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Socio-Informatics: Design for Social Practices
A condensed anthology of 25 Years of Research

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Preface

This anthology was composed on the occasion of a conference on “25 Years of Socio-Informatics - Where do we come from? Where are we? Where to go from here?”, taking place in June 2022 in Siegen, Germany. Its main purpose is to present a selection of re-publications of central papers by authors from the International Institute for Socio-Informatics (IISI) and the University of Siegen, representing milestones of 25 years of research. All re-publications are based on pre-print manuscript versions of the authors. The collection is structured in seven chapters, covering the main research areas of the research group. New contributions to this volume are the introductions to each of these chapters and external comments from prominent international scholars at the end of each chapter. Moreover, the first chapter was written exclusively for this reader, providing an introduction into Socio-Informatics, a respective research program and an overview regarding socio-informatic research, concepts and methods. There are two versions of this anthology: (1) a printed condensed version, that does not contain the re-publications in full texts (only their first pages), presenting mainly the new contributions (a general introduction, introductions on each of the seven chapters, and 11 opinion pieces commenting on our work), and (2) a web-based online-reader presenting all materials in full text. The free online version of the anthology can be found on our website: https://www.iisi.de/conference/e-reader/

We would like to thank the international scholars, who followed our invitation and wrote opinion pieces discussing our work: Mark Ackerman, Lance Bennett, Alan Borning, Geof Bowker, Peter Brödner, Gerhard Fischer, Geraldine Fitzpatrick, Sigrid Kannengießer, Kari Kuutti, Anders Morch, and Rob Procter.

We are also deeply indebted to Dave Randall, Peter Tolmie, Kjeld Schmidt, Ina Wagner, Peter Brödner, and Carla Simone who have significantly contributed to frame our research results towards international high-end publication venues. Over the years all of these senior colleagues became close intellectual fellow travellers and good friends. Discussing with them over quite some beers impacted our work considerably.

Siegen and Bonn, June 2022

Claudia Müller, Thomas Ludwig, Volkmar Pipek, Markus Rohde, Gunnar Stevens, and Volker Wulf

Socio-Informatics:
A Practice-Based Research and Design Paradigm

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Abstract. The paper provides an introduction into Socio-Informatics and an overview about socio-informatic research, concepts and methods in the understanding of scholars from the University of Siegen and the International Institute for Socio-Informatics (IISI). We introduce the field in its historical context and provide a definition of Socio-Informatics - an emerging field of design research. Institutional and (inter-)disciplinary trajectories of our research tradition are presented and relevant conceptual foundations and methodological frameworks are described. Moreover, a socio-informatic research program is motivated and reflected and potential issues and directions for future research are discussed. The contribution is based on and sums up experiences and insights from 25 years of socio-informatic research.

1 Introduction

Research ‘paradigms’ do not pop up in a vacuum. They usually develop over time and are institutionally embedded and framed by existing scientific discourses in reference communities. The development of our research program in Socio-Informatics happened in the context of such discourses, in critical interaction with existing academic communities. It was shaped over time and was inspired and influenced by existing literature, theoretical concepts, methodological frameworks and a vast number of vivid discussions over many beers and dinners. In the following we try to briefly retrace this context and the historical trajectories we discern.

The International Institute for Socio-Informatics (IISI) was founded in 2000 in Bonn by an interdisciplinary group of young researchers, somehow considered outliers, even outlaws, at the University of Bonn’s rather traditional computer science department. Having lost their home in that department, over time, the founding actors reestablished themselves in Fraunhofer Institute for Applied Information Technology (FhG-FIT) and the University of Siegen’s Department for Information Systems. From the beginning, the group was highly interdisciplinary, including computer scientists, psychologists, anthropologists, sociologists, and economists, with their very heterogeneous competencies. Of course, the personal and institutional context heavily impacted and pre-structured our academic world view, the selection of research topics, the communities we wished to engage with, and the opportunities to acquire research funding that we sought.

IISI became a crucial institutional base to start our exploration into making computer sciences more relevant towards the solution of problems in the real world, up to and including the societal level. We were looking for ways to better understand the relationship between societal change, specifically on an interactional level, and the design of meaningful IT artefacts together with and in support of human actors. Or to frame our research vision in concepts we still had to develop, we were interested in design-oriented investigations into the often complex interaction between social practices and IT artefacts implemented in their support. More ambitiously framed, and at that time not fully articulated, to explore how a *turn to practice* would spell out in the computing field.

Like in other countries, the academic field of computer science (‘Informatik’) had emerged in Germany out of mathematics and electrical engineering departments. These intellectual traditions emphasised the formal and technical dimensions of the field. Overall, there was understanding of the societal impacts of the vastly growing number of IT applications was lacking as was a commitment to making their design a legitimate topic of research itself. In the 1990s, the University of Bonn’s computer science department was not an ideal place to explore this broader landscape.

Inside the German computer science community, there was, however, a small and rather overlooked group of researchers in a field called 'Computers & Society' ('Informatik & Gesellschaft' (I&G)). From the 1970s, this small community had tried to conceptualize the societal impacts of computing and come up with recommendations for design. It also importantly contributed to the beginnings of the German discourse in the field of Human Computer Interaction (HCI) ('Software-Ergonomie' and 'Mensch-Maschine Kommunikation'). Normatively, it took a critical stance – questioning the societal effects and epistemological foundations of the dynamically growing computing field.

Outside of computer science departments, some variations of research into applied computing emerged, as well – the so called 'Bindestrich-Informatiken'. The most important of these applied fields became the Information Systems ('Wirtschaftsinformatik') community which, when compared to its international counterparts, had a very specific German flavour. Its mainstream interest was for long time rather oriented towards the modelling and design of applications in business domains, unlike the behavioural approaches of its Anglo-Saxon reference community. When looking at organizations, Wirtschaftsinformatik strongly emphasised the formal dimensions of processes – often overlooking the mundane details of organizational work practices. Normatively it, in the main, involved a rather management-oriented stance.

Our group grew up in the normative realm of an already institutionally declining 'Informatik & Society (I&G)' community. We arrived at the notion of *Socio*-Informatics ('*Sozio-Informatik'*) to position our research perspective against the predominant management-oriented tradition of *Wirtschafts*informatik and, moreover, aimed to widen the somehow narrow focus on business applications and its underlying processes. In this endeavour, we benefitted greatly and contributed increasingly to the epistemological and methodological innovations emerging out of the European community on Computer Supported Cooperative Work (ECSCW). ECSCW suggested that an ethnographically derived understanding of social practices ought to be related to the design and evaluation of innovative IT artefacts.

Elaborating on our research paradigm over time, we sought to developed the ECSCW research program by intensifying the interconnectedness of ethnographical work and the design of innovative IT artefacts. We suggested that an empirical understanding of the relevant social practices ought to become integral part of IT design, in which empirical and participatory design elements would interweave over a longer period of time culminating in examination of the appropriation of the artefact in its context of use (Wulf et al 2011; Rohde et al 2017; Stevens et al. 2018). We later extended the concept of design towards planned interventions in a socio-technical sense. We also opted for an inclusive research agenda looking in detail at a broad variety of social practices and their related societal problems and design opportunities. Thus, our version of Socio-Informatics was established in an attempt to evolve a practice-based and inclusive research perspective.

Rohde and Wulf (2011) defined it in the following way,

> *"Socio-Informatics should be seen as a transversal discipline of applied computer science which analyzes the design of information and communication technology (ICT artifacts) according to its sociotechnical double character. (...) Socio-Informatics (is understood) as a sub-discipline of computer science that is systematically dealing with design of ICT artifacts with respect to their interaction with the social practices of their users. Here, the design quality of ICT artifacts is not only determined by formal, technological criteria, but additionally by the quality of their interdependency with the social systems in which they are applied to and whose practices they are structuring." (Rohde/Wulf 2011: 210, translation by the authors)*

Socio-Informatics, therefore, aimed at a fundamental shift in the epistemological stance of applied computer science towards practice-based design research. Thus, the new approach not only targeted the research subject (designing ICT artifacts in support of social practices), but the paradigmatic research logic and design practices of the academic discipline as well. It was meant as a critical endeavor to reach a more inclusive research perspective in computing, taking the social context of ICT design (and) research explicitly and systematically into account. As Randall et al. (2018) put it:

> *"Design outcomes are not, in fact, the result of some logical and highly structured process that leads inexorably to a "best" solution. They are influenced by the institutional setting, the engagement of the different practitioners involved, and, not least, the funding sources for the research. The outcome results from negotiations of various asymmetries of power and knowledge, and of different sets of values. It is not enough, however, simply to assert that this is the case. We arguably need a much more systematic approach to identify exactly how such matters ramify in design practice. That way, we will be able to question and develop our research and/or design practices." (Randall et al. 2018: 11)*

Fundamental for this new research perspective was a strict praxeological dedication and a consequent orientation to social practices in which ICT artefacts are applied and used – and, therefore, to the contexts in which they are inevitably embedded (Rohde et al. 2009, Wulf et al. 2015a, Wulf et al. 2018, Müller 2019, Wulf et al. 2021). In this understanding, Socio-Informatics as *practice-oriented* design research must be seen as an approach that deals with socially embedded technical artefacts and focuses on a deeply situated research subject:

> *"As a contribution to practice-based computing, Socio-Informatics investigates into current shortcomings of conventional IT design approaches, and proposes alternative venues. While conventional criteria for good design in computer science are predominantly based on, formal technology-immanent criteria, Socio-Informatics aims at the thorough investigation of the relationship between IT artefacts and the social context in which they are used. (...) In this regard, practice-based computing and Socio-Informatics make two major points: a) qualitative/ethnographic methods may contribute to a holistic understanding of the anticipated field of application, and b) the need to understand existing practices and to provide a leverage*

effect upon their desired further development demands with applied research- and design methods." (Müller 2019: 10f)

The situated nature of socio-informatics research and the complexity and dynamics of social contexts require certain conceptual and methodological shifts in ICT design research and lead to programmatic necessities, notably towards an interdisciplinary orientation.

„The application (of ICT artifacts) stimulates social systems, in which they are appropriated, to challenge their established practices and to change these. This process is not deterministic and cannot (at least not entirely) be anticipated. According to the double character of the design object, socio-informatics requires a methodological combination of insights from social science, humanities as well as economics and law with design-oriented knowledge to be found traditionally in computer science and engineering." (Rohde/Wulf 2011: 211, translation by the authors)

This interdisciplinary and strictly practice-oriented design research approach obviously requires– and necessarily develops – new methodological concepts, procedures and frameworks, such as Grounded Design (Rohde et al. 2017, Stevens et al. 2018), Design Case Studies (Wulf et al. 2011, Wulf et al. 2015b), Integrated Organization and Technology Development (Wulf and Rohde 1995; Rohde and Wulf 1995 and 2018; Rohde 2007), Business Ethnography (Stevens and Nett 2009, Boden et al. 2011), End User Development (Lieberman et al. 2006, Wulf et al 2008, Ludwig et al., 2017), Praxlabs (Ogonowski et al. 2018, Dickel/Müller 2019), Infrastructuring (Pipek and Wulf 2009, Ludwig et al., 2018) and Appropriation Studies and Infrastructures (Pipek 2005; Stevens 2009; Stevens et al. 2010, Stevens and Pipek 2018).

To sum up, Socio-Informatics, in this understanding, represents a research discipline as a genuinely *interdisciplinary* sub-discipline of (applied) computer sciences,

- rooted in the discourse contexts of the European community of CSCW (ECSCW), the German communities in Informatik & Gesellschaft (I&G) as well as Information Systems (WI),
- that is understood as a *design research* discipline,
- with a strict *practice-based* and *sociotechnical* perspective on designing ICT artifacts for social practices,
- and a clear critical, *self-reflective perspective* on the own design practices and research activities,
- providing a new set of methodological design and research concepts.

Others have used the terminology of Socio- or Social Informatics (e.g., Zweig et al. 2014, Kling 2007, Jürgen Friedrich used the label at the University of Bremen (without publication)) but moved into only broadly related directions. Standing in the tradition of the ECSCW community, we do not claim radical originality. In tracing our own pathways, our concern is, however, to show how our understanding

of Socio-Informatics that has been developed over the last 25 years by the research group of the aforementioned International Institute for Socio-Informatics (IISI) and is represented by scholars located at the University of Siegen, Germany (sometimes called “Siegen school of Socio-Informatics”).

In the following we will describe the historical and disciplinary background to Socio-Informatics, and its theoretical and methodological foundation and achievements.

2 Institutional Trajectories

Members of IISI belong to academic societies and associations, such as the German Gesellschaft für Informatik (GI), the ACM Special Interest Group on Computer-Human Interaction (ACM SIGCHI), Informatikerinnen für Frieden und gesellschaftliche Verantwortung (FiFF) etc. These societies and their conference series constitute the broader institutional context which offers opportunities for academic publishing, networking and cooperation on a national and international level.

However, existing institutional structures, sometimes, can become too narrow for developing new ideas and research programs. Their institutionalized routines and regulations can restrain newly emerging research programs and practices. When the International Institute for Socio-Informatics (IISI) was founded in 2000, it was meant to give scientists with similar interests in socio-informatics research a home and to provide an institutional platform for projects and activities that transcended the existing institutionalized disciplinary boundaries. One of the first research projects we conducted within the IISI dealt with the configuration and introduction of a community system for Iranian NGOs (Rohde 2004). So, we became one of the first academic institution to position research in a domain which later would be called Information and Communication Technology for Development (ICTD).

We also created an edited series of publications, the International Reports on Socio-Informatics (IRSI) which published research papers, workshop proceedings, working papers, and project reports.

Furthermore, IISI was instrumental in building two new academic communities. By supporting the first international Conference on Communities and Technologies (C&T (2003)) in Amsterdam, we created a bi-annual format of meetings which last year saw its 9th reincarnation. It brings together a research community which is interested in the role of IT artefacts in fostering the social texture of communities. A few years later, we contributed to the establishment of the International Symposium on End User Development (IS-EUD) whose first incarnation was held in Siegen 2007. This series of events helped create an international community of researchers which is interested in the design of tailorable software applications

which enable non-professional software developers to modify their applications in their context of use.

IISI members were also involved in the foundation of the European Society for Socially Embedded Technology (EUSSET) in 2010. At that point, we believed that it was worth the effort to build an institution in support of the distinctive research paradigm which had emerged from the European CSCW tradition. Grounding IT design in an appropriate understanding of social practices was for quite some time contested. At ACM conferences, the practice-based approach to design and evaluation remained peripheral. Building EUSSET was important to create an institutional base for this type of research. Nowadays, EUSSET is organizing, among others, the ECSCW and C&T conference series. It also runs a highly popular digital library which makes the proceedings of 30 years of ECSCW publicly available in an open access mode (https://dl.eusset.eu/).

Later on, the existence of EUSSET helped us to influence the research paradigm of the leading ACM conferences. Together with our European colleagues, our input has made ACM-CSCW and ACM-CHI a more welcoming place for design research in practice.

Building a new research program, we always believed that it would be crucially important to contribute and shape the academic and institutional context, in which our research activities evolved over the past 25 years.

For some years we have been working on creating a larger scale research institute with institutionalized funding in the domain of Socio-Informatics. Such an institute seeks to specifically deal with the digitalization needs of the Siegen region. The Siegen region can be characterized as rural but industrialized. Locally contextualized designs and findings created in the counties around the University of Siegen could be of high importance for other rural (and industrialized) regions in Germany, Europe and beyond.

3 (Inter-)Disciplinary Trajectories

Socio Informatics can offer a different conception of basic research premises: Technology development takes place in close coupling with empirical research within interdisciplinary teams. It is often argued that disciplinary silos still restrict the real possibilities of interdisciplinarity and our work aims to systematically change the boundaries of the disciplines. Inevitably, then, a certain kind of critique has become explicit in our work. The Socio-Informatics approach refuses disciplinary dominance of any kind. We draw contingently on concepts, theories and perspectives to be found in those disciplines but see them as relevant only to the extent that they help clarify, examine and assist in the analysis of the ‘problem’ and subsequently in assisting us in positioning ourselves with respect to potential solutions. We are, in a nutshell, pragmatists. This makes the organisation and reflection on the exchange of expert knowledge itself part of the design task, for

instance in corresponding approaches in Integrated Organization and Technology Development (OTE) (Wulf & Rohde 1995), Metadesign (Fischer 2007) or in the concept of Business Ethnography (Stevens & Nett 2007). As mentioned above, not only institutional structures are seen as influencing the development of research approaches, but also access to scientific discourses, social networking and active interaction/exchange with other researchers. Besides the academic publishing tradition, these discourses and interactions usually take place at the venues of national and international conferences. These disciplinary and *multi-disciplinary event infrastructures* have impacted the development of the socio-informatics research program substantially. Our approach could not have been solidified and elaborated in the way they are without the inspiration from the (critical) discourses that were fostered at various conferences and scientific events.

Most of the founding members of Socio-Informatics have participated in conference series in the disciplinary fields of Computer Supported Cooperative Work (CSCW) and Human-Computer Interaction (HCI) for many years.

The body of knowledge and presented studies in CSCW (conference series like CSCW, ECSCW, GROUP, COOP or the Journal of Collaborative Computing and Work Practices – JCSCW) helped us in significant ways to understand basic concepts of collaborative computing, showed us the relevance of practice and sharpened our perception of the situated character of social practices and their technological support. Moreover, we learned a lot with regard to ethnographic research methods, action research and participatory design (esp. the Scandinavian tradition of Participatory Design).

Studies in Human-Computer Interaction (e.g., the national/German Mensch-Maschine-Kommunikation (MMK), the international conference series HCI, mobileHCI and – most important – ACM-CHI, the International Journal of Human Computer Interation, ACM Transactions on Computer Human Interaction (ToCHI), International Journal of Human-Computer Studies (IJHCS), Interacting with Computers (IwC), and Behavior an Information Technology (BIT) influenced us through debates about basic principles about usability and user experience design and brought approaches on user-centered computing to our agenda (e.g., Ogonowski 2018).

Discourses in the field of Information Systems (national/German conference on Wirtschaftsinformatik, international conference series ECIS, ICIS, the various journals) triggered our reflection on design sciences and related research methodologies and inspired the elaboration of our Grounded Design approach (Rohde et al. 2017, Stevens et al. 2018) and our core methodological concept of Design Case Studies (Wulf et al. 2011, Wulf et al. 2015b).

Given the heterogeneity of socio-informatics research topics and the diverse social practices addressed, our group attended many other conferences and events as well, e.g., on collaborative learning, community computing, pervasive and ubiquitous computing, participatory design, health, mobility, aging society, ICT4D

(for development), crisis management, social media, and many more. But the aforementioned (multi-)disciplinary conference strands and series represent the major influences on our development.

4 Conceptual Foundations

Over time, we have developed concepts which allowed us to speak, from a design perspective, about the enactment of IT artefacts in everyday life or what is sometimes called the 'real world'[1] (Wulf et al 2015). To position the nature of our research, we have developed a design-oriented conception of social practice and developed the characterization of 'practice-based' for our design work.

Normatively, we were always devoted to work on and with the ordinary human actors who actually use technologies and the implications of technology-use on their quality of life. So, our design work needed to go beyond any theory-driven or managerially-induced abstraction of people's work or life. It us required to understand the often mundane aspects of work or life in depth. Abstractions such as organizational charts, process definitions, or theoretical concepts have to be supplemented with an investigation and understanding of the actual conditions of work and life. We believed that only such an understanding would enable us to define the quality of IT-design by evaluating the appropriation of the newly designed artefacts in the actors' everyday life, or in the terminology used here, in social practice.

