Engaging with Practices: Design Case Studies as a Research Framework in CSCW

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ABSTRACT
Information and communications technology (ICT) pervades most aspects of our lives and changes everyday's practices in work and leisure time. When designing innovative ICTs, we need to engage with given practices, institutional arrangements, and technological infrastructures. We describe the research framework used at the University of Siegen. It is based on a collection of design case studies in particular fields of practice and identifies cross-cutting issues to compare and aggregate insights between these cases. To illustrate this framework, we describe our research activities and discuss three themes which became important in different design case studies.

Author Keywords: Practice-based computing, design case study, research framework, research program

ACM Classification Keywords
H.5.3 [**Group and organizational interfaces**]: Computer-supported cooperative work

General Terms Human Factors, Management

INTRODUCTION
Innovative applications of ICT are increasingly penetrating all aspects of our lives. They become the technical infrastructure for a large diversity of different forms of social life [1]. The design of artifacts has a considerable impact on the social systems which appropriate them. Therefore, the quality of design is not a merely technical feature, but needs to be understood in its interaction with the applying social system [2]. From such a perspective, the research challenge is to design innovative ICT applications so that their appropriation leads to (desirable) impacts on the applying social systems.

While exploring design opportunities, we need to get engaged with the social practices which become subject to the application of innovative ICT artifacts. To cope with this challenge, we follow an *action research paradigm* [3, 4] which stays in the tradition of CSCW research.

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CSCW was the first research community in applied computer science which stressed the importance of an in-depth understanding of practices when designing ICT artifacts [5, 6]. From our point of view, this is the key achievement of the research field. One could claim that the CSCW community prepared applied computer science research paradigmatically to deal with the challenges of an increased interrelation between social practices and ICT artifacts.

Exploring on these premises, Rohde and Wulf built in the mid 90s a first research unit at the University of Bonn, called ProSEC (Research Group on HCI and CSCW). Being a contested element in a traditional computer science department, we moved our activities in 2000 to Fraunhofer FIT. In 2002 Wulf became a faculty member at the IS department of the University of Siegen, Pipek was appointed in 2006, Rohde and Stevens in 2009.

Over time, we have developed a three phase research approach which: (1) analyzes empirically the given practices in a specific field of application, (2) comes up with an innovative design for an ICT artifact related to the findings of the first phase, (3) investigates into the appropriation of the technical artifact over a longer period of time. We call the documentation of such a three phase research approach a *design case study* [7].

Interestingly, to our best knowledge there are very few research groups in the field of CSCW whose research thrives on covering all three phases of a design case study. Moreover, our community still lacks a theoretical conception which deals with the entire development and appropriation cycle and allows us to transfer findings with regard to the design of innovative artifacts and their appropriation in social practice.

Contributing to the discussion about the foundation of CSCW, we will present in the following research activities at the University of Siegen and Fraunhofer FIT together with the conceptual framework of this research.

SOCIAL PRACTICES
Practice-orientation has become a key element of different schools of social science thinking. Some of the most important contributors to social science theories of practice

are Bourdieu [8-10], Giddens [11, 12], Garfinkel [13], and Latour [14]. While distinct in their specific focus and contribution, the authors contend that individual perception, cognition, and action are embedded in and formed by symbolic interpretation patterns of social reality. Their work turns against rationalistic or structurally deterministic interpretations of human interaction – interpretations which neglect historical imprint, sociality, and/or reflexivity of human interaction.

Building on these discourses, Reckwitz [15, 16] elaborates on an idealized core of practice-theoretical approaches in the social sciences. Practices are understood as the smallest unit in the analysis of social phenomena. A practice is understood to be a mainly routinized pattern of human action which is not only encompassed by mental and physical forms of activity but that is also greatly imprinted by objects, especially by tools, media, and their usage. A practice is grounded in background knowledge that is both not entirely explicit and containing emotional as well as motivational elements. Practices, therefore, represent collective patterns of interaction that are reproduced in specific contexts. While the collective patterns of interaction are routinized, the concrete action is situated context-specifically and may deviate from them.

