner, the specific culture of the organization would be taken into account, and it would thereby become more likely to affect local theory.

8.1. The Practice System

We have interpreted our approach in terms of social learning theory, as presented by Lave and Wenger (1991) and Wenger (2000). Both the learning by interacting and the learning by practicing approaches accentuate “learning” rather than “teaching,” thereby acknowledging the social process of acquiring new knowledge. The interaction between researchers and practitioners in the early phase is well understood as an attempt to create a Workspace Design community of practice based on asymmetrical roles between researchers and practitioners. By looking at the practitioners as boundary spanners between the emerging Workspace Design community and the community of practice in their own consultancy organization, we became aware of an important aspect. We did not fully
recognize what would happen when the ergonomic practitioners returned to their own organization and tried to introduce a new framework and work practice. This question concerns the practice system in the interactive research model (Figure 3). A single practitioner may learn the Workspace Design framework but to change the local theories in the organization and spread the framework may be difficult, as we observed in one case. Hence, in future programs aimed at learning a new work practice, it is important to take into account the organization in which the practitioners are situated. The local theories and the organizational politics will influence the possibilities to adopt a new framework. We suggest that the management of the organization be closely involved when entering into a contract between researchers and practitioners, which can ensure that the organization engages in the new framework learned by one of its practitioners. Regular, structured contact between the research team and management is also crucial in order to challenge the local theory of the organization over a period of time and to give organization management the possibility of informing the interactive development of the framework so that the final concept fits the organization better.

8.2. Implications of the Findings

This study contributes knowledge to academic researchers who develop new ergonomic frameworks aimed at practitioners. It is recommended from the outset to think of the learning process that should enable ergonomists to apply the new framework. Based on the findings in this study, we suggest a two-phase model. In the first phase, the ergonomists participate in the development and trial of the framework. Situated learning is important, in combination with reflections on practice. To induce organizational learning, it is important to enter into an agreement with the management of the organization to which the ergonomist belongs. The result of the first phase is a more mature description of the new framework. In the second phase, the mature framework can be learned through the learning by practicing approach in a real-life assignment. Again, it is important that the researchers allow space for reflection regarding practice.

8.3. Limitations

The Workspace Design program has primarily focused on the development and trial of the new framework. Therefore, collection of data regarding practitioners’ learning of the new work practice has been limited. A dedicated study on the learning processes, and especially the outcomes, would have strengthened the results. However, compared to previous studies, this study secured empirical data to evaluate the learning effects of the activities in the program.

8.4. Further Research

Further studies are needed on how ergonomic practitioners can learn work practices related to new ergonomic frameworks. The ergonomist’s role as a change agent is widely acknowledged within the ergonomics community. However, how to learn this role in practice needs further study. It seems especially important to study further how a new, individually learned work practice can be transformed into organizational learning in ergonomic consultancy firms or departments.

9. CONCLUSIONS

The research program Workspace Design has actively addressed the question of how to “transfer” the knowledge created through research to practitioners as an integrated part of the research setup. The strategy chosen had two phases: In the learning by interacting approach, the concept was developed and tested in an interactive research design, where the practitioners worked alongside the researcher. At a later stage of the program, after the concept has matured through the interactive process, the learning by practicing approach can be applied. Both approaches acknowledge the social process of acquiring new knowledge and accentuate “learning” as an active process, instead of the more passive role awarded the student in a “teaching” situation.

The evaluation of the strategy chosen to “transfer” knowledge created in academia to practitioners in the Workspace Design program has identified three factors that are essential for the learning process: 1) the interactive research setup, where the practitioners are included in the research team and take part in the development, testing, and interpretation of results from applying the new concept to a real case in a company; 2) the possibility for the practitioners to practice the new concept in the normal consultancy setting and to reflect on their experiences with other consultants and researchers; and 3) the focus on the home organization.
of the practitioner, so the newly developed work practice is not only practiced by one, isolated consultant but becomes rooted in the local theory of the organization. We believe that these three factors are applicable to other research programs and can have a more generic use for ensuring the “transfer” of knowledge developed in academia to practitioners.

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