From its origins, the practice term prevailed in the non-positivist tradition of (E) CSCW to depict the complex nature of mundane work settings. In the context of our interdisciplinary endeavours, Suchman and Trigg (1986) and Schmidt and Bannon (1992) have drawn on existing insights from humanistic psychology, cognitive ergonomics, ethnomethodology, Wittgensteinian philosophy to foreground the practice term in their foundational work on CSCW – associating it with an empirical research program to understand the largely unarticulated details of cooperative work. Following this line of thoughts, we argued that CSCW has brought the concept of practice to the broader field of computing:

"CSCW was the first research community in applied computer science which stressed the importance of an in-depth understanding of practices when designing ICT artefacts. From our point of view, this is the key achievement of the research field." (Wulf et al 2011, p. 505)

Schmidt (2018a) elaborated on a design-oriented use of the concept of practice:

> *"In CSCW, the concept of 'practice' is used, first of all, to be able to address and focus on the actual activities as unfolding contingently in the settings in which collaboration technologies may be used, in contrast to the ideal or average conditions typically presumed by engineers and*

[1] Speaking about the ‚real world' is, of course, a contradiction in itself taken from a epistemological perspective of non-positivist thinking.

managers. … Related to this, the concept is used in opposition to design paradigms in which new technologies are developed in laboratories, based on the experiences and predilections of the engineers and designers themselves. In the same vein, it is also used in opposition to an approach, prevalent in HCI, which is committed to base new technologies on models of (presumptively generic) human behavior derived from theories imported from cognitive or social psychology, from social linguistics, or from small-group sociology …" (p. 51).

In parallel, the concept of social practice has been reinvigorated in the social sciences, for instance in the work of Bourdieu (1980), Giddens (1984), Garfinkel (1967, 2006), Latour and Nicolini (2013). These authors attempted, in different ways, to integrate different (and contentious) strands of social scientific thinking and, in turn, led to explorations on topics such as materiality, agency, history, and emergence. Specifically from the perspective of our own group, Garfinkel's (1967, 2006) explorations have been highly influential in grounding the non-positivist CSCW tradition. While different authors associated with the group understand social practice in a rather heterogeneous manner, Wulf et al. (2011) draw on Reckwitz's (2002 and 2003) definition of social practice. Following his line of thinking, the concept of social practice could be positioned in the following manner:

"Practices are understood as the smallest unit in the analysis of social phenomena. A practice is 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." (Wulf et al. 2011, p. 506).

In this definition again, the potential differences between routines and their reproduction in situated action are emphasized.

Schmidt (2018) has criticized the practice theoretical school of thinking in the social sciences for conceptualizing practice in an abstract and not empirically founded manner, and therefore, he questions the relevancy of practice theories to ground IT design. What is at stake here, of course, is not whether theoretical analyses of practice are valid or not, but whether, for our purposes, they are useful. We subscribe to Herbert Blumer's (1954) view that concepts can be 'illuminating' or 'sensitising', pointing us usefully towards 'things to think about'. Kuutti (2022, in this volume) refers to this debate and concludes in the following manner:

"Thus the practice approach in IT disciplines is not and should not be "applied social science", but an approach of its own, still "in the making" and finding and defining its own ground and own interpretation of the practice concept."

The discussion shows that the final conceptualization of the term ‘social practice’ in the context of ‘practice-based’ (IT-)design is still in the making. From a Socio-Informatics perspective, we would suggest that it contained the following definitorical elements:

- Looking at everyday activities and collective patterns of interaction devoted towards an understanding of mundane, real world phenomena in all their situated complexities and the opportunities to support them in terms of design.
- Artefacts, formalisms, and routines which are part of and interfere with these collective patterns of interaction are to be understood in a scaffolding and rather not in a prescripting manner.
- Understanding these everyday activities and collective patterns of interaction as ordered and stable, but at the same time in a continuous process of remaking. There is a specific sensitivity for investigations into the difference between routinized stability and situated action. Specifically, there is a focus of analysis on how the appropriation of IT artefacts is contributing to the remaking of practices.
- An analysis of social practice is always taking a transformative perspective, in the sense of directing itself towards problem areas and potentials for development.
- An analysis of social practices thrives to enable ways to develop existing practices together with the participants. It sees itself as part of the intervowen activities of understanding and designing.

By suggesting the framework of Grounded Design, we have elaborated on the methodological implications of the practice term in Socio-Informatics (see section 5). At the core of our research, we were interested in conceptualizing the design and use of IT artefacts and infrastructures in practice. We developed the concept of infrastructuring to argue that the design and use of artefacts are interwoven and enduringly creative activities.

While some researchers applied the terminology of infrastructure in information systems in a rather techno-centric manner (Dourish 1999; Edwards et al. 2010), others outline the social aspects of an infrastructure, demonstrating that users inevitably reshape a new infrastructure during use, and should therefore also be considered as ‘designers’.

Over time, the concept of infrastructure has started to be understood in terms of the socio-technical dependencies it is operating in, as well as the ones it is producing, with a focus on the social processes that make a network of devices an infrastructure. In this regard, Star and Bowker (2002) have discussed the interplay between the ‘global’ establishment of available technologies and the development of ‘local’ use practices, alongside a focus on the dependencies between different layers of infrastructures. It was the title ‘How to infrastructure’ that particularly served to inspire a new discourse that studies the actors and activities that ‘do’ the

infrastructuring. This discourse now also seeks to advise actors involved in an infrastructuring effort to engage consciously in the process (Karasti et al. 2018).

When considering work-related information systems as infrastructures, Pipek and Wulf (2009) drew on infrastructural properties such as interconnectedness, complexity, layered architectures, standardization, as well as (in-)visibility in use. They introduced the term 'work infrastructure' to highlight the role of an infrastructure in supporting a specific practice or achieving acknowledged goals. The dependency between an infrastructure and its users is not especially defined by the sheer "spatial and temporal reach or scope" that allows it to offer a service. Instead, it develops to the extent that a practice becomes dependent on it, be it by developing routines using the functional components and services of the infrastructure, or be it by 'forgetting' alternative ways of doing. Additionally, it does not necessarily cover only technological systems, but – in accordance with Star and Ruhleder (1996) – also the "entirety of devices, tools, technologies, standards, conventions, and protocols on which the individual worker or the collective rely to carry out the tasks and achieve the goals assigned" (Pipek and Wulf 2009).

Following Star and Ruhleder`s (1996) idea of treating designed systems not as fixed products, but rather as ongoing infrastructures with emerging 'local' socio-technical processes, Pipek and Wulf (2009) understand the reshaping of a work infrastructure and the practice of "re-conceptualizing one's own work in the context of existing, potential, or envisioned IT tools" as infrastructuring. As Björgvinsson et al. (2010) stated: "Infrastructuring can be seen as an ongoing process and should not be seen as being delimited to a design project phase in the development of a free-standing system. Infrastructuring entangles and intertwines potentially controversial 'a priori infrastructure activities' (like selection, design, development, deployment, and enactment), with 'everyday design activities in actual use' (like mediation, interpretation and articulation), as well as 'design in use' (like adaptation, appropriation, tailoring, re-design and maintenance) (Karasti and Baker 2004; Pipek and Wulf 2009; Twidale and Floyd 2008). Here, the practitioner's angle is reflected by not taking the successfully designed technology product as the methodological end point, but instead the successful establishment of its usage in practice.

One of the major characteristics of infrastructuring as a technology development methodology is the "Point of Infrastructur(ing)" (PoI), which is the moment at which a (group of) practitioner(s) understand(s) that the current use of a technological infrastructure needs to be reconsidered (Pipek and Wulf 2009).

By applying the perspective of Infrastructuring, we widen the notion of design so as to encompass potentially heterogeneous (and long term) shifts in use. Based on the initial PoI, there is a period of in-situ design, consisting of activities of technology configuration, tailoring, and the development of conventions. In the 'last mile' of technology development (for a specific work practice) activities will be mainly performed by (not necessarily technologically skilled) practitioners until finally the point has been reached in which a new technology usage has been successfully established. Here, the appropriation of an infrastructure becomes a part of designing and using it. Concepts relating to the analysis and design of support

for ‘infrastructuring activities’ can be seen to complement other user-oriented, user-centered or participatory design methodologies (e.g. Sadar and Chyon 2011), where practice-driven approaches focus radically on evolving use. In this case it is not the completed technological artifact that is the focal point of design (Karasti and Syrjänen 2004).

Even before developing infrastructuring as a holistic model to understand design and use in practice, we had elaborated on the usage of ICT. The concept of appropriation framed the usage of ICT artefacts as a creative, mostly cooperative, and open-ended activity which had to be understood as a discontinuous but long-term learning endeavor in practice. The discontinuity referred to the moments in which creative insights let to a change in the pattern of usage (see above: the points of infrastructuring).

We framed the concept, ‘appropriation’ to describe and analyse the learning process which made (potential) users understand the use a new function which supports, and in doing so, often even changes their social practices. Volkmar Pipek (2005) and Gunnar Stevens (2009) elaborated in their PhD thesis upon the mostly collaborative and situated nature of appropriation. They grounded the concept of appropriation in the cultural–historical tradition going back to Georg Wilhelm Friedrich Hegel, Karl Marx, and Alexei N. Leontiev as well as de Certeau’s post-structuralist thinking (Stevens and Pipek 2018).

Appropriation and Infrastructuring studies the same phenomena – the work to make things work – but from different angles. While one focuses on the infra-structural aspects of this work, the other studies this kind of work with regard to the inner-structure of the local context. Within the process of appropriating arte-facts typically the subject (e.g. learning ways of doing), the object (e.g. tailoring and configuring the artefact appropriately), as well as the context (e.g. organizing cooperative work differently with the artefact) will be changed.

Understanding the appropriation of (ICT) artefacts is, first of all, an empirical research program which still offers considerable potential. Appropriation is a creative but discontinuously structured activity (‘design in use’) which happens while introducing the artefact or later on at an unpredictable point in time (‘point of infrastructure’). Understanding appropriation, therefore, requires a long-term research engagement. Action-orientation can make the support of appropriation an element of its research strategy.

Following the design-orientation inherent in our thinking, we also developed technical features which would support users in appropriating ICT artefacts (Pipek 2005 and Stevens 2009). Stevens (2009) suggested building communication channels into the interfaces of ICT artefacts to allow the community of users to share their experiences in learning about the way certain functions of the ICT artefact would make sense in practice. Similar built-in channels could encourage discussions between the users and the software developers of the artefact. The developers could also benefit from the discussions conducted within the community of users.

The concept of appropriation also opens our eyes to questions of how inclusion and participation for disadvantaged groups in society can be supported in the long term with the help of ICT. The question of how successful methods of appropriation

support can be discovered thus must also be addressed at a very early stage, when first contact is made with research partners. A big challenge is particularly in involving people who are "hard-to-reach", the non-digitally affine or experienced target groups. Support for appropriation thus entails opening up learning spaces and motivational elements to get to grips with new media. Our considerations are therefore particularly focused on the question: what are suitable methods of initial "access to the field"? In addition to intensive cooperation with local gatekeepers, these include methods that initially demonstrate off-the-shelf technology on a broad scale and make it discussable. In Struzek et al. (2019), we worked with the public use of simple ICT products, such as a church camera or an ICT installation in a doctor's office, to achieve this goal, and to engage older villagers in a joint design project. Approaching demonstrations of existing everyday technologies help open up spaces for ICT adoption and foster motivation and interest in potential ICT use by those inexperienced in technology. Methods and approaches of designing learning and imaginative spaces in the context of multi-year participatory projects with marginalized target groups , has been continuously developed by us (Müller et al. 2012, Hornung et al. 2015, Hornung et al. 2017, Cerna & Müller 2022, Paluch & Müller 2022, Weibert et al. 2017) in work in rural areas, with people with dementia and their relatives, in different life settings of older people (at home and in inpatient settings), and with people with migration histories. Inclusion and lasting opportunities for participation in the digitally supported world also mean that social support and exchange are always necessary for lasting ICT use. We have described this with the concept of " situated scaffolding", which refers to the necessity and meaningfulness of planning local inclusion, participation and health projects in the long term with local transfer partners and thinking about sustainability perspectives after the end of the project at an early stage (Cerna & Müller 2022).

Originally, we developed the concept of appropriation and appropriation support with regard to the design in use of ICT artefacts. Later on, with the wide availability of sensing devices, we also became interested in the appropriation of physical artefacts, such as 3D-printers or machine tools, and how to support their appropriation by technical means. The design approaches were based on projections combined with the tracking of physical movements as well as augmented reality tools.

Appropriation is a crucially important activity in making use of all artefacts. It is typically a collaborative activity, primarily entailing knowledge sharing which is enabled by actors of different capabilities such as ordinary users, expert users, mediators, and support stuff. However, it is restricted and shaped by the extent of the technical flexibility an artefact offers. Users appropriating an artefact can explore a wider range of opportunities in developing their practices in case of a given technical flexibility. At the same time, a wider range of technical flexibility makes appropriation activities and their support more important. The exploitation of technical flexibility is highly related to the collaborative activities of appropriation work.

Technical flexibility allows the adaptation of ICT artefacts in use. It is, on the one hand, distinct from interpretative flexibility which allow one to develop new patterns of use without modifying the artefact. It can, on the other hand, be

distinguished from software development which modifies the artefact as well but typically cannot be carried out during the runtime of an application. However, technical flexibility is created as a part of software development activities. It may increase the durability of a certain version of a technical artefact in its context of use. Therefore, we have suggested making the design of technical flexibility an activity in evolutionary and participatory approaches to software engineering (Wulf and Rohde 1995a,b). We also believe that an expression of technical flexibility are features which support the removal of an existing artefact and its replacement by a new one. Such features enhance opportunities for appropriation work, as well (Wulf 1999).

Conceptualizing (and designing) technical flexibility of ICT artefacts is a long standing research agenda in our group (see sections 'End User Development' and 'Conceptual Foundations' in this volume).

Later on, we studied the appropriation of technologies in political and even armed conflicts. The concept of appropriation helped us to understand how adversarial actors developed their technology supported practices in a mutual dependent manner. When we investigated conflicts such as the civil war in Colombia (de Castro Leal et al. 2019), the Donbas conflict (Shklovski and Wulf 2018), or opposition movements in Iran (Wulf et al. 2022; Grinko et al. 2022), infrastructuring and the appropriation of technological infrastructures played a major role on both sides of the conflict line. In de Castro Leal et al. (2019), we referred to activities of the Colombian army against the FARC guerilla as building an 'attritional infrastructure'. The army assembled and appropriated mainly US-delivered technologies to surveille, control, and destruct the guerilla. The FARC guerrilleros learned to protect themselves against the high-tech attacks of the army though they did not, at least in the beginning, fully understood their technological base. The concept of "counter-appropriation" describes this learning process: "how, in asymmetrical conflict, one side is forced to adapt their behavior to the use of attritional technology by the other side, while the exact functioning of the technology remains opaque" (de Castro Leal 2019). In contrast to simple appropriation, counter-appropriation is therefore a reaction to the establishment of an attritional infrastructure.

We further elaborated on the concept of counter-appropriation and attritional infrastructure when investigating the Iranian security apparatus' surveillance and blockage of the non-national parts of the internet and the counter reaction of the civil society. While authorities are using ICT and social media to establish an attritional infrastructure in response to political protest, citizens are finding ways to circumvent the restrictions in access to information and social media (Wulf et al. 2022, Grinko et al 2022).

5 Methodological Framework(s)

Socio-Informatics research is always directed towards impacting the 'real world' - in a manner which understands and respects the given social practices and involves local stakeholders. So, our research approaches could be characterized as *carefully*

designed interventions which explore opportunities for change at the intersection of new technologies and evolving societal needs (cf. Krüger 2022).

Interventions in the 'real world' are typically conducted in a participatory manner together with the local actors. They are structured around (a) building a mutual understanding of the given social practices and (b) designing, tailoring and supporting the appropriation of a suitable IT artefact. The extent to which the development of social practices is envisioned upfront, varies in the different frameworks and their instantiations in practice.

Since our work is deeply grounded in social practice and conducted together with local practitioners, reflective elements in the research program are desirable. We have suggested meta research as an activity to understand, analyze and devel-op our research practices. These activities are also helpful to design ICT artefacts in support of our research program (Randall et al. 2018).

When we started our design work in practice, we were influenced by constructivist thinking in the Computer & Society (I&G) community (Floyd 1992 and 1996 and Paetau 1991 and 2013). Floyd and Paetau drew on system theory, spe-cifically the constructivist ideas of second order cybernetics. Such an understand-ing has far reaching implications for the design, introduction, and use of IT-artefacts. If the appropriation of IT artefacts could not be anticipated, technical flexibility, an evolutionary understanding of software development, and participation are required (Wulf 1999). Assuming that the quality of ICT design could only be evaluated in social practice, we developed a research paradigm of a close coupling between empirical and design-oriented work. We explored the close coupling in long-term design engagements (Pipek and Wulf 1999; Hinrichs et al. 2005; Reichling and Wulf 2009). From this stance, we have developed different conceptual frameworks over time, each with a different focus.

To ground design empirically, for instance, we came up with the concept of Design Case Studies (Wulf et al. 2011 and 2015b). We stress that design should be based on an understanding of the everyday activities. Therefore, Design Case Studies recommend conducting an ethnographical context study. In addition, as the design does not determine the using in a mechanistic way, Design Case Stud-ies stress that design research should also cover appropriation studies. So overall, Design Case Studies are characterized by three types of activities: context studies, design studies, and appropriation studies.

Design Case Studies take place in a very particular setting and interventions are based on very specifically designed artefacts. So, the question arises how to make these highly context specific insights relevant for other cases of design and appropriation. To make these highly context-specific activities and their insights relevant to other cases, for a detailed and broad documentation of the particularities of the different design case studies – beyond the mere publication of academic papers. The documentation covers the results of empirical studies, participatory design activities, and the implementation, tailoring, and rollout of the resulting

artefact and its appropriation over a longer period of time. We suggested building up a repository of multifaced documentation, we called ‘ePortfolio’ (Li et al. 2021).

We argue that well documented design case studies allow for comparative analysis and design-oriented concept building. We referred to Herbert Blumer’s work on sensitizing concepts to emphasis on design relevant phenomena which can be found across different case studies (Wulf et al. 2015b). These cross-cutting themes can deal with different elements of the design process, namely as "analytical concepts" (for a better understanding of social practice), as "design-oriented concepts" (to document design questions, challenges, and principles) or as "methodological concepts" (which record overarching methodological aspects). The ePortfolio should enable the linkage between sensitizing concepts and the data they are grounded in.

The concept of Grounded Design is more influenced by the discourse of Design Through Research and Critical Design. As noted, the design does not mechanically determine future practice. The same is true in reverse. Design not mechanically determined by current practice. Grounded Design draw on this insight. Instead of arguing that context studies, design studies, and appropriation studies must carry out in a strict chronological order, Grounded Design stresses that all activities have their own regularities and temporal rhythm. As all activities are import design researchers, all of them must keep in mind and have to be aligned in an artful manner.

Grounded Design is a comparative research framework which allows us to structure the individual engagements, make their insights more accessible, and keep the research practices self-reflective (Rohde et al. 2017; Stevens et al. 2018). The aim of Grounded Design is to offer guidance in how to conduct individual design case studies, how to document them, how to preserve and share comparatively gained insights, how to make the engagement in practice sustainable, and how to conduct meta research (Rohde et al. 2017; Stevens et al 2018; Randall et al. 2018). Grounded Design builds on a practice-based and constructivist paradigm, seeking to study emerging and evolving practices of use over longer periods of time after new IT artefacts have been designed and introduced. In that sense, Grounded Design suggests a praxeological turn in the field of computing.

The third methodological framework, we developed, was Integrated Organization and Technological Development (OTD). While Desgin Case Study and Grounded Design is very much focused on understanding the quality of ICT design in social practice, OTD addresses explicitly organizational development in the context of the design, tailoring, and introduction of ICT artefacts. OTD tackles problems in organizational practice to which the appropriation of properly designed ICT artefacts could be an element in the solution space. The framework suggests that the design of new ICT functionality and the tailoring of existing ones should be conducted in association with attention to activities of organizational and personal development (Wulf and Rohde 1995a,b). OTD is defined as

"the process of change of an organization in which an organization and technology are designed and developed in a task- and needs-oriented fashion by the members affected through integrated means: the organization members affected con-sider the existing problems, search and evaluate the problems' causes, and negotiate a process of problem solving. OTD only takes place if the members affected are willing and able to define contents and course of the OTD-process, and are immediately taking part. (...)" (Hartmann 1994, 311, translation by the authors).

The OTD-process is characterized by a parallel development of workplace, the organizational and technical systems, the management of (existing) conflicts by discursive and negotiative means, and the immediate participation of the organization members affected (cf. Hartmann and Rohde 1993). OTD is based on the assumption that there exist several ways of designing organizational structures and processes instead of "the one-best-way". So, the division of labour, the distribution of tasks among different organizational subunits, the specific design of work-flows, individual degrees of freedom, the role and conditions of ICT use in the work process, and the design of technical support are to be negotiated in a participative manner.