The reproduction of practices within a social aggregate goes along with a related perception of the world, common language usage and shared identities. Human actors are typically engaged in various practices.

In defining a CSCW research agenda, Schmidt [17] gives an account of the origins of our modern concept of practice. He notes that the interest in practices, starting from Diderot's encyclopedia in the 18th century, was transformative in its nature. The documentation of practices was related to their rationalization and to the transfer to related settings.

In our research, we also study practices with a transformative intend. Taking the perspective of computer science research, our primary focus is on the design of technical artifacts which should be both *transformative* with regard to certain problem or need statements in a specific domain of practice and *innovative* in the sense that artifacts of this type have not yet been built for the respective domain of practice. Note that the dual goal structure can lead to considerable conflicts when conducting research.

Since we look at practices from the perspective of design, we primarily focus on the micro-level as we investigate in detail how humans interact with each other and with ICT artifacts. To analyze these interactions in a design-oriented sense, we appropriate aspects of practice-theoretical frameworks and related empirical methods for CSCW research.

We believe in a dynamic relationship between ICT design and the appropriating social system. Since the appropriation of ICT artifacts has a transformative effect of the given practice, at least on the micro-level, ICT artifacts should react to changing conditions of a social system. So the key research issue is to design innovative ICT artifacts whose appropriation challenges and transforms existing social practices. To better understand this design issue, we suggest design case studies as a methodological framework.

DESIGN CASE STUDIES

As already noted, design case studies ideally consist of three phases: (1) They should offer micro-level descriptions of the social practices before any intervention takes place. An analysis should particularly describe already existing tools, media and their usage. Such documentation is typically directed by a certain problem or need statement when setting up the research agenda. (2) Design case studies describe the innovative ICT artifact from a product as well as from a process perspective. They include a description of the specific design process, the involved stakeholders, the applied design methods, and the emerging design concepts. A focus should lie on the documentation of how changes in social practices have been anticipated and how these considerations have influenced the design of the ICT artifacts. (3) Design case studies document the introduction, appropriation, and potential re-design of the ICT artifact in its respective domain of practice. Such documentation allows to analyze the transformative impact of certain functions and design options realized within the ICT artifact.

One good example of a design case study is the development of *Expert Finder,* a recommender system to foster expertise sharing among workers within an industrial association and its member companies [18-20]. The project was initiated by a fraction of the association's management and partly funded by the German Federal Ministry of Economic Affairs within a funding scheme on knowledge management. In a first phase the field of application was investigated empirically by observational studies, an analysis of the ICT infrastructure, and 16 semi-structured interviews. The study focused on one section of the industrial association, some central units and their relationship with selected member companies. The study looked at collaborative work with a specific emphasis on knowledge exchange needs and practices [18]. Based on these findings the design of *Expert Finder* was developed. Specifically, the techniques to identify experts and the concepts to protect workers' privacy were stimulated by the findings of the pre-study [19]. Finally, the Expert Finder was rolled out for a period of nine months, mainly in those parts of the association which participated in the pre-study and one member company. While the somehow restricted field of application impacted the evaluation results concerning expertise sharing practices, the study provided interesting insights with regard to privacy-sensitive design of recommender systems [20].

Design case studies represent an idealized model of our research approach. As a result of the contingences of a practice-oriented research approach, the suggested phases

may not always be all conducted – at least not to their full extent. Specifically, the third phase requires the researchers to deliver a high standard of software-technical perfection, with regard to performance, stability, and usability. Moreover, the field of application needs to provide a sufficient technological infrastructure to roll out the newly designed artifacts. The practitioners need to be willing to engage with the technological opportunities.