While the early OTD concept focused on the "work system" (e.g. human work design, workplace studies etc.) as the central development task, Rohde (2007) analyzed five longitudinal case studies - applying the framework to different organizational settings over one decade - and pointed out that groupware support would be probably not be limited to work systems but can focus on (collaborative) learning systems and community-building as well. Furthermore, Rohde (2007) came up with some reformulation, esp. with regard to some theoretical limitations of the original OTD model. The empirical insights showed some indication of relevant socio-cultural processes which had not been considered in the original OTD framework. This was elaborated especially with regard to the design and introduction of groupware applications for informal and virtual (respectively hybrid) organizations, (social) networks, and communities.

To explore ICT-inspired opportunities for social developments beyond the duration of individual design case studies or an OTD engagement, it can be helpful to build lasting relationships with practitioners and local institutions. We have coined these infrastructurally supported environments PraxLabs (Ogonowski et al. 2018). Inspired by the concept of Living Labs, PraxLabs are social settings which allow the conduct of design research inspired by the Grounded Design or OTD frameworks. We have built different PraxLabs in the region around our university, for instance one with families in the domain of entertainment computing (Ogonowski et al. 2013) and others with elderly households in the domain of computer-supported sports and fall prevention (Vaziri et al. 2016). We are currently working towards a situation where the counties around the University of Siegen understand themselves to be a model region in exploring opportunities for digitalization in a rural and industrialized context.

PraxLabs are inter- and transdisciplinary social spaces of co-learning, where people from various backgrounds meet on a regular basis to mutually learn from their respective experiences and co-create new solutions for commonly understood problems (Riva-Mossman et al. 2016). The ultimate goal is to create technological interventions and artefacts that correspond to the already existing organizational and community structures, (human) resources, and practices.

Qualitative and participatory research components bring the central actors and their living and working contexts into focus. All stakeholder groups are both, co-producers of knowledge as a basis to further develop innovative socio-technical infrastructures. Likewise, they also will be receivers of knowledge, processes, and measures which are to be coproduced, discussed and evaluated in an iterative, long-term and practice-based approach.

PraxLabs are environments for reflecting on the inter- and transdisciplinary work between actor groups from research and stakeholders in the particular field, such as organisations, civil society, technology developers, and industrial partners and for stimulating exchange of research results and knowledge. Furthermore, the PraxLabs may serve as demonstration environments for manifold technological solutions which allow to gain interest from associations and political actors in the project early on and to adjust sustainable transfer and dissemination measures.

The PraxLabs are the research environment that enable a long-term and multi-stakeholder-based understanding of socio-digital innovations and infrastructures, which often are to be developed as proof-of-concept as well as fully-functioning prototypes.

Within the PraxLabs, end-user participation is constitutional in all phases of the development: from the beginning in order to find and define requirements, reflect on early alpha versions, improve usability and meaningfulness of solutions to end-users, test in practice and provide continuous feedback during use (Ogonowski et al. 2018).

The PraxLabs framework contains four main spaces that constitute open innovation research activities (Ogonowski et al. 2018):

1.) *"The user space is the physical regional network of people collaborating which evolves during the research process and which holds a central database during the recruiting process of possible participants. IT provides different established communication tools and materials to structure communication processes in the cross-regional Living Lab activities.*
2.) *The creative space comprises physical locations and resources, such as technical equipment, and material for stakeholder interactions. Such spaces may be associated with academic, clinical and company-based facilities or with other participating local associations, in form of meeting rooms for participants and researchers for joint workshops.*
3.) *The methodological space offers a set of qualitative empirical as well as participatory methods. The entire design process is covered by a methods toolbox providing selected methods for each process step.*
4.) *Finally, the management space covers experiences and best practices in the coordination of stakeholders and case studies. It also comprises reflective and analytical elements in regard to documenting strategies and activities deployed that fostered motivation and interest in the different stakeholder groups for their participation in the joint project. Additionally, the management space encompasses the development and use of strategies for supporting*

interdisciplinary collaboration with possible differentiating epistemological standpoints. E.g. the role of a mediator might be considered for bridging gaps between stakeholder groups, „translating" information in a way that keeps processes flowing and for conflict management."

Since the 2010s, we got increasingly interested in understanding political practices in the Middle East and Northern Africa (MENA) region. Our research started in Sidi Bouzid, the cradle of the Arab Spring in Tunisia. Our research tried to understand political practices - and specifically the role of social media therein. The academic discourse on the phenomenon of the Arab Spring was characterized by sometimes over-stated arguments about the determining role of social media (Lotan et al. 2011; Starbird and Palen 2012). Coming from a practice perspective, we suggested conducting 'on the ground' studies to complement findings based on an analysis of content from social media platforms - mostly from Twitter. These ethnographic studies require us to be at or near the place of the political turmoil and to acquire the trust of, and get access to, local actors. These studies are methodologically difficult and sometimes dangerous to conduct. However, they are crucially important for understanding local political conditions and the role of social media therein:

"Following the results of our investigation, there are at least three reasons why 'on the ground'-studies are required:
(1) They can relate social media usage to a broader understanding of the actors' political and social positions and practices, such as the motivational factors that illustrate their participation in discussions, demonstrations, or their engagement in political parties and trade unions.
(2) They allow understanding of how the usage of particular social media applications works as part of the (collective) information and communication ecology of citizens and political activists. This way it is possible to investigate how people perceive certain information (received via different applications), how actors switch among different social media applications, how they transfer data to tools for individual communication, and how they try to reach mass media.
(3) They may allow understanding (aspects of) secretive media usages that would typically not be found by traditional on-line data collection methods. Thus, the use of anonymous accounts, proxy servers, differing public and private Facebook settings, and so on, is largely invisible to online investigation. Investigations into usage data of social media applications can uncover interesting pattern of appropriation." (Wulf et al. 2013b, p. 1417).

We started our 'on the ground' research in Tunisia but expanded it to Palestine (Wulf et al. 2013a,b, Aal et al. 2015; Yerousis et al. 2015); the Syrian civil war (Rohde et al. 2016; Wulf et al. 2017); the political divides in Republica Sebska (Tadic et al. 2016); the Donbas Conflict (Shklovski and Wulf 2018), and political conditions in Iran (Wulf et al. 2022; Grinko et al. 2022). This way we have started to collect a rather unique set of empirical findings in a set of different political, specifically activist's practices.

We are now moving from mainly empirical studies also into a design mode. In a village in the Maroccan High Atlas mountains, we explore how media spaces would impact local publics (Aal et al. 2018; Rüller et al. 2022). Boris Tadic has

designed a tool which makes political activists aware of the specific dangers of online surveillance against them (Tadic et al. 2022).

So, while 'on-the-ground' studies offered different empirical insights into the social practices, they now lead to design-oriented activities to strengthen political publics.

6 Research Program

Looking at the over 25 Years of history of Socio-Informatics – and aspiring to an outlook over the 25 Years to come -, needs some understanding of the overall Socio-Informatics research program: What are the driving forces, what are the general objectives and guiding principles? What are the central characteristics that discriminate this discipline from other approaches – the differences that make a difference?

The core understanding, underlying all our research activities, is the definition of Socio-Informatics *as a design science*. We do not only strive to understand the world or analyze user practices with regard to ICT artefacts, but we want to add something to the world, to design ar tefacts and/or develop socio-technical solutions. However, our work should not be seen as the design (of artefacts) tout court. Rather, such design moves are predicated on the need to find appropriate solutions and provide support for social practices instead. This should be seen as our main objective. This defines a clear *interventionist perspective*: We want to change something – much like Marx, we see the task as changing the world rather than merely understanding the world. But – maybe different from Marx – we do not strive to change the whole world or the economic structures of whole societies, but we aim at *smaller changes*, often local, highly contextualized, empirically/ethnographically informed and participatory designed changes of social practices by *careful interventions* (Krüger 2022).

This leads to the question(s), what to change and why? What shall we design and add to this world and why should we do it? What is the intention behind such moves? The closest answer to the last question is a normative one: We want to make the world a better place, help people to improve their practices, to find solutions for existing problems, spell out potential, and to support their quality of life – at least on a situated, local level This is an explicit *normative approach* that might appear self-evident and does not discriminate our motives from many other researchers, at least in applied design sciences (cf. Friedman's Value Sensitive Design, Friedman and Hendry 2019). Nevertheless, this clear perspective is far from common or widely accepted in mainstream informatics, IS or computer sciences. Especially, when it comes to the *issue of responsibility* of scientific research and design projects and researchers.

A normative approach requires responsible research practices and a sensitive, self-reflective academic identity. The intention to "improve the world" needs an

understanding of what an improvement is and how to get there – and the consequences of one own's activities. The naïve answer of scientific experts might be, that you need a good analysis, a good methodological knowledge, a plan – and then to develop the very best expert solution to a given (design) problem. Unfortunately, if talking about design for practice – and, therefore, socio-technical context – we have to be aware that a positivist, deterministic understanding of scientific expert knowledge and one-best-solutions has consistently proven to be inadequate. Hence, our research program is based on a *strictly practice-based and user-oriented, non-determinist design understanding*. The question what the relevant problems are or how people's lives might be improved, can only be answered by systematic, trustful engagement with these people. Legitimation for interventions should be strictly based on the needs of the involved persons and on their explicit mandate to design. Appropriate artefact design or adequate solutions and improvements can only be achieved together with the respective stakeholders. And whether a solution is a good one or a design means an improvement can only be evaluated by and with the people affected. This requires, consequently, a *participatory design* approach.

Furthermore, responsible design research is a *long-term endeavor*. Analysis, (participatory) development, appropriation and evaluation of socio-technical solutions take time – as does a reflective, responsible research practice. Lastly, every case is different. Socio-technical practices and solutions are situated and case-sensitive. social practices are culturally embedded and historically contingent. Therefore, Socio-Informatics needs a *case based, context-sensitive methodology*.

7 Conclusion/future work

Our journey as socio-informaticians began with the understanding that social phenomena and technical systems are inextricably intertwined and that our primary goal as socio-informaticians is not merely to design a technical artifact, but to support or develop a social practice. In doing so, our research has benefited from research traditions in other disciplines and has been inspired by theoretical concepts, research findings, and ongoing discourses from the international research community. Over the past 25 years and more, our case-based research has enabled us to design individual technical prototypes and develop socio-technical solutions in a range of socially relevant application domains, and to study their appropriation and impact on social practice. In this way, we have acquired very context-based, situated insights, but have also been able to identify patterns and derive concepts, draw methodological conclusions that we have been able to feed back into the international academic discourse via top-level publication media.

This text serves to introduce the socio-informatics project and to trace its development over the last 25 years. It would be incomplete if we did not venture an outlook on the next 25 years: where is our journey going? Where do we see

challenges for further research priorities or for the further development of socio-informatics as a discipline? At the end of the day: what drives us?

If you follow our development since its beginning, as we have done here, you will notice that it is not a straight, linear course, but a development process that has curves, loops, bumps and so on. There have been influences, nudges, inspirations and irritations, but also resistance from outside, sudden access to institutional, human and financial resources, there have been unexpected encounters and experiences that have enabled further insights and development steps along the way. So it will be for our future development. Historical developments are contingent, not predictable. That is why -long term deterministic planning fails. And why we do not even attempt to do so in this chapter.

Instead, we would like to identify some socially relevant topic areas that we believe socio-informatics can make a strong contribution to in the coming years. The list of these research areas will likely change or expand over the real next 25 years, but this is the outlook we currently see. What is not so contingent, not so dependent on outside influences, that is our motivation as socio-informaticians to do research devoted to a better human future. So even if the subject areas change, our drive remains to do socially relevant socio-informatics research. This is our overarching goal which unites our interests, our mission. In this concluding chapter, we will talk about this as well.

Over the past 25 years the socio-informatics research paradigms has turned out to be a fruitful approach to contribute to the tackling of societal problem areas. We have developed a normatively positioned but empirically grounded design paradigm in practice.

The question is what will be the challenges and research directions for the next 25 years? What are the societal challenges and In which way can Socio-Informatics contribute in tackling them?

Research in Socio-Informatics is driven by both: the unfolding of new areas of societal potentials and problems as well as new technological opportunities. In the following, we will speculate about Socio-Informatics could contribute to societal developments.

We believe that the manner in which the economic system is structured will change over time. The drifting apart between ecology and economy, rich and poor as well as north and south require a rethinking of the global economic order. In this context we would expect upcoming issues and direction for socio-informatic research concerning new economic structures, new forms of industrial production, entrepreneurship and innovation, agriculture and forestation, regional development of urban and rural industries and economic structures, new modes of fair globalization, sustainable production and consumption. Furthermore, we foresee a growing societal and political relevance of strategies against the climate change, (lifelong) learning and creativity, demographic changes and healthy living and ageing, crisis management, cyber warfare and security, gender justice, diversity and

inclusion, democracy, political engagement and public participation, civil society and empowerment. Not claiming the comprehensiveness of this tentative list of topics and not excluding any potential future challenges, we would expect socio-informatic contributions to the aforementioned areas.

Stating that Socio-Informaticians aim to make these societal contributions, it is also part of our responsibility to reflect and critically question our own motivation, our own drive, our own goals. Why do we do what we do, and what are our intentions? We will not be able to completely illuminate the far-reaching implications of the complex and ongoing discussion in this text, but we would like to at least touch on them in the following.

The simple answer according to our overarching goal- and it has already been mentioned here in the text- is: to make the world a better place. Why would we, as scientific experts and designers, go into different application domains with the tools of computer science in hand to change the way people work or the way they live if we didn't have the stated goal of making it better? So simple, so good. But also, unfortunately, so incomplete: who determines what an improvement is? And who called us to improve their life practice in the first place? Answers can be found to both of these critical objections. The key factor here is a consistently participatory approach: from the very beginning, over the lifetime of an entire socio-informatic project, the affected users and stakeholders are to be directly involved, it is important to understand their needs, to understand their practices, to build trust, and to develop possible design solutions or socio-technical solutions together with them. We must never forget that the choice NOT to design is a real one. Also, the quality of any technical or socio-technical solution is measured solely by its appropriation and impact in the users' practice. In other words, whether a socio-informatic project leads to an improvement of the world or not is ultimately decided by the users in practice and through their practice - and not by us researchers. If one of our prototypical projects fails, it must be guaranteed that our solution can removed from the field again without causing long-term damage. It then remains for us as researchers to analyze why this socio-informatics intervention did not work in this design case study and what can be learned from it for the future.

In other words, if we as researchers link an interventionist design claim with a normative perspective, we must continuously reflect on our own research practice, be able to recognize contradictions, endure them, and also resolve them through appropriate methodological responses. Contradictions that we encounter in practice are, for example, when we work with users in countries of the global south, the colonialism/de-colonialism debate, general power imbalances in many of our projects between us as experts and largely non-empowered users, intercultural conflicts in the work with users from other cultures, in many ways the inclusion problem, consideration or violation of group-specific needs, e.g. of seniors, sick people, or people in need of care, just to name a few of the most obvious ones. It is a constant and important part of our work to remain attentive here, to recognize the

contradictions, to confront them and to develop solutions together with the persons concerned and to learn from them for the future. This also includes the clear realization that in the field of practice the experts are not us, the socio-informaticians, but here the experts are the local actors. And we must learn from them.

Lastly, we do not intend that all the above should be read as a celebration of our achievements alone. None of what we have done in this time would have been possible without the support, friendly interrogation and intellectual inspiration provided by our colleagues in Europe and elsewhere. You know who you are. We owe a great deal to you.

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Introduction to Knowledge-Intense Work

Volker Wulf, Thomas Ludwig, Volkmar Pipek, Markus Rohde

Being strongly influenced by the European CSCW tradition, we started our investigations in settings where the introduction of IT artefacts, at that time mainly understood as groupware, would support collaborative work ('Work' understood as being spelled with a major 'W'). Taking the perspective of those who carry out the work, we came up with a manifold of detailed descriptions and analysis of skilled labor as well as with IT artefacts and design concepts of how to support mundane types of work settings.

To start our engagement with work practices, in the mid 1990s, we were lucky enough to become members of the Polikom research program. Following the decision to move the capital from Bonn to Berlin, the German Federal government funded research to design technologies for the political administration to work in a more distributed manner. Over a period of five years, we explored the design and appropriation of a shared desktop application with the Federal Ministry of Familiy Affairs, Senior Citizen, Women, and Youth and the state government of Mecklenburg-Vorpommern (Wulf 1997, Pipek and Wulf 1999). The experiences gained in this engagement very much shaped our capabilities for research-in-practice as well as our understanding of the interplay between organizational and technology development (Wulf and Rohde 1995, section 8).

Still at the University of Bonn, we explored the concept of Integrated Organization and Technology Development (OTD) while looking at the cooperation of engineers when maintaining a major steel mill (Wulf et al. 1999). This work was distributed between different engineering service providers and the central engineering department of the steel mill. While we originally intended to explore the potentials of 3-V viewers and 3-D CAD models in developing the distributed cooperation between the actors. However, in the course of our investigation problems in the central archive documenting the construction state of the steel mill became obvious.

We therefore, investigated into the state of the central archive and the access to it – in taking a critical perspective on knowledge management (Pipek and Wulf 2003). The paper in this collection looks specifically at the social practices of access control and how to support them via an extended access control model.
Continuing our investigations into the document management in technical domains, we looked at sewage company. After being turned over from a public institution into a private company, the central technical archive was abandoned. In this volume we included a paper which deals with the problems of federated partial archives and ways to support the engineers in classifying their documents.
Management science, at end of the 1990s, was propagating Virtual Organizations as a new form to overcome the supposed inertia of traditional organizational structures. We investigated into a network of business consultants, which had self-declared itself to be a virtual organization, to better understanding work practices and technological opportunities (Rittenbruch et al. 1998). An important point of interest was the way knowledge sharing would happen in such a network of legally independent consultants.
Given the rich empirical materials, we collaborated with Mark Ackerman to develop a practice-based perspective on knowledge management – focusing on the immediate sharing of expertise among qualified actors rather than merely looking at the externalization of knowledge by means of documents (Ackerman et al. 2003).

This perspective of Expertise Sharing and its technical support guided our future research. In the early 2000s, we got involved with a major German industrial association covering many sectors of the German economy. A couple of hundred employees worked in different locations, thousands of companies were members of this organization. The industrial association was interested in exploring how to better share knowledge and expertise inside its organization and with and among its members. We developed application, we called Expert Finder, which helped finding experts based on keyword vectors of documents which the users locally processed (Reichling et al. 2007). The paper in this volume details how the Expert Finder had an impact on the location and perception of expertise inside the industrial association.
Working with Fraunhofer-FIT, we got involved in building up the Virtual Software Engineering Centre of Competency (ViSEK). We were rather skeptical with regard to the project's overall vision of explication all software engineering knowledge into a content management system (Hofmann and Wulf 2002). While this vision gradually desintegrated, we converted parts of our resource to conduct different work place studies in the software industry (e.g. Boden et al. 2007). At that time, software engineering was on the way to become more globally distributed by means of off-shoring of development work to mainly low income countries. An influential position held in parts of the software engineering community argued that off-shoring would require a further formalization of the software engineering process with tools limiting articulation work and individual creativity. We were rather skeptical again and wanted to investigate this issue empirically. We looked at two small German software companies which followed fundamentally different approaches with regard to the formalization of their distributed cooperation with

Russian partners. We could show how a highly formalized approach to define the interfaces between the cooperation partners failed (Boden et al. 2009). In the paper in this collection, we describe practices of expertise sharing across geographical, temporal, and cultural boundaries, practices which enabled cooperation between workers in off-shoring development – comparing two offshoring cases in the software industry.

Research into the design of IT support for cooperative work in business organizations requires typically public funding. We also work with companies in modes in which they pay directly for our efforts. However, these types of engagements do not necessarily lead to publications – due to temporal restrictions as well as for confidentially reasons. For quite some time the German and European institutions for research funding did not pay too much attention to innovations in cooperative work. The landscape changed with the emergence of the buzzword 'Industry 4.0' (Internet of Things). While the original conception of the 'Industry 4.0' research agenda was very techno-centrically driven by a vision of full automatization, it turned out that in practice a technology design suitable for the needs of skilled workers was important. The industrial structure around the University of Siegen is characterized by highly specialized and internationally competitive small and medium sized companies. They rely on skilled labor. With political support, we were lucky enough to acquire for this region one of the German government's funded Centres of Competence 'Mittelstand 4.0'. Working with these companies of the traditional 'old' industries, their employees, and the work councils, we developed an agenda to network and augment existing machinery with sensors and computer devices in a way which support skilled workers instead of replacing them. In the paper in this volume, we show the potentials of augmented reality (AR) in supporting workers' learning processes – taking the case of sharing the knowledge necessary to set up a mashine after changing a tool.

While we were interested in engaging with the regional companies and their workers to contribute to their development and quality of labor, we also maintained an international perspective. Like in the case of off-shoring in the software industry, our research interests were often driven by phenomena and problems of globalization. In a critical sense, we were interested in understanding how the global economic order influenced the quality of labor in other parts of the world. In the paper in the volume, we look at Chinese migrant workers who, at that time, left their homes in central China to work in coastal factories producing for the world market. The paper draws a rather unique picture of a group of migrants workers living conditions – observed from the perspective of their use of social media.

Looking at the IT artefacts, they were directed towards the support of qualified labor rather than constraining it through formalisms or replacing it by means of algorithms or automatism. Against the background of this normative setting, the design of innovative artefacts is always driven by both the particularities of the concrete work setting as well as the technological opportunities at hand to be explored. It should be noted that both dimensions are developing over time. So IT artefacts in support of qualified labor have to be seen as evolving (see section 7 in this volume).

The agendas of public research funding are often triggered by technologically defined hypes, such as ‘Industry 4.0’ or ‘Artificial Intelligence’. Therefore, it requires some creativity and lobbying efforts to be able to interpret and shape them in a manner which focus on IT designs in support of skilled labor in organizational practice.

Looking at the IT-artefacts developed in support of skilled labor, we have created rather differentiated solutions. They reach from the technologically rather advanced ones to the realization of technologically rather minor tweaks whose appropriation, however, had a large impact on the work to be supported. For instance, the functionality added to the decentralized archives of the sewage plant operator helped employees to collect metadata to categorize technical drawings in an easier manner. While the technical core of this functionality was by itself neither innovative nor complex, it helped greatly to search for technical documents. In a socio-informatics research tradition, the measure for technological achievement is not defined by inherent features of the technology but its impact on the work.

We also developed complex technologies in the realm to support cooperative work. The Expert Finder was at the time of its invention an innovative approach to support expertise sharing, its implementation was complex – since currently available software libraries were not yet existing and the artefact had to be fitted into the technical infrastructure of the had to be fitted into the given software infrastructures of the industrial association and its members. Our approach to investigate how Augmented Reality (AR) can help capturing and documenting skills in dealing with material industrial practices, such as the change of a tool in a bending mashine, is technologically complex, as well. Here again, one of the major challenges is building the AR-layer into old not yet digitalized machines. However, the major achievement even when developing technologically complex and innovative solutions is the artefacts fit with the opportunities of local practice. The Expert Finder has rather unique and differentiated solutions how to keep the expert profiles updated while minimizing users’ efforts and maintaining their privacy. The AR-tool needed to be designed in away that local experts would be able to externalize their material knowledge. In the socio-informatics tradition, these context-specific elements of design determine the quality of the IT artefact.

Therefore, the quality of IT-design needs to be explored in practice. We need to understand how the appropriation of these technologies change the work practices and to which end. Such type of investigations are laborious and specifically difficult to run in business organizations. The IT artifact needs to be technologically mature with regard to its performance, stability and usability. The cooperating organizations needs to trust its research partners that the deployment will not harm their normal procedures and other interests. They need to be willing to let their employees take some extra time to explore the opportunities of the IT artefact and potentially appropriate it. The deployment needs to be large enough to warrant sufficient appropriation.

So, investigations into the appropriation of IT artefacts in business organiaztions are really hard to conduct. It is often easier to investigate into the appropriation of IT artefacts designed by other parties and introduced into an organization (e.g. Orlikowski 1996). Over the past decades, we were capable to investigate into the

appropriation of IT artefacts designed by ourselves only in few cases. In the PoliTeam project we able to investigate into the appropriation of a shared desktop application in a federal ministry and a state government (Wulf 1997, Pipek and Wulf 1999). The Expert Finder was rolled out in the industrial association, and finally, we also explored AR applications for expertise sharing in two regional companies (Hoffmann et al. 2021). In this volume, the paper describing the appropriation of the Expert Finder in the industrial organization. Though not yet perfectly widely rolled out, the study came up with really surprising findings which could not have been anticipated. They offered additional insights in the redesign of the artefacts as well as an understanding of the way organizational practices would evolve when applying this functionality.
So, appropriation studies are the most sophisticated level of socio-informatics design in organizational practices. We have elaborated on this finding conceptually (see subchapters 7 and 8).

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A New Dimension in Access Control: Studying Maintenance Engineering across Organizational Boundaries

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Abstract Inter-organizational cooperation has specific requirements for access control. The paper presents the results from a field study which looks at the cooperation between two engineering offices and a steel mill. Based on these findings we have developed new mechanisms for access control in groupware. These mechanisms allow to restrict operations on shared data while or even after they take place. The new access mechanisms can be decomposed and implemented into a component-based framework. We show how this framework can be extended to realize additional mechanisms for access control with little efforts.

Keywords Inter- inter-organizational cooperation, case study, access control, tailorability

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Expert Recommender Systems in Practice: Evaluating Semi-automatic Profile Generation

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ABSTRACT Expert recommender systems (ERS) are considered a promising technology in knowledge management. However, there are very few studies which evaluated their appropriation in practice. In this paper, we present results of a case study of expert recommender technology in a large European industrial association. Unlike existing expert recommender approaches, the system involves users in selecting textual documents for semi-automatic profile generation. Our study focuses on the appropriation of this functionality and discusses impacts from an organizational perspective.

Author Keywords: Expertise Recommender System, Knowledge Management, Second Wave

ACM Classification Keywords: J.4 [Social and Behavioral Science]: Sociology

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Context Grabbing: Assigning Metadata in Large Document Collections

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Abstract Classification schemes are an important issue in the collective use of large document collections. We have investigated the classification of technical documentations in two engineering domains: a steel mill and a sewerage plant company. In both cases we found a coexistence of different classification schemes and problems resulting from distributed local archives. In supporting human actors to maintain different classifications schemes while working on a common archive, we developed the concept of context grabbing. It allows assigning context information efficiently in the form of meta-data. Based on a document management system, a tool kit for context grabbing was developed. Its evaluation in a sewerage service company allows us to comment on important aspects of understanding the role of classifications in collaborative work.

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Knowledge sharing practices and the impact of cultural factors: reflections on two case studies of offshoring in SME

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in: Journal of Software Maintenance Vol. 24, No. 2, 2012, 139-152

Summary The impact of culture on knowledge management in international teams is an important topic which is still not well understood. We contribute to the discussion by presenting two case studies of small software teams involved in distributed software development. In doing so, we illustrate how cultural and social issues influence the way knowledge exchange is performed by analyzing four knowledge sharing practices: status meetings and maintaining awareness, the collaborative use of shared artifacts and repositories, spending time at the other site and human 'bridges' that mediate between people and cultures. Our findings suggest that organizational culture is permanently re-negotiated and adjusted to fit the distributed collaboration, as the teams learn how to deal with each other. Socialization plays a significant role in this learning process, and people are more likely to draw on national stereotypes when breakdowns occur. The influences of national culture and site-specific organizational culture are subtle and not easy to separate from other factors. Based on our experience, we argue that in order to achieve an accurate understanding of knowledge sharing practices in globally distributed software teams, these need to be studied in context, longitudinally, and from both the onshore and offshore perspectives. Copyright q 2010 John Wiley & Sons, Ltd.

KEY WORDS: global software engineering; culture; small enterprises; nowledge haring practices; offshoring; ethnographically informed studies

Towards a Model Enabling Design. Journal of Comput. Support. Cooperative WorkCSCW), Vol. 28(3-4): 469-509 (2019)

Cyber-Physical Systems for Knowledge and Expertise Sharing in Manufacturing Contexts: Towards a Model Enabling Design

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Abstract. Cyber-physical systems (CPS) are currently attracting a great deal of attention as a part of the discourse surrounding the fourth industrial revolution. Thus far, the chief focus has been upon complex architectures for supply chain-wide data exchange between intelligent machines. Here, however, we take a very different tack by examining the support CPS may offer for the exchange and acquisition of knowledge-intensive human practices in the context of manual set-up processes on modern production machines. The paper offers contributions to both CSCW and the ongoing development of CPS in three ways. Firstly, it presents a detailed empirical study of knowledge and expertise sharing practices in a production environ- ment. Secondly, the results of this study are used as the basis of an over-arching model that was developed with the express purpose of facilitating design. Finally, CPS-based technical possibilities are matched to the practice-relevant knowledge and expertise sharing requirements captured within the model.

Key words: Knowledge Sharing, Expertise Sharing, Manufacturing Context, Cyber-Physical Systems, Augmented Reality, Sensor Technology

in: Proceedings of the ACM Conference of Computer Supported Cooperative Work (CSCW 2014), ACM Press New York, 2014, 710-721

Enriching the Distressing Reality: Social Media Use by Chinese Migrant Workers

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Abstract Based on a field study in Guangdong Province, this paper describes the social media use of Chinese migrant workers in the manufacturing sector. It was found that social media plays a significant role in the lives of young workers who have left their rural hometowns in early adulthood and struggle to survive in the urban centers. They buy expensive IT devices to gain a social reputation, as social media provides opportunities for self-expression; strengthens their self-consciousness; and to a certain extent, influences their world view. For most of the workers in our study, social media has become a very important part of leisure time and entertainment. Moreover, the life in virtual worlds provides them a psychological compensation mechanism to temporarily avoid the pressure of their daily lives.

Author Keywords: China; social media; virtual identity; migrant worker; field study

ACM Classification Keywords: H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms: Human Factors; Theory

On the Dialectics of Form and Process – Comments on computer systems in knowledge intensive work

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According to Denning (2003), the discipline of computer science can be comprehensively characterized by the following »great principles«:

- C*omputation*: What can be computed, limits of computing.
- C*ommunication*: Sending messages from one point to another.
- C*oordination*: Multiple entities cooperating towards a single result.
- A*utomation*: Performing cognitive tasks by computer.
- R*ecollection*: Storing and retrieving information.

Taking these principles as kind of a map for the wide-ranged and diverse computer science landscape, the five papers presented concerning the development and use of computer systems in knowledge intensive work refer to the above domains of communication, coordination and recollection. They specifically address issues of maintenance practices across organizational borders, the handling of different classification schemes in distributed archives, finding specific expertise in large organizations, knowledge sharing in globally distributed software development teams, and, in a different perspective, specific use practices of social media in a rapidly changing society.

Within this context, the papers engage in a social practice perspective by predominantly evaluating computer appropriation and , use experiences for

knowledge sharing and certain cooperative practices. In this perspective, the activities of designing and appropriating computer system functions for such purposes are regarded as massive interventions in social practices and, hence, also in organizational structures. They, therefore, need to be treated within a sociotechnical design framework of »integrated organization and technology development« (OTD; Wulf & Rohde 1995). Accordingly, the papers take the form of in-depth case studies of some typical aspects of cooperative work processes.

Practices of computer-supported cooperative work as the more general domain into which the five papers can be classified typically raises a number of basic problems such as the principal limits to elicitation of explicit knowledge from practical know-how, the particular dynamics of an effective interplay between the forms of tacit and explicit codified knowledge in learning and socialization processes or difficulties in effectively appropriating systems functions for practical use. As research findings on cooperative work in general reveal (including my own, cf. Brödner 2010), effective and succeeding cooperative work strongly depends on meeting a number of necessary requirements such as a clearly defined and communicated common working task, accepted and shared methods for structuring processes and documenting working results, competent and powerful project management, and sufficient room for informal communication building trust and social coherence. For computer-supported cooperative work in particular, additional success conditions hold: allowance for defined privacy in the virtual work space, arranging explicit rules for cooperation, providing options for additional meta-communication, and stipulating specific awareness features for states of working objects and means of work, working activities, social roles and relationships respectively. Most of these issues are, within the specific context of their cooperative process, also dealt with in the papers presented.

With respect to these issues, the paper »Maintenance Engineering Across Organizational Borders« particularly investigates in a case study component-based mechanisms and practices restricting access and operations on a shared date base. Regarding integrated inter-organizational work processes it discloses a number of trade-offs between different views and interests and, hence, formal access regulations. This makes it difficult to determine those regulations *ex ante* and in general. They often require enough room for flexible treatment via situation-specific agreements.

The paper »Context Grabbing by Assigning Metadata« deals with another practical problem in cooperative work: handling different classification schemes in distributed archives over time. Cooperative work requires a shared knowledge base that can be systematically searched with respect to objects treated, documents related, their creators and users in related work processes or projects. The practice-oriented case study deeply looks into the variability problems and needs for adaptability of classification schemes due to varying contexts and perspectives over time regarding e.g. structures of objects, project relationships or ascribing attributes that additionally may be overlapping. Grappling with these problems often encountered led to the development and practical test of different interactive

software tools to support the generation and maintenance of appropriate classification schemes grabbing context-dependent data partly automatically, partly by human input. Here again the limits to formalizing highly situated work and formally capturing different »classification cultures« become visible.

Experiences with an »Expert Recommender Systems in Practice« again point to similar aspects of formalizing interpretive work. Different approaches to appropriately characterizing specific expert knowledge by combining automatic keyword mining from existing documents like reports or e-mails with self-reported directory information by the respective experts (like »yellow pages«) are evaluated in the paper under practical use conditions. Again a number of contradictory perspectives and usability issues crystallise such as a missing differentiation between professional and role-specific expertise, the trade-off between role-dependent visibility versus task-specific expertise, the issue of choosing appropriate documents for keyword mining or the need of understanding how the matching algorithms work. Coping with these issues refer to the limits of automatic mining procedures and the demand for sufficient personal editing.

The paper »Knowledge Sharing: Practices and Cultural Factors« investigates knowledge sharing practices in two globally distributed software development teams. In a critical view, it specifically identifies the important role of face-to-face meetings as well as direct contacts to customers, the comprehensive collaborative use of shared artifacts and repositories and the need for appropriate and shared documentation of project progress as critical conditions for success. These ties are important for effective socialization and building mutual trust.

The paper »Enriching the Distressing Reality: Social Media Use by Chinese Migrant Workers« addresses a wholly different topic by providing an in-depth case study of how seven young migrant workers having left their rural environment for industrial urban work use the new social media. These media offer multiple opportunities to them for keeping in touch with their rural families and communication among themselves and helps them to learn about better surviving in a stressing urban environment as well as to strengthen their self-consciousness and self-expression capacity within an ongoing deep general societal and cultural modernization shift in China changing the relationships between individual, society, and cultural traditions.

This last study of social media use seems to open an entirely different window for looking on computer-supported cooperative work and communication processes. Each of the other case studies presented in the above papers addresses specific and highly relevant aspects of CSCW practices. As such, the results reported can, in its proper way each, augment the practice-oriented knowledge base for development and appropriation of software artifacts for effective use in cooperative work as initiated and outlined in the »Grounded Design« approach (Rohde et al. 2016). Moreover, they once more refer to and emphasize the basic issues of reducing work practices to abstract entities, of formalizing living work processes for computation, and of formally capturing working capacities and skills in algorithms and data

structures. They once more highlight the need for appropriately combining the skills of human working capacity with the performance of computer artifacts by thoroughly studying and intervening in work practices. In short: They emphasize the dialectics of form and process, of explicating knowing how into knowing that and, reversely, of appropriating it for practical use.

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Some remarks on Knowledge Intense Work

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I will refer to the papers in this section in a selective manner.

All are exemplars of the Siegen approach to Information Systems and Collaborative Work studies. In each of these papers, people's practices are central. In each of these papers, the social context is elaborated as a key element of technical use.
Over their historical trajectory, the papers show the continued development of a central intellectual problematic: how social context is to be considered, portrayed, and incorporated.
The Siegen approach, based in the Integrated Organization and Technology Development (OTD) method (Wulf and Rohde, 1995), takes a highly nuanced view of how technology designs and organizational/social considerations must fit together for systems to be workable and useful.
This view is expounded through the details of field work and grounded in ethnographically based methods. The detail that is derived from the field work brings out the important issues for potential users in specific social setting. The Siegen approach is notable for its attention to both technical advances and social understanding.

The papers here all take a task of practical significance and explore its social context. These issues are then generalized, and the socio-technical requirements constructed. The social context foregrounds the issues, constraints, and organizational needs - the day-to-day realities of work, work life, and social

connectedness that must be met and facilitated in order to make any technology, no matter how innovative, into something that is workable in its context of intended use. Many of the Siegen papers, including three in this section, go on to find a technical solution that is a research contribution to the social computing or practice-based research communities.

As a whole, these papers show a remarkable progression of scholarship, showing the development of intellectual bases for future research, system development, and the design of social processes (including work). Each offers a significant contribution both to evolution of the Siegen approach as well as to the scholarly dialog around information use in its organizational and social contexts.

The paper, by Stevens and Wulf, examines in great depth and with considerable acuity the issues of information reuse in networked organizational settings. The paper begins with a field study of a specific work site, uncovering the requirements that will allow a system to facilitate its interactions. In this case, the study concerns how to augment information flows among networks of organizations.

The field study unpacks the organizational structures and workflows that currently exists in a steel plant and its maintenance office. It goes on to consider the information flows between the steel company and two external consulting groups.

The paper begins by noting that the importance of understanding information flows in terms of conflict and cooperation. There is a desire for the companies to collaborate and coordinate so as to be competitive in the global economy, but the companies also have a natural inclination to compete since they also must maintain their own staffs and market shares.

Stevens and Wulf examine what might be considered at first glance a rather simple case of information flows, the kinds of documents necessary to perform maintenance projects by the steel company as well as the two external consulting groups, both of which help with maintenance projects. These consulting groups need the blueprints in the archive to do their work. When the study began, the internal engineering group in the steel company, MeltIt, oversaw the dissemination of the archived blueprints. This arrangement can be cumbersome, however, and the process slowed down attempts to work together.

While the simplest solution might be to give free access to the consulting groups, the paper points out there are confounds. The internal engineers want to maintain control both to preserve their jobs and to not risk leaking proprietary details to competitors. (The consulting groups also serve other steel companies.) This is an important finding, as it is the natural result of economic and organizational conditions and is likely to occur in almost any networked inter-organizational activity. The particulars will be different, but the basic social tension found with MeltIt and its consulting groups, and its effect on information flows, is likely to occur in many settings.

Based on this analysis of the organizational tensions around information flows, Stevens and Wulf go on to offer a technical solution. The solution allows companies to set their access control over documents in a number of flexible ways. The access control can also be set dynamically, so that access can be changed on an

ad-hoc basis as required. This access control formulation was a new contribution to the technical literature.

The paper, by Hinrichs, Pipek, and Wulf, is about another information problem, refinding old documents. Even after access is achieved, there is still the problem of finding documents in a large archive. The paper is similarly constructed to the previous paper. This second paper is based on two case studies. One of these was the same steel plant, MeltIt; the other was a sewage treatment company. An organizational archive can be enormous; the steel plant has an archive of over 300,000 documents. Finding documents within both companies was difficult but for different reasons. The steel company's indexing methods were based on project and location within the plant, but the indices had changed over the course of 100 years. The sewage treatment company's archive was, on the one hand, simpler because the treatment facility is simpler. On the other hand, many separate archives have been kept. The findings point out that indexing is not based in technical issues. Instead, the indexing is based on social considerations - how the engineers worked as well as project management and leadership. The constraints are actually socio-technical, a combination of both social and technical considerations - the constraints of obtaining paper documents and keeping indexing up-to-date with paper.