RESEARCH FRAMEWORK

Our research approach documents design case studies (or parts of them), in currently four application domains. Based on a growing corpus of design case studies, we try to identify cross-cutting themes, compare the context-specific findings, build terminology, and try to develop abstractions as elements of a theory of practice-based computing. Figure 1 presents our research program. The individual design case studies (in orange red) are grouped in application domains and meet three cross-cutting issues:

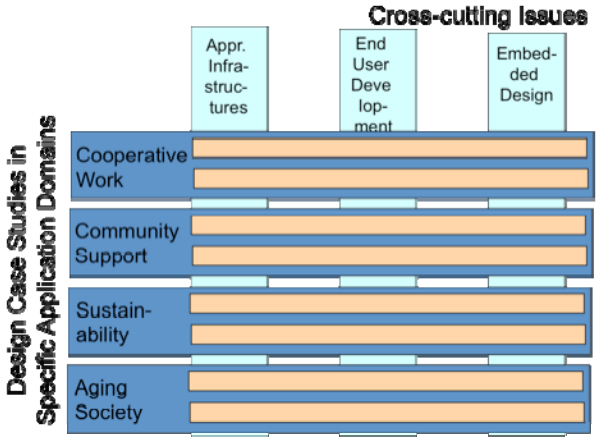

Figure 1: Research program for practice-based computing

Application Domains

Our design case studies are not limited to the area of cooperative work, but also cover other application domains that emerged by technological developments (like Ubiquitous Computing) or by social developments (like Aging Society). Of course there will be other application domains to come to the fore in the future.

In the following we give a survey about design case studies we have conducted in different domains.

Cooperative Work

Our research started some 15 years ago in the traditional domain of cooperative work. We had a long-term engagement in designing groupware functionality for two government bodies [21, 22] and a steel mill [23]. Still investigating into maintenance engineering in the steel mill and later on in a sewage plant, we started to develop a focus on practices of expertise sharing and their technical support [24, 25]. Reichling's already mentioned design and evaluation of the *Expert Finder* within the industrial association was another step in this line of research [18-20]. Looking at the supply chain of the car industry, Betz [26] has recently investigated into physical references of knowledge sharing among machine operators while dealing with break down situations.

Currently we investigate mainly into two areas of cooperative work: distributed software development and work in security-critical domains. The software industry is an interesting domain for CSCW since the immateriality of its products allows for interesting cooperation patterns over the phases of a development cycle. Moreover, the mainstream perspective in software engineering has not yet investigated sufficiently into the practices in detail. In a first step, we got interested in off-shoring phenomena which could be even found among small German software companies. Boden analyzed the cooperation between two small German companies with software partners in Russia. We were specifically interested in how they divided the labor and conducted the required articulation work across geographical, temporal, linguistic, and cultural boundaries [27-29]. In a next step we will investigate into appropriate tools to support their cooperation.

Following September 11, security-critical domains became a topic of public interest. We got particularly engaged in understanding navigation practices of firefighters in burning buildings and technical support to enhance their abilities. Over six years we have meanwhile studied firefighters in collaboratively navigating while trying to rescue lives and turn out fires. First we looked at the Paris firefighters [30] and later on at the Cologne fire brigade. As a result, we came up with the design metaphor of a 'landmark' which would enable firefighters to annotate space. To elaborate on the design metaphor, Ramirez engaged in a participatory design activity with the firefighters, evaluating different kinds of prototypes through workshops and practical exploration in the firefighter's training centre [31, 32]. A more recent research effort investigates how information chains between organizations and individuals involved in coping and restoration work after a larger power outage (http://www.infostrom.org/) are being set up and how ICT can support organizational learning in this network. Besides the usual organizations (Police, firefighters, electricity provider, administrative bodies), the project acknowledges the social networks of professional individuals as well as the citizens affected as an important resource to support.

Community Support

Our investigation into knowledge intense work settings had indicated already the importance of informal social ties and social capital [8, 33]. Inspired by Wenger's [34] and Brown and Duguid's [35] work on socio-cultural theories of learning, we looked into opportunities to stimulate learning and to cultivate communities by means of appropriately designed ICT and its introduction.

In a first step, we applied socio-cultural theories of learning to university settings, specifically to computer science and information system's education. A concept was developed

to allow students to enculturate inside communities of practice of the software industry [36]. To support these types of learning, a community system, CommSy, was developed by colleagues from the University of Hamburg and evaluated in a variety of different CS and IS courses [37, 38].