The Hinrichs, Pipek, and Wulf paper, like the first paper in this section, offers a technical solution based on these social considerations. The authors' system performs "*context grabbing*," the ability to pre-fill indexing terms for new documents and to change indexing terms when the archive's indexing scheme is re-organized. As the paper points out, *"...flexibility has to be complemented by appropriate tools to manage it...."* Yet, that flexibility must also handle the organizational needs. Like the first paper, this paper offers an elegant application to solve a common problem with considerable organizational complexity. Thus, the research reported in the paper again uncovers something that can help in many organizational settings.

A third paper in this section, by Reichling and Wulf, follows the Siegen approach so as to find people with expertise within an organization. The organization supported a regional network to foster a regional economy in Germany. The proposed recommender system was to allow people in the regional organization to find experts within the organization.

The paper that is included in this book is part of a two-paper sequence. The first of the two recommender papers, Reichling and Veith's paper from E-CSCW 2005 (not included here), examined the organizational and social characteristics of the work and information flows within the network organization itself. The second paper, which is included here, examines the design of the recommender system and an evaluation of its use.

The recommender system, based on the findings in the earlier paper, focuses on a problem that is analogous to constructing indexes for documents. Since one needs to find someone with sufficient expertise about a specific topic, expertise recommendation requires profiles of the different potential candidates. The earlier paper uncovered that the regional organization was sufficiently large that its

members would often not know and could not find the proper expert, but speedily finding experts was critical to the success of the regional organization. To find people with expertise, profile statements about each organizational member and their expertise about different topics had to be created. However, since users' desire and ability to fill out detailed profiles, as is their desire to maintain them, are limited, the profiles were constructed by using email and documents to automatically create these profiles.

Putting the system in the hands of potential users and testing it led to a greater understanding of what was necessary in expertise recommendation systems. Some staff members, such as administrators, wrote or handled documents and emails that contained the same keywords as other people who had substantial expertise. These administrators and similar staff members lacked actual expertise about a topic. People with expertise wanted to claim their expertise - and they wanted to make sure that it was correct. The evaluation's major finding was that users wanted to be able to correct and to correct their automatically generated profiles. The design of a workable system could not have been accomplished without the cycle of field study to uncover basic characteristics of the organization, a technical design, and then a further evaluation of the system being used within its context. Again, consideration of how the system can be modified by its users is key. And, while the specific findings were grounded in a specific company, the considerations - especially the need for users to correct and tailor their profiles - is likely to be true for all companies.

Another paper in this section, by Liu, Boden, Randall, and Wulf, is notable because it extends the examination of social context, as seen in the other papers in this section, into cultural issues. Design has become societal in scale. In the larger digital ecologies of systems, fit is no longer bounded within organizations; the connection must be between practices in society overall, bound in their cultural context, and systems. Understanding cultural context has become key to being useful.

The paper examines the use of consumer-oriented mobile devices and applications in China by a particularly interesting group. Many rural people migrated to Chinese urban areas to seek work. As one might expect, they maintain family and community social networks through mobile apps. In addition, however, because of the Chinese residential laws, citizenship is tied to the historical residence of one’s family rather than current location. Workers who come from rural areas and their offspring cannot become true urban citizens. In addition to their work often being long and difficult, they are also denied many common privileges such as education, and they have a diminished status. Yet, the authors these workers - now the second generation of migrant workers - want to seek a higher. Standing as outsiders, these workers can achieve a vestige of status largely in symbolic form: They can buy expensive cell phones and laptops, or upgrade their social media avatars. The migrants’ needs are deeply tied to Chinese cultural context: family, community networks, hierarchical relationships, and tradition.

Introduction to Sustainable Consumption

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One of the great challenges of our time arises from the physical fact that increased CO2 emissions led to global warming. In this context, sustainability refers to efforts to minimize CO2 emissions to avert or at least mitigate climate change, to preserve the foundations of life for future generations. In other words, this means acting today in a way that prevents negative consequences in the future. However, the physical perspective focuses on the consequences, rather than determining who is responsible for CO2 emissions or who needs to contributions to mitigate climate change. In this sense, it is not a physical question only, but a social and political one - and ultimately a question of justice. It is important to understand this normative and ethical dimension when talking about sustainable consumption and the respective design approaches. Two different types of norms and values must be distinguished. On the one hand, the norms and values of the acting persons, which are manifested in the social practices. We can call them also the socially embedded norms. On the other hand, there are exterritorial norms and values of the researcher used to analyze and evaluate the social practices under investigation. By its very nature, the demand for sustainable consumption is linked with a set of norms, values, and justice claims. In many studies on sustainable consumption, however, it is unclear, if sustainability presents an embedded norm of the practitioners or an exterritorial norm of the designers and researcher. From this stance, we can understand sustainable consumption as a lens to study and judge about the everyday consumption practices regarding the challenge to mitigate the climate change. Due to the difference user-centered design must not sustainable-centered design and vice versa. This does not imply that the one is better than the other, but following the notion of value-sensitive design, such conflict of values should be consired (Friedman, 1996).

In line with the above lens, consumption always consists of a symbolic as well as a material level. The symbolic level means making sustainability as a norm visible in or through consumption. An example of this is the so-called Earth Hour, where consumers are asked to turn off non-essential electric lights for one hour to raise awareness and discuss ideas for engaging people on climate change. We also find such symbolic efforts in consumers' everyday lives, for instance, when parents tell their children to quickly close the refrigerator to save the climate. Sustainability also has its own aesthetics, which is for example expressed in the color green, the rejection of blown-up SUVs, or other emblems of alternative lifestyles. This symbolic level should not be misunderstood as being superfluous and purely decorative or even inviting to green labeling. In contrast, it points to the social construction of sustainable consumption - it must be made observable and reportable for all practical purposes. In other words, it must be made accountable in the sense of Garfinkel: "*Look here, this is sustainable*".

Moreover, making it accountable also means making it an object of accounting in terms of measurement, processing, and communication of sustainable information, where the usual currency is CO2 or CO2 equivalents. This also refers to the material level, where we can calculate that a product, a service, a consumption practices or a lifestyle has a particular CO2 footprint. The notion of materiality stresses that the footprint depends on the physical processes of CO2 emission during production and consumption. But besides this output focused measurement the attribution of a footprint also depends on the accounting practices. This can be illustrated by the following thought experiment: A consumer buys a shirt and throws it away after once wearing it. A simple, but straight forward, accounting practice would be to attribute the entire CO2 emission to the one-time-wearing demander. But now someone else takes this shirt and wears it for three additional years. Does this reduce the CO2 footprint of the first consumer? Or is it more equitable if we just define the second consumer's footprint as very low because she rescued the shirt from early disposal?

As we see, the symbolic and material levels are not independent but represent two sides of the same coin. Therefore, we can study sustainable consumption that is perceived as such by the actors themselves, but also when it meets external normative criteria of sustainability. Thereby, the two views must not necessarily lead to the same assessment, which is not solely based on a wrong assessment of the acting consumer. This disparity results from different accounting practices regarding who is responsible for CO2 emissions, what alternative consumption options exist, and to what extent the consumption is necessary.

This social construction of sustainable consumption is often neglected in sustainable HCI (DiSalvo et al., 2010), where it is taken for granted, what sustainable consumption means. In HCI, the primary objective is to motivate, persuade and nudge individual consumers to consume properly. Common design

strategies (Bang et al., 2006; Froehlich et al., 2010; Lockton et al., 2008) are about raising consumers' awareness about the negative impact of consumption, reaching their emotions and guilt, or offering pro-environmental choice architectures.

These approaches can be useful and successful in individual cases. In general, however, the paradigm of persuasive design is considered harmful. By neglecting the social construction at the theoretical level, consumers, who do not change consumption in line with the nudge, appear as awkward, sluggish, and random errors without taking a closer look at their perspective and reasons. In addition, the persuasion lens narrows the design space as it neglects other factors that shape consumption practices such as social norms, political arenas, personal competencies, infrastructures, or the materiality of products and services.

The concept of practice-based consumer studies consists of broadening the perspective on a theoretical as well as on a design level, by studying the consumption from the perspective of the consumers, but also by studying consumer practices from an external sustainability lens. In line with the CSCW tradition, the aim of socio-informatics and practice-based consumer studies is not just the motivation of consumers to act sustainable but to understand and support practices that are more sustainable. The papers collected here address this research program in different ways and in the context of different consumption fields.

In the area of energy consumption, the work of Schwartz, Stevens et al. (2013) describes a study where smart meters serves are used as design probes (Hutchinson et al., 2003). The work analyzes minute-by-minute how consumers use smart metering to make sense of their (wasteful) electricity consumption. The study uncovers the various methods consumers apply to make their consumption accountable. This study also shows that electricity consumption does not represent a unique unit for the consumers but that this unit is weighted in relation to the activity to judge its sustainability. Building on this stance, the work of Schwartz, Denef et al. (2013) observes the appropriation of smart home technologies in a long-term study. Their findings uncover some understudied issues, especially regarding energy literacy and collaborative sense making. Moreover, their study shows that the usages and the meaning of a technology changes over the time. In the beginning there was a high information need to understand the own domestic practices and the respective electricity consumption as well as to understand the sensor technology. After a while, however, this need is satisfied, and usage moves into the background. Still, the device remains part of practices and is repeatedly used in exceptional or new situations.

Lawo et al. (2020) study such appropriation of technology more systematically around sustainable nutrition, especially vegan and plant-based diets. An important parallel to the energy sector is that sustainable nutrition does not present the norm but must be learned and practiced consciously. As Lawo et al. show, meat consumption is not simply an individual choice, but a social practice underpinned

by a value system (where meat means prosperity), a corpus of knowledge and skills (expressed in a variety of cookbooks, recipes, and implicit knowledge on how to cook meat), and infrastructures (manifested by the dominance of the food industry, animal-product-oriented stores, and restaurants). Vegan diets, therefore, involve the transformation and acquisition of new tastes, values, skills, and infrastructures. With the help of narrative interviews with vegans, Lawo et al. trace the role of digital artifacts in the transition of consumer practices. Their participants typically start to reflect on their own consumption in reaction to documentaries and stories about the unethical and unsustainable production of meat. The interviews also show that several artefacts and supportive infrastructures were adopted and used to gain new food competencies and practice veganism. Again, a lot of these artefacts serve an initial information need, while in long-term it is only used in exceptional situations.

Mobility presents the third area for sustainable consumption. Consumers are mobile for various reasons such as commuting to work, meeting friends, going shopping, or simply leisure activities. Thereby, mobility is organized around various modes, such as walking, using the bus, bicycle, or the train. Most of the transport, however, is organized around the car, which emits a high carbon footprint.

Similar to Schwartz, Stevens et al. (2013) investigation on energy accounting practices, Meurer et al. (2019) investigate the effect of eco-feedback on mobility behavior. The goal is not to use eco-feedback as a tool to nudge pro-environmental behavior but use it as a design probe to stimulate the reflection on sustainable mobility. Their findings show that sustainable mobility is not only an individual decision, but also a shared decision that needs collective attention as well as a political action, for example, it shows the consumers where the government is responsible to provide a more environmentally friendly infrastructure.

From a sustainability perspective, we also should understand the demands and practices of non-private car mobility better. From this perspective, Meurer et al. (2014) focuses on the perception of older people of ridesharing. In their work they show that ridesharing is a social practice that is tied to the logic of gift exchange, where a ride is costless but not free. In particular, the study shows that older people have a high need for autonomy and flexibility which must be considered when designing support services. The results are considered by Stein et al. (2017), who design a platform allowing users to retrieve intermodal transportation information. Their goal was to provide an easy-to-use interface that takes the spatial-temporal order of mobility routines into account. In addition, the design concept makes use of the insight that older consumers' mobility activities are often related to participation in events or visiting a point of interest.

It is the old wisdom of cultural studies that one recognizes one's own through the foreign. Comparative ethnographic studies are therefore helpful to understand the socio-cultural context and the dynamic and changeability of social practices. Wulf et al's (2019) study on overland transportation practices in Madagascar is quite interesting for two reasons. First, the ethnographic study reveals opportunities for computer-supported mobility which address the local needs and constraints of a country like Madagascar. Secondly, the study shows how different mobility practices can be different compared to industrialized countries in many different ways.

In contrast to natural science, social practices as the subject of socio-informatics research do not present a static subject but co-evolve with the new technological possibilities. Both consumers and researcher, for instance, are faced with the challenge of figuring out how autonomous driving might affect existing mobility practices in the future. The work of Meurer et al. [REF] as well as Stevens et al. (2019) illustrates different ways to address this challenge designing for and understanding future mobilities. Meurer et al. (2020) conduct a Wizard-of-Oz experiment, where people can use a simulated robo-cab for a week, to get a grip on the appropriation of such service. They figure out that passengers were not passive, but actively monitoring the trip to adjust routes and stops and handle emergency situations. Stevens et al. (2019) focus on the materiality of practices. From this perspective they conduct a co-design study where, in a first step, consumers envision what activities they might conduct in a driverless vehicle and, in a second step, how the car interior should be designed to support these. Their study shows that people tend to prefer mobile offices and camper-like interiors. From this stance, the study raises awareness about two rebound effects: First, a user-centered design might lead to heavier and larger cars in the future and secondly, the option to work on the trip would allow people to save time which could lead to longer commuting distances. To prevent such negative effects, they conclude that other forms of mobility should be investigated beyond the vision autonomous driving.

Altogether, the studies show that sustainability presents a global challenge, yet we cannot hope to find a global answer. Yet, practice-based design means that we must study each consumption field (housing, mobility, nutrition, etc.) in its own and develop concepts for and with the specific socio-material context at hand.

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Uncovering Practices of Making Energy Consumption Accountable: A Phenomenological Inquiry

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Reacting to the discussion on global warming, the HCI community has started to explore the design of tools to support responsible energy consumption. An important part of this research focuses on motivating energy savings by providing feedback tools which present consumption metrics interactively. In this line of work, the configuration of feedback has been mainly discussed using cognitive or behavioral factors. This narrow focus, however, misses a highly relevant perspective for the design of technology that supports sustainable lifestyles: to investigate the multiplicity of forms in which individuals or collectives actually consume energy. In this article, we broaden this focus, by taking a phenomenological lens to study how people use off-the- shelf eco-feedback systems in private households to make energy consumption accountable and explainable. By reconstructing accounting practices, we delineate several constitutive elements of the phenomenon of energy usage in daily life. We complement these elements with a description of the sophisticated methods used by people to organize their energy practices and to give a meaning to their energy consumption. We describe these elements and methods, providing examples coming from the fieldwork and uncovering observed strategies to account for consumption. Based on our results, we provide a critical perspective on existing eco-feedback mechanisms and describe several elements for a design rationale for designing support for responsible energy consumption. We argue that interactive feedback systems should not simply be an end, but rather a resource for the construction of the artful practice of making energy consumption accountable.

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What People Do with Consumption Feedback: A Long-Term Living Lab Study of a Home Energy Management System

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Abstract One of the great societal challenges that we face today concerns the move to more sustainable patterns of energy consumption, reflecting the need to balance both individual consumer choice and societal demands. In order for this 'energy turnaround' to take place, however, reducing residential energy consumption must go beyond using energy-efficient devices: More sustainable behaviour and lifestyles are essential parts of future 'energy aware' living. Addressing this issue from an HCI perspective, this paper presents the results of a 3-year research project dealing with the co-design and appropriation of a Home Energy Management System (HEMS) that has been rolled out in a living lab setting with seven households for a period of 18 months. Our HEMS is inspired by feedback systems in Sustainable Interaction Design and allows the monitoring of energy consumption in real-time. In contrast to existing research mainly focusing on how technology can persuade people to consume less energy ('what technology does to people'), our study focuses on the appropriation of energy feedback systems ('what people do with technology') and how newly developed practices can become a resource for future technology design. Therefore, we deliberately followed an open research design. In keeping with this approach, our study uncovers various responses, practices and obstacles of HEMS use. We show that HEMS use is characterized by a number of different features. Recognizing the distinctive patterns of technology use in the different households and the evolutionary character of that use within the households, we conclude with a discussion of these patterns in relation to existing research and their meaning for the design of future HEMSs.

RESEARCH HIGHLIGHTS

- We developed an own Home Energy Management System (HEMS).
- We rolled out our HEMS system in a living lab setting to seven households over a period of 18 months.
- Our System provides feedback through TV, PC, smartphone and tablet-based interfaces.
- This allowed us to explore ‘what people do with HEMS in daily life’
- We identify and discuss nine meaningful categories of appropriating HEMS
- Based on our results, we discuss potentials for the design of future HEMSs.

Keywords: user studies; empirical studies in interaction design; sustainability

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Going Vegan: The Role(s) of ICT in Vegan Practice Transformation

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Abstract: With the debate on climate change, topics of diet change and the reduction of animal products have become increasingly important in both public and academic discourses. However, sustainable ICT studies have so far focused on individual aspects, in particular investigating the criticized persuasive design approach. We argue for a broader perspective on the role(s) of ICT, one that helps in identifying opportunities to support consumer practice transformation, beyond motivational aspects. Based on retrospective interviews with 16 vegans, we argue to understand practice transformation as co-evolution of practices and ICT artefacts, as this perspective helps to understand how tensions arising from complex entanglements of practices, socio-material contexts, and communities can be resolved. Rather than a motivational process, we observe various roles of ICT artefacts co-evolving with practices: Ranging from initial irritation, to access to information about vegan practices, to the learning of vegan food literacy, to the negotiation of a vegan identity, and vegan norms at the intersection of the 'odd' and the 'norm'.

Keywords Vegan; Practice Theory; Co-Evolution; ICT; Consumer Informatics; Sustainability; Design

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Opportunities for Sustainable Mobility: Re-thinking Eco-feedback from a Citizen's Perspective

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Abstract In developed nations, a growing emphasis is being placed on the promotion of sustainable behaviors amongst individuals, or 'citizen-consumers'. In HCI, various eco-feedback tools have been designed as persuasive instruments, with a strong normative appeal geared to encouraging citizens to conduct a more sustainable mobility. However, many critiques have been formulated regarding this 'paternalistic' stance. In this paper, we switched the perspective from a designer's to a citizen's point of view and explored how people would use eco-feedback tools to support sustainable mobility in their city. In the study, we conducted 14 interviews with citizens who had used eco-feedback previously. The findings indicate new starting points that could inform future eco-feedback tools. These encompass: (1) better information regarding how sustainable mobility is measured and monitored; (2) respect for individual mobility situations and preferences; and (3) the scope for participation and the sharing of responsibility between citizens and municipal city services.

Author Keywords Sustainable mobility; eco-feedback tools; mobile phone data; mobility; interview study.

ACM CCS CONCEPTS Human-centred-computing; Visualization; Empirical studies in visualization.

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Social dependency and mobile autonomy – Supporting older adults' mobility with ridesharing ICT

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ABSTRACT Alternative mobility modes for older adults are increasingly important for economic, ecological and social reasons. A promising option is ridesharing, defined as use of the same vehicle by two or more people traveling to a common destination. In particular, mobile computer supported rideshaing provides a promising way to enlarge older adults' mobility choices in addition to private driving and public transportation options. In order to understand the opportunities and obstacles of ridesharing from the point of view of elderly people, we conducted an interview study in order to examining ridesharing experiences. It turns out that 'mobile independence' and 'decisional autonomy' are key issues for mobile wellbeing. This partially conflicts with common ridesharing concepts. Hence, we further analyze older adults' strategies dealing with these conflicts and show that these strategies offer departure points for the design ridesharing solutions, which are better suited to the demands of older adults.

Author Keywords: Dynamic Ridesharing, Elderly, Design, Ethnography, Social Experiences.

ACM Classification Keywords: Human Factors, Design.

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Mobility in Later Life – Appropriation of an Integrated Transportation Platform

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Abstract We present the results of a design case study focusing on supporting the daily transportation of elderly in Germany. We conceptualized, developed and studied the appropriation of a transportation information system intended to ease switching between different transportation modes. Based on a literature review and a context study with 21 interviews we explored routinized transport mode usage and barriers when switching between modes. Iteratively, we co-designed a transport platform accessible via a website, a mobile app, and an iTV app. We further looked at the appropriation of the platform into the daily lives of 19 persons. Studying the appropriation highlighted different factors that facilitate the adoption of alternative transport options. The factors included reducing uncertainty, complementing transport information with context information (e.g. weather) and providing informational access based on the user's preferences as well as fitting in with the situational needs (activity related).