We also looked at on-line communities and the motivation of users to participate in such communities. Designing user-centered applications for interactive TV (iTV), Hess is investigating in community-based communication in the home entertainment domain. Future development of Social Media will integrate modern mass media that allow for two-way communication channels. In the Siegen region we have set up a "living lab" of fifteen private households, which are involved in generation of new design ideas, prototype evaluation and re-design activities. The main design tasks in this iTV setting do not only include community applications but new communication concepts and innovative I/O devices, too.

Furthermore, with respect to user contributions to public goods, three case studies are currently conducted: a knowledge management platform for employees of a major European telecom provider, a web service engineering community, and an online gaming community. These comparative empirical investigations focus on an understanding of the motivational structure within communities and relevant incentives. In a second phase, we will explore the design of features which incentive users' participation in the generation and classification of content [39].

In a third line of research we investigated into opportunities to enable the civil society by means of ICT support. We implemented a community portal for Iranian non-governmental organizations (NGOs). In the context of a participatory adaptation of the BSCW groupware [40], we engaged with members of the Iranian civil society in community-based learning, knowledge management, and sustainable network development [41, 42].

Currently, we conduct a longitudinal study on political activists engaged in the European Social Forum (ESF) to better understand the role ICTs plays in supporting the civil society. ESF is a bi-annual meeting which gathers networks of NGOs, labor organizations, trade unions, and social movements from all across Europe. We are interested to understand how the organizers use ICT to prepare for an event in which up to 15.000 activists participate and how ESF's technology infrastructure evolves over time. In the course of the study we also analyzed the knowledge and ICT transfer practices linking the organizers of the past event with those of the upcoming one [43, 44]. In a next step we want to develop and evaluate tools which support the organization of ESF and also the World Social Forum (WSF) events to foster higher transparency and wider participation.

Social and Ecological Sustainability

Like other actors in our community [e.g. 45] , we have explored opportunities to contribute to social and ecological sustainability. Starting from the UN definition which states that *"sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* [27], we decided to work from two angles. We look at sustainability, in a traditional ecological sense, by investigating into ICT artifacts which make energy consumption more visible and better controllable.

Additionally, we look at social sustainability, in the sense that we try to support disadvantaged parts of the global society and explore opportunities how technology and its appropriation is apt to trigger enduring community structures. Currently, we focus on computer club houses in multi-cultural German neighborhoods and microfinancing institutions which deliver services to the poor in the developing world. Our work on Social Sustainability is conceptually closely related to the one on Community Support.

A sustainable integration of migrants is an important societal task, touching numerous parts of everyday life. To deal with this problem, we have developed the socio-technical concept of intercultural computer clubs. The aim is twofold: via computer-based project work in the clubs, its participants (a) establish and strengthen relationships in the neighborhood they now live in, and (b) acquire computer skills that may broaden and ease their access to the job market as well as help them to keep up a remote relationship with their respective home countries. We have implemented this concept in a network of six computer clubhouses and conducted an evaluation study over six years. In the course of this study, we design specific artifacts to support the well-functioning of the clubhouses [46-48].

We also investigate into the practices of microcrediting and its potential for community development and knowledge sharing among economically disadvantaged communities in the south. So far we conducted empirical studies in two microfinancing institutions: the Grameen Bank in Bengaladesh [49] and the Kushali Bank in Pakistan [50]. We tried to uncover the interrelationship between practices of microfinancing and the technological infrastructures the institutions use. The practices of the Grameen Bank showed the importance of social capital in the relationship between bank and (female) customers and the importance of community building with regard to the goal of poverty reduction. In a next step, we will investigate into mobile applications to foster knowledge exchange among field offices and customers of microfinancing institutions.

With regard to ecological sustainability, we currently investigate into practices of energy consumption both in households and in office environments. After conducted interviews, we rolled out smart metering devices which

track the actors' electricity consumption in detail. While the smart metering devices could already be bought from technology providers, we explored different presentation options such as information granularities, visualizations, and output media to understand their potential impact on the actors' consumption patterns [51].

Aging Society

Given the demographical changes in many developed and even some developing societies, such as China, elderly care and self-care become an important challenge. Therefore, we started to explore ICT support and needs for aging societies. Our research has focused so far mainly on two problem areas: (1) to foster social ties and enable emotional support among elderlies, their families, friends, and the neighborhood, (2) to support dealing with age-related disabilities and sicknesses.