Author Keywords: Transportation; Mobility; Elderly; Participatory Design; Qualitative Research

ACM Classification Keywords H.5.2 User Interfaces - User-centered design

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Travelling by Taxi Brousse in Madagascar: An Investigation into Practices of Overland Transportation

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Abstract Organising public mobility is a global challenge. However, most studies directed at ICT support approach the subject from the perspective of developed countries. In contrast, we conducted a modest and initial attempt to study practices of public transportation in Madagascar – one of the poorest countries in Africa. We found that central assumptions, usually unquestioned in prevailing studies, were challenged in the context of this developing country. We present an empirical study which analyses how collective taxis, locally called Taxi Brousses, are used in overland travel. The study reveals complex socio-political conditions which passengers face in this country. Security as well as corruption issues shape these transportation practices. Based on our findings, we indicate opportunities for supporting intra-organisational cooperation and the customers' interaction with ICT artefacts.

Using Time and Space Efficiently in Driverless Cars: Findings of a Co-Design Study

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ABSTRACT The alternative use of travel time is one of the widely discussed benefits of driverless cars. We therefore conducted 14 co-design sessions to examine how people manage their time, to determine how they perceive the value of time in driverless cars and to derive design implications. Our findings suggest that driverless mobility will affect both people's use of travel time as well as their time management in general. The participants repeatedly stated the desire of completing tasks while traveling to save time for activities that are normally neglected in their everyday life. Using travel time efficiently requires using car space efficiently, too. We found out that the design concept of tiny houses could serve as common design pattern to deal with the limited space within cars and support diverse needs.

ACM CCS CONCEPTS Human-centered computing - HCI design and evaluation methods; Human-centered computing - Interaction design

KEYWORDS Self-Driving Cars; Value of Time; Car Interior Design; Co-Design; Design-Fiction

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A Wizard of Oz Study on Passengers' Experiences of a Robo-Taxi Service in Real-Life Settings

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ABSTRACT Autonomous driving enables new mobility concepts such as shared-autonomous services. Although significant research has been done on passenger-car interaction, work on passenger interaction with robo-taxis is still rare. In this paper, we tackle the question of how passengers experience robo-taxis as a service in real-life settings to inform the interaction design. We conducted a Wizard of Oz study with an electric vehicle where the driver was hidden from the passenger to simulate the service experience of a robo-taxi. 10 participants had the opportunity to use the simulated shared-autonomous service in real-life situations for one week. By the week's end, 33 rides were completed and recorded on video. Also, we flanked the study conducting interviews before and after with all participants. The findings provided insights into four design themes that could inform the service design of robo-taxis along the different stages including hailing, pickup, travel, and drop-off.

Author Keywords Robo-taxi; Shared Autonomous Vehicles; Wizard of OZ; Service Design; Passengers.

CSS CONCEPTS Human-cantered computing -Human computer interaction (HCI); Empirical Studies and Interaction design

Comments on Sustainable Consumption

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One of the great challenges of our time is how we can live within the limits of the earth and its resources and natural cycles. The papers in this section address various aspects of this challenge.

"Sustainability" is a complex, multi-faceted, and contested concept, but certainly includes living within those limits. It should also include societies and economies that let us prosper within those limits, thus linking with the conception of sustainability as having three pillars: social, economic, and environmental (Purvis et al. 2019). The term "consumption" reminds us that humans need to consume materials and energy to survive and hopefully thrive. The term often has negative connotations as well (e.g., "consumerism" or "overconsumption"). However, if we are to exist at all, we humans do need to consume materials and energy, hopefully in a way that falls within the earth's limits, and that doesn't undermine the needs of others – including future generations – in the process.

Turning now to the papers in this section, the bulk of these papers concern personal mobility. This is certainly fitting, since personal mobility touches on all three sustainability pillars. For example, on the environmental side, private autos are a significant contributor to CO_2 emissions. Economically, people depend on personal mobility to get to work, school, recreation, and so forth; and of course transportation is a key economic sector. Socially, too, personal mobility is an essential element of people's functioning in society.

Two of the papers concern personal mobility for older adults. Rather than focusing on just logistical and infrastructure considerations, the papers take the user's perspective: what are the obstacles and opportunities for using different sorts of transportation, and what are the key values at stake for them. The earlier paper

(Meurer et al. 2014) focuses on ridesharing. It presents the results of an interview study, which highlight opportunities to use ICT to help support ridesharing, and in particular how such systems might help address the value tensions between independence and autonomy (key values for the users) and the pragmatics of ridesharing. It also presents ridesharing as a social practice that is seen as a kind of gift exchange. The later paper (Stein et al. 2017) presents a design case study with a transport platform (available on a mobile app and elsewhere) and its appropriation. Here are some important features of the approach taken: design and testing in a "living lab" that provides a natural setting; focus on the user's perspective and values (again, independence and autonomy being key values); and linking the mechanics of getting from A to B with other considerations, such as the social aspects (meeting people while underway), the availability of toilets, restaurants at the destination, and so forth.

Another pair of papers focus on driverless cars. Meurer et al. (2020) describes an innovative wizard-of-oz study of riders' experiences with an autonomous taxi service using electric vehicles, simulated by having a human driver hidden behind a curtain and with simulated voice interaction. The principal results are a set of design themes that could inform the design of robot taxis for the different stages of a ride (hailing, pickup, during travel, and drop-off). The paper also does a good job of connecting with the theme of sustainable consumption. On the positive side, this includes the potential for greatly reducing the number of cars needed in a city, and (given the use of electric rather than internal combustion engines) significantly reducing greenhouse gas emissions. On the negative, this may include rebound effects, and mode shifting from public transport to (personal) autonomous vehicles. The second paper in this set (Stevens et al. 2019) presents results from a co-design study on features and layout of driverless cars, to let them make the most use of travel time, which in turn requires that they use car space efficiently as well. The designs could support the car as a mobile office, as a place for relaxation or sleep, as a mobile restaurant, and entertainment venue. On the one hand, this seems likely to be the future of autonomous vehicles, absent strong regulation or economic shifts. On the other, the implications for sustainable consumption are very negative. Personalizing a car to be like a tiny home means that it would likely be a personal rather than a shared resource; and by making it increasingly comfortable and efficient, we are likely to see increased use. Even major traffic jams, which otherwise might serve as incentives for example to take rail instead, lose some of their influence, since the time stuck in traffic becomes just office or home time rather than wasted.

The paper by Meurer et al. (2019) tackles the issue of sustainability and personal mobility directly, by presenting the results of an interview study regarding eco-feedback tools for personal travel. Early HCI work on sustainability had a focus on personal eco-feedback tools; this was subsequently criticized as focusing too much on individual behavior and choice, and also as being overly paternalistic. The Meurer et al. paper changes perspective from that of the designer to that of the citizen, and presents some thought-provoking findings regarding eco-feedback

tools, e.g., some of the feelings they reported in reaction to quantitative feedback on CO_2 emissions: "insecure," "irritated", "helpless"; and the distinctions between individual and shared responsibility. I also appreciated the attention to the different values at play and tensions among them, and to moving beyond general normative appeals ("be sustainable!") toward tools that integrate with people's real experiences and daily activities.

"Travelling by Taxi Brousse in Madagascar: An Investigation into Practices of Overland Transportation" (Wulf et al. 2018) presents a study of a very different transportation environment, in the Global South rather than in Germany. In addition to a series of fascinating stories and observations, the paper presents a set of ideas for making further use of ICTs in this sort of environment, including real-time information and vehicle tracking, assistance in finding taxis, mobile banking (both for convenience and also driver safety), and data transfer among the different parts of the taxi cooperative. I was struck with the efficiency with which the collective taxis were used (no wasteful unoccupied seats here); and also the challenges, for example bandits or infrastructure in bad repair – and the resourcefulness with which the drivers and passengers dealt with them.

There are also two papers on feedback and accountability for home energy consumption (Schwartz et al. 2013, Schwartz et al. 2014). As with the transportation work, these emphasize theoretically grounded, practice-based empirical work -- the first paper reports on a 4 month study with 16 households, while second paper reports on a much longer (18 month) study with 7 households, both in a living lab setting. They emphasize what people can do with interactive feedback technology – how they understand it, how they can incorporate in lived experience – rather than on tools that are part of a rationalistic paradigm that stresses efficient and rational decision-making. I was struck in particular by the distinction made by the study participants between useful and wasted energy consumption. From the standpoint of simply reducing consumption, it doesn't matter whether a kilowatt-hour of electric energy is used for some essential household activity or whether it is just wasted because someone left an appliance running when not in use – but it clearly *does* matter in terms of connecting with people's views and values, and their motivations for using and acting on the feedback.

Finally, the paper by Lawo et al. (2020), "Going Vegan: The Role(s) of ICT in Vegan Practice Transformation," concerns a quite different but also important topic for sustainable consumption, namely food. It takes an important perspective, namely by interviewing participants who have successfully adopted a vegan diet. The paper emphasizes the co-evolution of practices and artefacts, taking place over multiple iterations. Further, ICT is used not just for initial motivation, but to support long-term transformation of practices of consumption. There is an interesting analysis of artefacts as "irritants" in the initial stages of becoming vegan, echoing a theme in the paper about eco-feedback tools for personal mobility. Later, though, the tools foster ongoing learning and mutual support. It does seem like the perspective in this paper – interviewing participants who have successfully

transitioned to a more sustainable lifestyle – could be usefully taken in the personal mobility space as well. One can envision a useful paper that presents the results of interviewing people who have successfully transitioned to a car-free life, for example: what helped them in the early stages of doing that, and what kinds of ongoing support are useful, and how could that support co-evolve with practice? In both cases, another useful study would involve a focus on people for whom the practice didn't work out (either trying unsuccessfully to be car-free, or at least with much reduced auto usage; and trying to become vegan but not succeeding).

A final comment: several of the papers take a critical perspective on persuasive technology. It seems like there is room for additional theoretical work on this topic, building on what we might call the "Siegen Approach." Other authors (e.g., Berdichevksy and Neuenschwander 1999, Atkinson 2006) have applied an ethical lens to persuasive technology. Berdichevksy and Neuenschwander propose eight ethical principles of persuasive design, including "Persuasive technologies must not misinform in order to achieve their persuasive end" and "The Golden Rule of Persuasion: The creators of a persuasive technology should never seek to persuade a person or persons of something they themselves would not consent to be persuaded to do." These ethical commitments seem essential as starting points, but the papers in this chapter suggest additional criteria so that the persuasive technology is acceptable and useful in people's lived lives. For example, it should connect with what is important to the participants and not be paternalistic. Initially, it might be useful for the feedback to be an "irritant" (to use a word that came up in several papers) that motivates change. However, this doesn't seem sustainable in the longer term – people will reject it. We could frame this in terms of values and apply value sensitive design techniques: where the underlying values here might include respect, autonomy, and (in the longer term) congeniality.

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Introduction to “Crisis Informatics”

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1 Introduction

People all over the world are regularly affected by disasters and emergencies. In November 2013, typhoon Haiyan killed approximately 10,000 people and forced nearly one million people to leave their homes. One year earlier, in October 2012, hurricane Sandy turned New York into a disaster area. Approximately 18 months earlier, the 2011 tsunami in Japan, triggered by the Tohoku Earthquake, cost nearly 16,000 lives and half a million people had to be accommodated in temporary shelters. If we look at current climate developments and associated disasters such as drought, floods and severe weather events, it quickly becomes obvious that the appropriate management of such crises has a crucial role to play. In addition to natural disasters, mankind is often confronted with man-made disasters such as wars or terrorist attacks. Especially in the aftermath of 9/11, a multitude of funding programs were established on an (inter)national level to conduct research within the area of civil security.

Research within this field of tension is known as “Crisis Informatics”, which was defined as an inter-disciplinary call for research by (Palen, Vieweg, Sutton, Liu, & Hughes, 2007). Following their definition, crisis informatics “includes empirical study as well as socially and behaviorally conscious ICT development and deployment” (Palen et al., 2007). In this context, the structures and work practices that have evolved over many decades must be explored and their influence on information technology, and vice versa, must be examined and suitably supported.

When dealing with emergencies and disaster situations, a variety of official organizations is involved. They consist of the public authorities with security

responsibilities, such as professional emergency services (e.g. police, firefighters) or the public administration as well as different private, national and international aid organizations, and operators of critical infrastructures. Most of the authorities have developed well-established responsibilities and work practices, which are prescribed by laws and regulations. During emergencies and disasters, a significant degree of collaboration between the involved stakeholders is often required. Although organizations have developed systematic approaches to deal with these uncertainties and to allow for planned, coordinated activities during crises (Ley, Pipek, Reuter, & Wiedenhoefer, 2012), the scale of disasters such as Hurricane Kyrill 2007, the Love-Parade in Duisburg 2010, the earthquake and tsunami in Japan 2011, Hurricane Sandy in the USA 2012, or the European Floods 2013 can be so extensive that the relevant organizations can be overwhelmed simply by the number of tasks to be performed. Therefore, understanding and analyzing the complex work processes in practice to determine socio-technical design spaces is crucial.

On the other hand, the recent disasters have shown that in addition to official crisis management through professional emergency services, citizen-based crisis management, often characterized by situated altruism, is a common behavior (Dynes, 1994). However, the individual getting together to form temporary groups for improvised relief and rescue activities is hardly a new phenomenon (Stallings & Quarantelli, 1985; Wachtendorf & Kendra, 2006). Emergent citizen groups are not inherently in opposition to the public authorities with security responsibilities. However, emergency services often did not planned for the emergent behavior and therefore cannot 'control' as well as manage the groups during disaster events (Stallings & Quarantelli, 1985). How to identify, integrate and manage emergent on-site as well as online activities into the official work practices in time-critical and uncertain situations is challenging.

Looking at the field of crisis informatics over the last two decades, two major methodological approaches have emerged. On the one hand, several approaches focus on a rather retrospective analytical studies of behavior with respect to information, communication, and cooperation as well as technology usage during and after emergency situations. These studies often include analytical studies of social media (e.g. the Twitter-based information distribution during floods (St. Denis, Palen, & Anderson, 2014) as well as qualitative on-the-ground studies about the practices within emergency management (e.g., the use open street map in the aftermath of earthquakes (Soden & Palen, 2014)). On the other hand, some approaches have a prospective design claim and focus on IT-based interventions within the current practices of crisis management before, during and after emergencies. Such studies primarily involve the design of new systems to support crisis management.

The socio-informatics research approach, as represented by IISI and our Siegen research group focuses on practice-based crisis management and combines the

analytical and design currents. The retrospective analyses of behavior during a disaster serve primarily to inform possible design challenges as well as implications and to examine the later appropriation of designed technologies in practice. The work focuses on a number of relevant aspects within crisis management. For example, supporting emerging self-help communities during disasters as well as information distribution and technology use within affected populations, supporting professional emergency services practices through the design and implementation of new technologies, and examining and designing interfaces between professional emergency services as well as affected populations.

We took our first steps in researching crisis management back in 2006 within the project "Störfallkommunikation – Pro-Aktives Kommunikationsmanagement für den Störfall" (Incident Communication - Pro-Active Communication Management for Incidents) where new possibilities for customer communication in the event of an incident at a large energy provider were investigated. In particular, we examined which communicative measures and actions can be taken to inform and support those affected by power outages. Based on this first project, two major research strands emerged. One is the study of the internal coordination and work practices of professional organizations and their technological support (e.g. Landmarke 2008-2011 and Koordinator 2012-2014) and the other is the study of inter-organizational collaborative relationships and their technological support (e.g. InfoStrom 2010-2013, EmerGent 2014-2017, KOKOS 2015-2018).

Within the first strand, (Ramirez et al., 2012) investigated how firefighters perform indoor navigation (e.g. during a house fire) and what challenges currently exist. Based on an analysis of the practices, they designed an ad hoc ubicomp infrastructure to support navigation of firefighters inside the zone of danger. To design the technology, Ramirez at al examined the development of effective navigation practices based on technology available and outline a concept that encompasses ubiquitous technologies for supporting navigation during the operation. The technology involved suspending small beacons so that responders could track which rooms had already been entered and which still needed to be investigated.

Based on these findings of the Landmarke project, it quickly became clear that ubiquitous technology could be used not only for indoor navigation but also for communication of the emergency units. Thus, (Betz & Wulf, 2014) designed new technologies based on the beacons, which allowed text-based messages through integrated sensors and mini-computers. These messages were automatically sent to the other units. Through an extensive practical evaluation within the official training centers of the fire departments, the prototypes were refined, so that they finally found their way into the actual practice of the fire departments as "smart door wedges".

In parallel, (Ludwig, Reuter, & Pipek, 2013) examined how different emergency response organizations within the control centers communicate with teams on-site to generate necessary information for the coordinating instances. They implemented a mobile application that supports the communication between control centers and on-site units by a semi-structured request-and-report concept. Based on its evaluation, they show that the accuracy of request and reports can be improved by using an appropriate metadata structure in addition to creating multimedia-based information content and that requirements of trusted and fast information need to be respected in support concepts although they may even be contradictory.

Within the second strand, (Ley et al., 2014) focused on the inter-organizational crisis management by examining different organizational cultures, distinct individual and coordinative work practices and discrete information systems of organizations involved in crisis management. They detailed the collaboration practices between organizations and public authorities with security responsibilities such as the police, fire departments, public administration and electricity network operators, mainly in scenarios of medium to large power outages in Germany. Based on these results, they designed a system that supports inter-organizational situation assessment as well as inter-organizational collaboration functionalities.

(Ludwig, Reuter, Siebigteroth, & Pipek, 2015) examined within the KOKOS project how non-professionals can organize themselves and coordinate private relief activities during crisis situations. These activities can be found in physical groups of affected people, but also within digital social media communities. Through a large empirical analysis of current practices, coordination mechanisms between professional and non-professional actors within crisis management were elaborated and a system was implemented to structure and integrate activities from the population into the official crisis management by facilitating the detection of physical and digital activities and assigning specific tasks to citizens.

Based on these initial findings, (T. Ludwig, Kotthaus, Reuter, Dongen, & Pipek, 2017) investigated how to support the various on-site tasks of volunteers and spontaneous helpers in emergency situations. To gain insight into actual coordination practices, an empirical study with 18 different stakeholders involved in disaster management was conducted. Based on the findings, a physical public display was implemented to coordinate the located on-site tasks through situated crowdsourcing mechanisms. Practical evaluations at the Kieler Woche (one of the largest festivals in Germany) as well as at the Kirchentag (church congress) have identified requirements for the long-term use of such technologies to coordinate unbound helpers.

Current projects (e.g. REALIS 2021-2022) aim to combine the concepts and technologies already developed in past projects and roll them out as a large-scale

infrastructure for preventing and responding to disaster events within the entire. This shows the social implications that practical research can have.

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Landmarke: an ad hoc deployable ubicomp infrastructure to support indoor navigation of firefighters

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Abstract Indoor navigation plays a central role for the safety of firefighters. The circumstances in which a fire- fighting intervention occurs represent a rather complex challenge for the design of supporting technology. In this paper, we present the results of our work designing an ad hoc ubicomp infrastructure to support navigation of fire- fighters working in structure fires inside the zone of danger. We take a wider approach, complementing the technical questions with the development of effective navigation practices based on technology available today. We provide an overview of the complete design process, from the theoretical and empirical underpinnings to the construction and evaluation of three iterations of the platform. We report the results of our evaluation and the implications and tensions uncovered in this process, and we discuss the challenges and implications of it for the design of ubicomp for firefighters.

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EmergencyMessenger: A Text based Communication Concept for Indoor Firefighting

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Abstract Finding and rescuing missing or injured people or fighting fire inside burning buildings is a central challenge for fire brigades. To ensure the safety of indoor work, monitoring the operations of firefighting units is crucial. As in most countries, firefighters in Germany utilize radio sets to establish voice communication between indoor operating units and the supervisory structure outside. Based on findings from a long term ethnographic study in cooperation with different German fire brigades over a time span of more than 5 years we analyzed the advantages and disadvantages of the current voice over radio communication tactics and techniques. We designed and evaluated a complementary text based communication device-the EMERGENCY- MESSENGER-to support the time critical work of indoor units working under harsh conditions, wearing Self- Contained-Breathing-Apparatus (SCBA). We conducted 13 full scale training missions including extensive debriefings to design and evaluate the communication concept and the corresponding device.