While looking empirically at live practices and needs in a multi-cultural low income neighborhood and an old fox homes, our research in the first problem area can be conceptually and technologically seen as a specific case of 'community support'. In the second domain area, we develop a locating system for caregivers of demented persons with Alzheimer's disease in earlier stages. A disposition of wandering is one of the most problematic symptoms as it fosters anxiety, disorientation and can even lead to life-threatening situations. Müller has conducted an empirical study to understand the current practices of dealing with the wandering symptom, both in old fox homes and families which take care themselves for the patients. Based on these findings we have developed different prototypes in which localization information from GPS tracker is presented to the caregivers via stationary and mobile devices.

Cross-cutting Issues

Addressing different application domains, multiple design case studies offer opportunities for comparative analysis, the identification of common themes and the building of concepts. The design case studies and their further analysis are our main vehicles for transferability of our findings.

A recurrent topic in almost all of our design case studies is that the interaction between technological system and social system come along with transformation of both of them. This topic is addressed by the concepts of Appropriation Infrastructure, End User Development, and Embedded Design as cross-cutting issues.

Appropriation Infrastructure

We understand the quality of design related to the way the ICT artifact irritates and changes practice on a micro-level. We, therefore, thought of technical means to support users in activities we framed as *appropriation work* [52]. Contrary to many physical artifacts, ICT applications are typically built in a modular manner and allow integrating communication channels into their interfaces in a non-obtrusive manner. We have picked upon these features to enable users to share their experiences and to tailor their individually adapted functionality [52, 53].

In a first step we changed the user interfaces by replacing context-sensitive help texts through wiki tools, that allowed users to express their understanding of the function via *direct activation* [54] and to share experiences in appropriating it [55, 56].

End User Development

However, appropriation work may require the modification of a given function to gain a better fit of ICT tools with the supported work practices. Therefore, applications need to be tailorable in a way that users can modify their functionality at run time [57]. We extended component- and service-based approaches to software architectures to implement modules which users could recompose and tailor according to their current needs [53, 58]. We experimented with different interface concepts for the tailoring environment and metaphors to break an application down into modules which are meaningful to users [59]. We also investigated into collaborative tailorability -- in the sense of supporting users to share and reuse tailored artifacts [60].

While tailorability increases the technical flexibility largely, it will have limitations due to the fact that not every requirement for flexibility coming up at use time can be anticipated at design time. So even with highly tailorable applications, developers may need to modify or extend their functionality over time. Therefore, we have developed concepts to integrate communication channels between users and ICT developers into the interface. Moreover, we integrated a requirements tracking system into the user interface of an application. Users can take screen shots in a specific situation of usage and annotate them. This way they can express problems, needs, and requirements between the community of users and the IT developers [56, 61].

Embedding design in the development of practice

The conceptual foundations of CSCW are characterized by both an ethnographic and a supportive design stance which are related, but independent. They can be described as follows (1) grounding design in the recovering of social practices and (2) design *for* social practices (instead of designing a computational model *of* social practices). Taking the transformative potential of design into account, we elaborate on a supplementary perspective: (3) embedding design research in the development of practice towards an open future.

An evolutionary stance affects the conduct of design research in different ways. Firstly, the software development process should be carried out in an agile manner to incorporate new demands emerged during the appropriation process. Secondly, practice and technology development should be organized as an integrated process. These arguments have been elaborated in the approach of Integrated Organization and Technology Development (OTD) – a framework for participatory action research [4].

In our more recent work, Nett and Stevens developed Business Ethnography [3] an approach to action research which helps users to develop new practices making use of new technologies. Dealing with the dialectics between tradition and transcendence in design [62], we have developed a set of participatory methods and design strategies to inspire users to express possible futures, and uncover seeds for innovation overlooked in daily life [3, 32, 51]. The openness of the design process is nothing to be prevented, but serves as a resource.