Author Keywords Firefighting; communication; cooperation; text; messaging; indoor; monitoring; autonomy; safety; security
ACM Classification Keywords H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

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Information and Expertise Sharing in Inter-Organizational Crisis Management

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Abstract Emergency or crisis management, as is well-attested, is a complex management problem. A variety of agencies need to collaborate and coordinate in real-time and with an urgency that is not always present in other domains. It follows that accurate information of varying kinds (e.g. geographical and weather conditions; available skills and expertises; state-of-play; current dispositions and deployments) needs to be made available in a timely fashion to the organizations and individuals who need it. By definition, this information will come from a number of sources both within and across organizations. Large-scale events in particular necessitate collaboration with other organizations. Of course, plans and processes exist to deal with such events but the number of dynamically changing factors as well as the high number of heterogeneous organizations and the high degree of interdependency involved make it impossible to plan for all contingencies. A degree of ongoing improvisation, which typically occurs by means of a variety of information and expertise sharing practices, therefore becomes necessary. This, however, faces many challenges, such as different organizational cultures, distinct individual and coordinative work practices and discrete information systems. Our work entails an examination of the practices of information and expertise sharing, and the obstacles to it, in inter-organizational crisis management. We conceive of this as a design case study, such that we examine a problem area and its scope; conduct detailed enquiries into practice in that area, and provide design recommendations for implementation and evaluation. First, we will present the results of an empirical study of collaboration practices between organizations and public authorities with security responsibilities such as the police, fire departments, public administration and electricity network operators, mainly in scenarios of medium to large power outages in Germany. Based on these results, we will describe a concept, which was designed, implemented and evaluated as a system prototype, in two iterations. While the first iteration focuses on

situation assessment, the second iteration also includes inter-organizational collaboration functionalities. Based on the findings of our evaluations with practitioners, we will discuss how to support collaboration with a particular focus on information and expertise sharing.

Author Keywords Information management, Expertise sharing, Collaboration, Design case study, Inter-organizational crisis management, CSCW

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What You See Is What I Need: Mobile Reporting Practices in Emergencies

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Abstract Decisions of emergency response organisations (police, fire fighters, infrastructure providers, etc.) rely on accurate and timely information. Some necessary information is integrated into control centre's IT (weather, availability of electricity, gauge information, etc.), but almost every decision needs to be based on very specific information of the current crisis situation. Due to the unpredictable nature of a crisis, gathering this kind of information requires much improvisation and articulation work which we aim to support. We present a study on how different emergency response organisations communicate with teams on-site to generate necessary information for the coordinating instances, and we described, implemented and evaluated an interaction concept as well as a prototype to support this communication by a semi-structured request-and-report system based on Android devices. We learned that (1) the accuracy of request and reports can be improved by using an appropriate metadata structure in addition to creating multimedia-based information content, (2) requirements of trusted and fast information need to be respected in support concepts although they may even be contradictory, and (3) the coordination strategy of the emergency response organisation also shapes the way this interaction needs to be designed.

Proceedings of the International Conference on Human Factors in Computing Systems (CHI), Bo Begole, Kim Jinwoo, Inkpeni Kor, Woo Woontack (Hrsg.), 4083-4092, New York, USA: ACM Press, pdf

CrowdMonitor: Mobile Crowd Sensing for Assessing Physical and Digital Activities of Citizens during Emergencies

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Abstract Emergencies such as the 2013 Central European flood or the 2013 typhoon Haiyan in Philippines have shown how citizens can organize themselves and coordinate private relief activities. These activities can be found in (physical) groups of affected people, but also within (digital) social media communities. There is an evident need, however, for a clearer picture of what exactly is going on to be available for use by the official emergency services: to enlist them, to keep them safe, to support their efforts and to avoid need- less duplications or conflicts. Aligning emergency services and volunteer activities is, then, crucial. In this paper we present a mobile crowd sensing based concept, which was designed as well as implemented as the application CrowdMonitor and facilitates the detection of physical and digital activities and the assignment of specific tasks to citizens. Finally we outline the findings of its evaluation.

Author Keywords Emergency Management; Crowdsourcing; Mobile Crowd Sensing; Social Media; Design Case Study
ACM Classification Keywords H.5.3 Group and Organization Interfaces

Introduction to “IT, Health and Ageing”

Claudia Müller

Recent demographic changes in Europe such as increasing life expectancy and reduced birth rates will have major impacts on age structures. The number of people aged 80 and over will have doubled by 2025; yet at the same time, the availability of workers in the care sector will be drastically reduced (European Commission 2015a). In its program ‘Innovation for Active & Healthy Ageing’, the European Commission faces these challenges for the future, attributing information and communication technology (ICT) a major role in the development of innovative solutions for preventive and curative measures. ICT is seen as a major driver for quality of life and everyday support increasing the agency of older adults in their everyday lives (European Commission 2015b).

In the past decades, a lot of funding has been spent on the development of new digital solutions supporting quality of life and care of older but few innovations have found their way into commercial products for older target groups thus far (Chung et al. 2016). Research on barriers of technology acceptance is abundant and diverse, with a major reason being seen in belated and inadequate user involvement (Mort et al. 2015). As a result, innovations too often do not address real user needs and their every-day practices and challenge daily routines (Fitzpatrick & Ellingsen 2013). R&D project lack a deeper understanding of cultural values and psycho-social needs and thus do not fit into everyday practices and cannot become embedded into the social worlds they were designed to become part of (Procter et al. 2016). The early and consistent integration of end-users is therefore increasingly seen as a mandatory requirement for product innovation and development. European and German funding programs have been adapted accordingly, launching research policies which aim at designs which follow a more integrated real-world perspective fostering co-creation and participatory research and design, which put the inclusion of primary, secondary and tertiary end-user groups at the forefront. However, its implementation is demanding and often hesitantly implemented (Rodriguez et al. 2013, Stubbe 2018).

The socio-informatics research approach, as represented by IISI and the Siegen research group, has successively adapted principles of practice- and human-oriented research to "*sensitive settings*" (Hamidi et al., 2016). On the basis of the PRAXLABs concept developed by the Siegen socio-informatics group (Ogonowski et al. 2018, Müller et al. 2014), long-term research engagements with representatives of local user groups have been adapted in specific ways to accommodate for acknowledging mundane everyday life worlds of those who often

are overlooked in technology development. Specific adaptations have been made to involve the target groups in the design of technology where their practices take place - that is, in their homes and neighbourhoods, but also in work and living environments of care homes and in specific housing arrangements of older adults. In the design for particularly vulnerable groups, such as people with dementia or caring relatives, the Siegen-based socio-informatics department has successively reflected ethnographic and participatory research methods in home and inpatient living contexts in order to better understand how those affected and their familial and professional caregivers deal with chronic illnesses and particularly severe physical and cognitive losses in their everyday lives (Carros et al. 2022, Unbehaun et al. 2021).

A particular challenge for practice-based design is to trace the practices and ways of dealing with chronic physical and cognitive illnesses, such as dementia, and how these are embedded in treatment regimes. Wan et al. (2016) demonstrate how the evaluation of possible IT-related interventions depends on attitudes of what is considered the goal of "good" dementia care or "good care" in more general terms. Ethnographic studies in our first funded project "Alzheimer Monitoring" (2019-2011, BMWi) detected two major competing guiding principles in dementia care: a bio-medical approach and a person-centred approach to the treatment and care of persons with dementia. Both guiding principles could be found in dementia care settings in institutions and in homecare contexts. Both imply very different types of design requirements for digital support. A monitoring system can then appear in different ways – as an electronic ankle bracelet for monitoring the whereabouts of a person or, in contrast, as a digital means which enhances the autonomy of a person. Both configurations depend on the respective level of knowledge of current nursing theories among the caregivers (Wan et al. 2016).

This finding had far-reaching consequences for us in reflecting on the positioning of informatics within interdisciplinary research projects in the field of health and aging. On the one hand, it became very clear that we had to reconsider and possibly enhance the previously well-founded research approaches of socio-informatics, such as participatory design (Joshi and Bratteteig 2015) and appropriation support (Pipek & Wulf 2009) for research fields in "sensitive settings" (Hamidi et al. 2016).

On the other hand, it became extremely important to confront our own normative notions and those we found in each project. It became particularly important for our research in the field of "health & ageing" to offer negotiation spaces for participating stakeholder groups, such as the affected persons themselves and their informal and professional caregivers. Offering spaces for negotiation, learning and exploration for all groups involved in a research project proved to be particularly important but also challenging in settings where technology still strongly points to the future, such as in many robotics projects for care that were and are currently

being carried out in our group (Carros et al. 2022, Paluch et al. 2022, Unbehaun et al. 2021, 2020).

Wan et al. (2016) and Unbehaun et al. (2020, 2021) are representative of a number of research projects in Siegen that deal with *methodological and conceptual challenges in sensitive settings* for which little differentiated knowledge is yet available in informatics contexts. This also applies to questions regarding the support needs of caring relatives of people with serious chronic illnesses who are cared for at home. Schorch et al. (2016) describe this group of people as a group that is too often neglected in health-related IT development contexts. All research efforts in the highly sensitive contexts described entail that classic user-centred design methods such as creative methods, interview or group-based methods must be subjected to thorough reflection. Schorch et al. (2016), demonstrate the importance of proceeding very cautiously and developing a possible design perspective step by step together with the people concerned. The role of the researcher also receives special attention, as s/he often experiences stressful situations as a listener and thus builds up a special form of closeness to the participating families. The "*user-designer relationship*" is thus given a charge that needs to be reflected upon in a particularly determined way (Hamidi et al. 2016).

This is in stark contrast to rather static procedural models within technology development, such as the Technology Acceptance Model (TAM) (Venkatesh and Davis 2000), or user research that is predominantly defined in terms of usability aspects, which are criticised for ignoring socio-cultural contexts and thus forcing serious undesirable developments (Vines et al. 2015, Procter et al. 2016). To address the unique challenges of researching, co-designing and implementing IT applications in the "health & ageing" domain, the group drew out a number of distinct findings using the Design Case Studies framework (Müller 2014, Wulf et al. 2015, Meurer et al. 2018). One such challenge is how to deal with the great heterogeneity and diversity of the 50+ social group in design contexts. The group of “older people” is rarely sufficiently taken into account in development projects and technology is predominantly developed in a top-down manner instead of orienting technology development towards meaning-making processes by means of recognising and researching individual preferences, needs and interests of older people (Procter et al. 2016).

Long-term ethnographic and action research-based studies with older people were conducted to explore and formulate the requirements and conditions for success of participatory design of socio-technical infrastructures to promote social participation of older people. For the joint work between researchers and older study participants, the concept of "*Experience-based Participatory Design Workshops*" (EbPDW) has been developed, which involves a special form of coupling ethnographic and action research methods (Müller et al. 2015b, Hornung et al. 2017). The concept aims at identifying the (possibly stereotypical) views, ideas and

practices that researchers incorporate into the design of technologies for everyday home and health support tools (Vines et al. 2015). However, how participation is concretely conceived and practised in research projects, and which modes of participation of older people with only a low level of media affinity and competence are applied and also critically reflected upon, is seen as a topic that has so far been dealt with in an under-complex manner. Compagna (2018) has worked out that participation of older people is often more lip service than lived project reality in IT design projects. Accordingly, an important research interest is the question of the possibilities and limits of establishing cooperative relationships "*at eye level*", taking into account practices in dealing with (self-)images of age(ing) by older people as well as by scientists working in design.

On the one hand, the empirical results confirm that the research and development of ageing technologies is charged with deficit-oriented images of age. However, our studies also show that not only designers (researchers/developers, caregivers) configure potential users and enrol them in technical programmes. They also trace how older people self-affirm, position and locate themselves as potential technology (non-)users (Hornung et al. 2017). In this way, older users also project themselves onto technology, adopt guiding images of technology and images of ageing which guide them in their appropriation processes, in their interest and motivation or also in their rejection of digital media.

Precisely because IT research for support in old age or illness is so heavily socially charged and produces certain images and ideas, the question of appropriation support must be considered as early as access to the field and in light of social debates and institutional frameworks.

Participatory Design thus requires extensive attention to factors that enable people to participate in design projects, i.e. work which supports *"enabling for co-design"*. This means that co-design projects with older and technology-distant groups of people must give a lot of space to the aspect of learning and the acquisition of digital competence. Digital literacy and digital sovereignty are areas of research that have always been part of Participatory Design, but which need to be emphasized and taken into account in a much more determined way. With the concepts of *"situated scaffolding"* we have pursued initial approaches here (Cerna & Müller 2021, 2022).

Situated scaffolding addresses "enabling for co-design" but also points beyond the timeframe of a defined research project with questions about how design outcomes can be sustainably embedded in local communities.

The question of how IT design projects can be implemented in a sustainable manner establishes another major research interest of the Socio-Informatics Group (Simone et al. 2022). We have identified specific aspects for the research area of IT support for aging societies (Meurer et al. 2018). One challenge are current trends in research that are difficult to implement at the practice level. For example, there is

an increasing demand in funding programmes for participatory procedures with the requirement to closely involve local user groups and organizations in order to achieve a higher level of practice orientation and to trace change processes through the IT systems introduced. This creates high dependencies, new usage practices and routines. So far, however, there are hardly any answers to the question of what is to be done with them after the end of the project. What is to be done, for example, if older people have achieved improvements in the way they live their lives with IT products, but they will hardly be able to continue doing so after the project ends and without the support of the researchers? What happens to the organisations and end-user groups that have embarked on an intensive learning journey with us?

We have noticed that especially people who are not so "*tech-savvy*" still need some support and they still need contact persons to be able to continue using the technology in their everyday lives. Challenges here are often the language/terms (English terms), but also the continuous change and further development of the digital applications themselves. All these challenges lead us socio-informaticians to new research questions or to a new perspective on (participatory) research: among other things, questioning the role of researchers in local settings: is it not also our role as researchers, instead of looking at our "*research subjects*" from a bird's eye view, rather to jointly formulate research questions about how we would like to live in the future? Then the role of research is also one of a facilitator, a mediator or a bridge builder. A changing perspective is needed from joint work with local organisations (e.g. care/medical providers, neighbourhoods/municipalities, associations, etc.) to consolidate sustainable research alliances that deal with the digital transformation at local level in the long term.

The need for sustainable implementation is particularly evident in research projects for rural areas: In order to support older people in their social participation, mobility and health care with digital products and infrastructures, it is important to recognize the social structures in rural areas and to involve many different stakeholder groups. However, it is particularly challenging to even reach the groups of people for whom the benefits of IT support are particularly formulated; the old, withdrawn ones who have had little contact with digital media, the so-called *"hard to reach"*. To get these groups of people interested in possible ways of using IT products, we took a special approach with off-the-shelf technology. By implementing a church camera and a registration system in a local family doctor's practice, we were able to open up spaces for exploring digital community-based applications and making them discussable by all stakeholder groups (Struzek et al. 2020). This strand of research is concerned with rather 'mundane' technologies which may support community development and mutual awareness and as such build a fruitful ground for the build-up of community-based support structures. We have recently pursued concepts of living well for older people in rural areas with the help of IT in the "Caring Community Living Labs" (SNF 2019-2022) project,

which closely brings together participatory health research approaches with PRAXLABs approaches (Gashi et al. 2020). In the future, community orientation will play an even more important role in research on IT for health and aging and will bring with it a whole range of research challenges, such as questions about the orientation of co-design and participatory processes with larger and heterogeneous user groups and a variety of ethical questions.

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How Live Streaming Church Services Promotes Social Participation In Rural Areas

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Insights

- We report on a qualitative study on the development of a live-streaming system for Sunday mass in a small rural community.
- Methodologically, the study examines the issues around co- creation processes with a largely elderly population.
- The study further examines the specific features of local community practices, notably those of religious observance.

In 2000, Robert Putnam's Bowling Alone was published. It represented the culmination of a trend in community studies, which identified a decline in the solidarities that define "community" [1]. Of interest is the fact that Putnam's argument is founded in part on an analysis of religious behavior. Putnam

was clear that community was in decline and that the networks that define it would disappear. At much the same time, however, a wholly different trajectory was evident in studies of online communities, where different kinds of networks were seen to be growing [2]. Such discussions matter, above all, at the point where the online and offline intersect. That is, there is both a challenge to and an opportunity for the maintenance of physically located communities via online support [3]. One such opportunity is presented by live streaming, used by millions every day.

Platforms like Twitch.tv (https://www. twitch.tv/), with a number of functions to foster not only community building but also the interaction between the users and streamers, are developing rapidly [4,5].

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Social Technology Appropriation in Dementia: Investigating the Role of Caregivers in engaging People with Dementia with a Videogame-based Training System

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Abstract There has been increasing interest in designing for dementia in recent years. Empirical investigation is now needed of the long-term role of caregivers in appropriating ICTs into the complex daily life of people with dementia (PwD). We present here the outcomes of a 4-month evaluation of the individual, social and institutional impact of a videogame- based training system. The everyday behavior and interactions of 52 PwD and 25 caregivers was studied qualitatively, focusing on the role played by caregivers in integrating the system into daily routines. Our results indicate that the successful appropriation of ICT for PwD depends partly on the physical, cognitive and social benefits for PwD, but especially on the added value perceived by their social care-network. We discuss the need for design in dementia to develop more socially embedded innovations that can address the social actors involved and thus contribute to practical solutions for professional and private care.

KEYWORDS Care, Dementia, ICT, Exergame, Caregiver, Appropriation

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Designing for Sustainability: Key Issues of ICT Projects for Ageing at Home

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Abstract Achieving the sustainability of IT-based solutions is a challenge. We will argue in this paper that it is helpful to conceptualize designing for sustainable IT-based solutions as taking place in a multi- dimensional space. It requires thinking about how a project is framed; the perspectives and commitments of the project partners; the type of innovation that is foregrounded; the motivations and needs of the user group; and the level of sustainability a project or research program may achieve. The paper describes some of the challenges and possible solutions by revisiting a portfolio of projects that developed IT support for elderly people who continue living in their own homes.

Author Keywords ICT design, Sustainability, Elderly people, Appropriation, Capacity building, Funding schemes, Collective learning

in: ACM Transactions on Computer Human Interaction (ToCHI), Vol. 23, No. 5, 2016, Article No. 31

Design of a GPS Monitoring System for Dementia Care and its Challenges in Academia-Industry Project

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Abstract We present a user-centered development process for a GPS monitoring system to be used in dementia care to support care for persons with wandering behavior. The usage of GPS systems in dementia care is still very low. The paper takes a socio-technical stance on development and appropriation of GPS technology in dementia care and assesses the practical and ideological issues surrounding care to understand why. The results include: 1) Results from qualitative user studies from which design ideas, implications and requirements for design and redesign were developed. 2) Description of the politics, negotiations, and challenges encountered in the project at hand. These processual matters had a powerful impact on the product that was finally envisaged. The design process was taken as a whole to illuminate the way in which design outcomes are arrived at and to foster discussion about how 'best practice' might possibly be achieved.

Author Keywords Wandering behavior, GPS monitoring system, design research, joint research

in: Proceedings of the ACM Conference of Computer Supported Cooperative Work (CSCW 2016), ACM Press New York, 2016, 787-799

Designing for Those who are Overlooked – Insider Perspectives on Care Practices and Cooperative Work of Elderly Informal Caregivers

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Abstract This paper focuses on the complex and intimate setting of domestic home care. The majority of care for chronically ill people is realized by non-professionals, the relatives, who are often overlooked. Many of these informal caregivers are also elderly and face multiple, seriously demanding challenges in the context of informal care 24/7. In order to support this increasing user group, their cooperative work and coordination adequately, it is essential to gain a better understanding of their care practices and needs. This paper is based on ethnography in ten households in Germany. It combines data from the analysis of participant observations over eight months, interviews and cultural probes. Besides detailed descriptions of two cases, the central features of informal care experience and implications for design are discussed: the self-concept of the caregivers as being care experts, the need for social support, timing issues and coordination with other actors in this field.