With the 'Infrastructuring' approach [1], Pipek and Wulf described a more radical theoretical framework that aims at overcoming the traditional distinction between 'users' and 'designers' by mapping out all activities that lead to a successful establishment of a technology usage in an application field as equal when it comes to addressing them methodologically and developing technological support.

FUNDING SCHEMES AND ORGANIZATION

While typically little discussed, research agendas and methods in the field of CSCW are strongly influenced by the funding schemes available.

Most of our larger research projects are funded by German or European framework programs. The topics covered by these programs are subject to political decision making which implies typical reference to a however constructed societal need. Therefore, we need to focus on societal challenges and be aware of trends in public funding, such as the current one towards security-sensitive domains.

Most of these funding schemes allow or even enforce the involvement of application partners to input design requirements and ICT companies to transfer the results into products. The basic structure of these schemes enables a design approach which engages with practices, but requires attention to sustain academic freedom. The projects have normally run between two to four years and are typically staffed with phd students. They usually need a fully fledged design case study for their PhD. When working with practitioners, even longer running projects may not necessarily lead to the intended results in time. Therefore, the acquisition of follow-up funding is key to enable both, scientific quality and as well as continuity. This is an obvious challenge in an ever changing funding market.

This funding often allows us to work with more than one researcher per project. We establish research teams with interdisciplinary competencies to conduct profound empirical work as well as to implement innovative software applications. Our PhD students need to be able to work in interdisciplinary teams with a background in e.g. computer science, information systems, engineering, anthropology, psychology, sociology, or media studies. As another consequence, the academic environment needs to be willing to pass overlapping theses from different backgrounds.

CONCLUSION

Our research program is dedicated to address societal challenges, for normative as well as for institutional reasons. Grounded in evolutionary theories of practice, we presume that that design of IT artifacts and their appropriation irritates and moves existing social practices -- at least on the micro-level.

Following an action research approach, we understand design and appropriation of ICT artifacts to facilitate a practice-oriented problem solving strategy and as a means for emancipation. We use mainly critical, qualitative research methods aiming at a profound understanding of a particular social practice, problems and potentials for ICT support while not reifying the existing as the only possible. We frame our research as design case studies.

Practice-orientation is a labor-intense, risky, and long-term research approach. To be able to conduct in depth field studies in real world settings and to roll out innovative IT artifacts, one needs to build trustful cooperation with practitioners and their management. A considerable part of the research efforts are dedicated to satisfy the practitioners' problems which are not always academically interesting. In addition, the technical artifacts, which we build and roll out, need to be technologically well performing, stable, and usable. Hence, an open challenge is to develop design approaches to observe appropriation phenomena in a timely and cost efficient way, not deformed by technical issues in a disturbing sense. Finally, practice-orientation is a risky research framework. Design case studies can break for a variety of different reason of which many are not under the control of the researcher.

Our approach has a great affinity to the work of Kjeld Schmidt, yet there are also important differences, Schmidt [17] has suggested defining CSCW by the application domain and the type of supported activity: dealing with coordination in traditional work settings. Our definition of the field is not based on a specific application domain but on a research methodological standing [2, 3, 7]. We would claim that such a design approach is the core innovation CSCW has brought to computer science. Yet, we do not see any principal epistemological difference between activities in various application domains, given the design case studies are conducted properly. The interaction of social practices with ICT support should in principle be learnt in one settings and the resulting understanding can be meaningful for the design in another.

Therefore, we extended our research focus from cooperative work in the traditional sense towards other socially relevant domains such as community support, social and ecological sustainability, and the aging society. Of course, we need a clustering of the design case studies, for instance according to the activities to be supported. Moreover, we started identifying cross-cutting issues which help us to compare our findings from single design case studies and derive deeper insights.

Last but not least, the transferability of findings is a problematic issue in practice-oriented research. Although particular design solutions and empirical findings might have been validated with regard to the particular case, their

transfer to other (more or less) similar cases and practices remains a methodological challenge.

In our view, the CSCW community still lacks a sufficient understanding how knowledge sharing happens and how it could be better supported, specifically towards practitioners in the IT industry and IT user organizations. A growing corpus of design case studies could be a base for such an endeavor.

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