Author Keywords Aging society; caregiver; cooperation; health; ethnography
ACM Classification Keywords D.2.10 [Design]: Methodologies.
H.5.2. [User Interfaces]: Theories and Methods, User- Centered Design.
J.3. [Computer and Society]: Computer-related health issues..

in: Proceedings of ACM Conference on Computer Human Interaction (CHI 2015), ACM-Press, New York 2015, 2295-2304

Practice-based Design of a Neighborhood Portal: Focusing on Elderly Tenants in a City Quarter Living Lab

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Abstract We present a user-centered development process for a GPS monitoring system to be used in dementia care to support care for persons with wandering behavior. The usage of GPS systems in dementia care is still very low. The paper takes a socio-technical stance on development and appropriation of GPS technology in dementia care and assesses the practical and ideological issues surrounding care to understand why. The results include: 1) Results from qualitative user studies from which design ideas, implications and requirements for design and redesign were developed. 2) Description of the politics, negotiations, and challenges encountered in the project at hand. These processual matters had a powerful impact on the product that was finally envisaged. The design process was taken as a whole to illuminate the way in which design outcomes are arrived at and to foster discussion about how 'best practice' might possibly be achieved.

Author Keywords Wandering behavior, GPS monitoring system, design research, joint research

Remarks on Health and Ageing Societies

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The papers in this section cover a relatively short period of the Siegen group's research. However, it is an important body of work, whose quality is evident from the conferences and journals in which it has been published. Continuing their commitment to practice-based computing and grounded design and drawing on their lengthy and impressive record in computer-supported cooperative work (CSCW) research, the Siegen group's work has helped to further our understanding of methodologies for practice- and human-oriented, co-design research in settings that are both sensitive and complex, their work is making novel and important contributions to the field.

Finding cost-effective ways of supporting 'ageing in place' that enable the elderly to live independently at home, avoid or defer institutional care and remain active participants in their communities has risen rapidly up the policy agenda in many countries in the last decade (ref). Harnessing the affordances of digital devices and networks is seen by health and social care policy makers as a solution to dealing with the inter-related trends of ageing populations, rising rates of chronic illness and disability, shortfalls in health system capacity and budgets, and shifting social roles and expectations. A range of solutions. e.g., telehealth—remote medical care, treatment or monitoring—and telecare—remote social care services or monitoring are now widely available. However, their uptake has often fallen significantly short of levels desired, owing to problems such as reluctance by intended users (the elderly and their carers) to adopt and poor sustainability (Cook et al., 2018; Kavandi and Jaana, 2020; Wang et al., 2020). Addressing these failures

has opened up several new challenges for IS research, which the Siegen group has helped advance our understanding of. There are three particular themes in their contribution to this field that stand out for me.

First, from the beginning, the Siegen group's research has been driven by a desire to move from a deficit-focused approach to the elderly and their care needs, to one that is person-centred, which takes the view that identity and sense of self is enacted through habitual embodied gestures, actions and routines (Unbehaun et al., 2020; Wherton et al., 2021). Guided by this principle, the Siegen group's work has evolved to provide a template for how to pursue a participatory, co-design approach to creating digital technologies for ageing in place (Wherton et al., 2015). This effort begins with Muller et al. (2015) taking on a 'living lab'-based research project in the context of a co-designing with the elderly tenants in a medium-sized housing complex. The project's goal was ambitious: "*development of a socio-technical infrastructure for the neighbourhood, which contributes to supporting and maintaining information & communication, social interaction, and both formal and informal support.*" They document in detail how they addressed the challenges of working with diverse stakeholders and of drawing the elderly residents – whose digital skills were often limited and whose motivation for being involved often low – into the co-design process. This is no mean achievement and Muller et al. emphasise how important it is to prepare the ground for the elderly through education and workshops. This same painstaking attention to detail is evident in the ensuing papers (Muller et al., 2015; Wan et al., 2015; Schorch et al., 2016; Meurer et al., 2018).

Second, the Siegen group's work has helped to recover the critical but often hidden work of carer givers in supporting the elderly, emphasising that technologies designed to provide for the needs of the latter must also be aligned with those of the former (Procter et al., 2018). Their studies of what the work of carer givers entails (Schorch et al., 2016) is important in and of itself but is also a timely contribution to the field of CSCW (Procter et al., 2016). Unbehaun et al. (2020) make the needs of care givers their focus in their evaluation of a videogame-based training system for people with dementia. They argue that the designers of such systems need to "*develop more socially embedded innovations that can address the social actors involved and thus contribute to practical solutions for professional and private care*." (ibid: p. 519). It is a conclusion that reflects and underscores the Siegen group's longstanding position that technology adoption should be seen as a process of social appropriation (e.g., Wulf et al., 2011).

Third, collectively this collection of papers provides a clear sense of the trajectory of the group's research into health and ageing societies as new issues are encountered and solutions are sought. Their willingness to take a longitudinal approach has enabled the group to reflect on how success in designing technologies for the elderly may ultimately be judged, and the lessons to which future projects should pay attention from the very beginning. Otherwise, as this collection of

papers shows, it may be too late to save whatever technologies have been developed from falling into disrepair. This is a welcome change from much of the research literature, where interest in the outcomes of a project has tended to end when the researchers pack up and depart the scene (Wan et al., 2016). A project may have run its course but the need for support doesn't end if it is to deliver lasting benefits.

Wan et al. (2016) point out that questions about what happens once research projects are over have often gone unanswered or simply been ignored in the PD and CSCW literatures. The all-to-common outcome is that projects fall victim to neglect as key actors (researchers, device manufacturers, care service providers, etc.) withdraw or wind down their participation. The implications of this lack of ongoing engagement can be a source of problems in any ICT project (Hartswood et al., 2002a; 2002b) but it may be especially critical when they involve elderly people: the pace of technological innovation digital devices continues to be very rapid, and requirements change and evolve as users – the elderly and their carers – become more familiar with the capabilities of the technologies (Procter et al., 2014; Wherton et al., 2016) and, not least, as the needs of the elderly themselves change as they age. As Wan et al. conclude, care business models need to reflect the costs of 'design in use': "*service before-, at- and after- sale are at least as important as the technology itself.*" (Wan et al., 2016: 30).

The paper by Meurer et al. (2018) explores this issue in more depth as it picks up the story at the end of the research project, examining what it takes for the technologies that have been developed to be sustainable. Related work has noted that much of the burden of sustaining technologies for the elderly has often fallen on the shoulders of their carers, with very mixed results and that this can become intolerable unless other elements of the care network are able to respond and adapt (Procter et al., 2018). What is innovative about the Siegen group's approach is their focus on helping users – especially elderly ones – to develop the skills that would enable them to become more actively involved in delivering sustainability. It also shows that users may be willing to take on some responsibility for sustainability if this is presented, for example, in ways that satisfy a desire for sociability. Sustaining the technologies then becomes rewarding and a part of their life worlds and also for those of their carers (Unbehaun et al., 2020). Of course, this itself may involve significant resources and effort and is one of the lessons to which researchers should pay attention when planning future projects. Securing long term sustainability may still require contributions from various actors, however, and not only for the continuing provision of technical support but also for the wider care network. Here, again, the Siegen group took a distinctive approach by securing the involvement of a local voluntary agency, which is another possibility that future projects would do well to consider.

Meurer et al. also examine the challenges associated with attempts to scale up projects (Greenhalgh et al., 2017). Naturally, when a small project is seen to be delivering significant benefits, the question arises of how it can be translated into

new communities and scaled up in terms of its user base (which may be necessary in order to reach a critical mass of users, itself important for sustainability). They identify a number of issues, including the different priorities of project partners. For example, as has been noted before, whereas academic partners be motivated to create innovative technologies (which may then prove more difficult to sustain), for users their needs may be met with more simple and mundane technical solutions (Bjerknes and Bratteteig, 1988). Most critical, perhaps, is that the limited duration of projects makes it difficult to create a robust socio-technical solution (ibid:512), i.e., one that successfully aligns skills and resources on the one hand (i.e., the social infrastructure) and the technical infrastructure on the other. Echoing their earlier call for advancing ways of promoting the re-use of successful design methodologies (Rohde et al., 2017), Meurer et al. call for the creation of a 'common information space', a "*knowledge base of methods and techniques in support of creating sustainable IT-based solution*" (ibid:530) as a necessary step towards achieving that goal. With that in mind, it is to be hoped that the Siegen group will revisit these projects to add to their already significant contribution to the field of health and ageing societies..

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Re-Framing How We Engage with Health and Aging and Technology

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As stated in the Introduction to this 'Health and Ageing' section (Müller 2022), demographic changes have created a number of significant societal challenges around how to care for an increasingly aging population and how to promote active and healthy aging. Unsurprisingly, technology is seen as a key enabler for addressing these challenges and has been the focus of significant governmental support for university research and industry innovation. However, for too long, and by too many policy makers, technology developers and researchers, the aging population has been seen as a 'problem to be solved' (e.g., Mafauzy 2000). Language matters. We only need to think of the language around these challenges, for example, about 'the burden of care' for an increasingly aging population (e.g., Kehler 2019), and 'the aging tsunami' (e.g., Li et al 2018). Given such an orientation, technology solutions often implicitly frame aging as a physical decline process that needs technology help and have the implicit, often even explicit, aim of reducing the costs of care. Yet despite significant investment over decades, we are yet to see many assistive technology solutions have a real impact in the market (Hallewell Haslwanter and Fitzpatrick 2017).

Active and healthy aging has not only been a research interest of mine since the early 2000s, it is also becoming increasingly personal, given that I now fall into the age group targeted by initiatives to address the challenges mentioned above. My common response to many of these initiatives and their utopian paternalistic technology solutions is *"Not for me!"*.

I am therefore both heartened and excited by the sensitive careful work undertaken by the Siegen socio-informatics group, as reflected in the papers in this section. These papers showcase a very different way of conceptualizing aging and older people, and also of empowering and equipping people to participate in the co-design of technology to meet their real needs, contextualized by their everyday practices. Our research group has also had an opportunity more recently to collaborate on a shared project for supporting older people in care homes and we have been able to see the 'care-ful' work of the Siegen group first hand.

Similar to the Siegen group, we have sought to take a much more critical stance in our research towards aging rhetorics, grounding our work in positive development theories of aging, e.g., (Baltes and Baltes 1990; Carstensen 1992; Tornstam 1989, 2005). We have also sought to engage more directly with older people and their family members and carers, to understand the ageing experience from their lived perspectives, the potential of technology and its place in their lives, both literally and metaphorically, and how we might support good quality of life as defined by them not us. Like the Siegen work, this reflects a broader socio-technical view, making use of qualitative methods for understanding everyday life and contexts, participatory approaches for co-designing 'good' solutions, and in-situ field studies for evaluating technologies in use (e.g., Axelrod et al 2009; Balaam et al 2011; Güldenpfennig et al 2016; Harley and Fitzpatrick, 2009; Güldenpfennig et al 2019).

We can critically reflect across all this work along a number of themes and lessons learnt. One is the unrealistic weight put on technology in isolation to address the challenges. As particularly illustrated in the Siegen work presented in this section, it becomes clear that the technology in some ways is the easy part, however difficult it might be to design and develop good technical solutions. To move from innovation to impact, the real challenges are located in the social, organizational, and political arenas and entangled with people's everyday practices.

However, many approaches of aging-technology related funding calls foreground a focus on the technical innovation and its path to market, with clear milestones and deliverables planned out some years ahead. This a priori commitment to a particular path creates a funding and innovation straitjacket. It does not allow room for us as researchers and co-designers to genuinely engage with older people, listen to their voices and opinions, and evolve ideas accordingly (Hallewell Haslwanter et al 2018).

We had one particular project experience where we were funded to produce a technical solution for community building, with 'participatory user engagement' a key criteria for getting the funding. However, from the very first co-design workshop, the participants stated clearly that they wanted a non-technical rather than a technical solution to the challenge. We had to apologise to them and explain that, even though it was supposed to be a participatory process, there was no scope to shift the project focus and deliverables. We have had similar experiences in other so-called participatory projects – where in reality it is about participating in our

funded monitored agenda rather than seeking innovative co-designed solutions to real challenges, with an open mind as to if and how and what role technology might play.

Interestingly, the participants in all our projects have continued to engage with us in the co-design iterations of the technology. Some of the reasons they have given include that they enjoy meeting up with each other, that they learn something, and that they want to help us. Similarly, the strategy of the Siegen group to build long-term PRAXLAB relationships can be both useful for building relationships and deep understandings, and also increases the likelihood of such inter-personal commitments and people wanting to help them. This raises interesting questions then about the motivations of our participants to engage with us in our participatory processes. We can interpret this in the light of theories of aging and reciprocity (Fyrand 2010; Lindley et al 2008), around the importance of purpose and being able to contribute, not just being seen as needy:

> *"In our eagerness to find ways to help needy populations (such as the elderly and the handicapped), perhaps we have too often overlooked one of the most genuinely rewarding and mutually satisfying arrangements- encouraging the 'needy' to give useful help as well as to receive it."* (DePaulo, 1982; cited Fitzpatrick et al, 2015)

Our challenge in light of current funding constraints is how to respectfully and ethically embrace ways for people to help in genuinely reciprocal relationships (Fitzpatrick et al 2015) and what we leave them with, as discussed by Müller et al. (2018) in terms of designing for sustainability after the funded project formally ends.

This ethical stance also includes the question of how we might think about the role of technology in health and aging and people's relationship to it, and how we allow room for these different relationships to co-exist and be supported as relevant. In the anonymous project mentioned above, participants were voicing a positive choice for a different solution, not a rejection of technology per se and it would have been ideal to see through a non-technology solution, into which technology might well have played some later role. In other cases, there may be a learning curve that needs scaffolding, to help people move from technology avoidance or lack of understanding to technology engagement. Müller et al. (2015; and this volume) provide an excellent example of such scaffolding in their preparatory workshops with their older participants using off-the-shelf technologies. Here the aim was to "prepare the elderly to become co-designers" (p. 2299) by helping them gain some technological literacy as a basis for their later participatory design engagements, i.e., scaffolding learning and equipping participants with relevant skills.

Another lesson learnt is around the challenges of multi-/inter-disciplinary work. It is encouraging that many funding schemes and projects are increasingly recognizing the complexity of the challenges at hand and the consequent importance of bringing together diverse disciplines to address the design of these

technical solutions. The next step though is to recognize the new challenges this brings. Towards this, I was particularly struck by the discussions in Wan et al. (2016; and this volume) about the tensions and challenges of the interdisciplinary project team developing their dementia solution. We reported very similar experiences from a European-funded project that involved partners from a commercial design company, a municipal government, a community organization, citizens from two different countries/cities, and researchers from three different universities and coming from different disciplinary traditions (Fitzpatrick and Malmborg 2018).

Taking the socio-technical seriously requires then not just different funding models and more open plans of work that take participation seriously, but also new skills for how to effectively work across these diverse disciplinary, sector and stakeholder boundaries to achieve real impact (Fitzpatrick 2021). It also requires an explicit focus on, and effort to, identify the different disciplinary and stakeholder agendas and values, and how to navigate and negotiate among these tensions (Fitzpatrick and Malmborg 2018). As stated by Greenhalgh et al. (2012) in relation to telecare/telehealth, which can also apply here:

> *"If investments in these technologies are to bear fruit, more effective inter-stakeholder dialogue must occur to establish an organizing vision that better accommodates competing discourses."* (p.1)

These multiple voices and perspectives are not just from the side of the organizing project partners but point to questions about how we define our 'unit of analysis'. Rhetoric around notions of usability and technology acceptance models – the static procedural models noted in the introduction to this section (Müller 2022) – implicitly put the focus on the individual 'user', often divorced from their context. The work of the Siegen group, along with our own and various others, points to this notion of 'user' needing to be expanded to include the broader socio-technical network that is deeply entwined in putting technology to work and being part of the 'target' person's aging experience. This network can include other people in the same living situation and/or extended family and friends and local community members, among others, as engaged with in Schorch et al. (2016). This fits well with the practice focus of the 3rd wave of HCI (Kuutti and Bannon 2014), a focus that Siegen researchers have been pivotal in defining and shaping (Wulf et al. 2011).

However, it may also be time to expand this to consider Frauenberger's call for an 'entanglement' discourse in Human Computer Interaction (HCI) (Frauenberger 2019). This suggests developing the practice focus into a 4th wave that de-centers the human and more deeply embraces the socio-material interdependencies of people and things. In doing so Frauenberger also calls for a greater accountability and ethical responsibility for how our designs continue to shape the world, a call

that is particularly relevant to how we are shaping what it means to age, what is a good older life, and what role technology might play in this.

For those of us working in the space of health and aging, this entails complex methodological challenges about how we should work across the various levels noted in the introduction to this section (Müller 2022), i.e., how do we practically move from our deep long term situated engagements, using ethnographic and participatory methods, to not just influence the micro level of specific (technology) design solutions, but also how do we package (or better still co-design) insights to influence appropriation practices at the meso level, and to influence institutional and policy practices at the macro level? Cutting across this challenge is the recognition that there is no homogenous group we can call the 'aging population' and that the experience of aging is diverse and individual. There is no one-size-fits-all.

Towards this it may be time we explored adopting and adapting new methods to complement the qualitative/participatory methods we more traditionally draw from. These can range from micro-randomised control trials (Klasjna et al. 2015) to understand the impact of particular design features for particular people at the micro level, to realist evaluation methods (Pawson and Tilley 1997) that allow us to ask questions at more of the meso and macro system levels about 'what works, for whom, in which circumstances, and why' and how these may then translate into new work practices to deliver solutions (meso), as well as new policies (macro).

In sum, the papers in this section show pivotal contributions that the Siegen socio-informatics group have made towards reframing how we engage with the topic of health and aging and technology. And there is much still to be done. Selfishly, it is my hope that they will continue this important work, and influence others, so that we may get to better technologies we want to live with, and that support a good quality of life as we grow older.

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Introduction to Community and Political Activism

Volker Wulf, Konstantin Aal, Anne Weibert, Markus Rohde

'Community and Political Activism' is very much grounded in personal interest and dedication of the main actors who give shape to this research line. Most of the research activities in this area resulted from personal engagement, which was occasionally later turned into externally funded research, and many of these activities continued even after the funding expired.

While the range of topics and activities is rather broad, there is a common denominator: approaching major global or societal issues through the perspective of particular settings in which these issues become manifest. Here, the socio-informatics perspective brings to the fore an understanding of the imagination at work in technology appropriation. It helps to approach and conceptualize the learning and skill building within, and to understand how these are channeled into local political or social and community action. The socio-informatics perspective provides a standpoint from which to observe and engage with the rapid and profound changes affecting communities and individual actors within. Political in this is the deliberate aim to come to an understanding of inherent power structures surrounding a topic, and to determine who has access and who doesn't, who gets to speak and who doesn't, and how and why all this feeds into action or inaction. The individual works described in the following show, how there is close interdependency of technological development and social transformation. The (participatory) action research paradigm (e.g. Lewin 1946, Whyte et al. 1991, Maguire 1996) that is speaking from some of our research considers technological intervention as a lens that is fostering an understanding of evolving practices around the respective topic.

The research agenda started in the early 2000s when Markus Rohde was asked by a German political foundation to network Iranian non-governmental

organizations (NGO) – among other means by offering a www-based shared workspace application (Rohde 2004). It was hoped that networking NGOs would strengthen the civil society within the ever-changeable scopes of development offered by the Islamic Republic.

Research also focused on those parts of the civil society in the (Western) World, which explored alternative models in politics and economies. Starting in 2001, the World Social Forum (WSF) was considered to be one of the most visible manifestations of the global civil society, bringing together NGOs, advocacy campaigns, and formal and informal social movements seeking international solidarity. The WSF movement had regional branches, and access became possible to the European Social forum (ESF) being one of them. A PhD student, Saqib Saeed, spend three years working with the organizational committee of the ESF in preparing two of their bi-annual meetings (Saeed et al 2010). The paper included in this volume describes the way generic IT tools, such as an email and a content management system, were appropriated to be the IT infrastructures of a decentralized and distributed planning process. It also indicates how specific socio-technical configurations restrained the transparency of ESF's agenda setting process.

It is the local, neighborhood community context, where global topics play out and have an immediate impact. Living in a multi-ethnical neighborhood, Volker Wulf experienced lacking cross-cultural social networks when his children entered primary school. Being inspired by a research stay at MIT Media Lab, he developed together with teachers and parents of their elementary school the come_IN computer clubs (Wulf et al. 2005). Starting from the Bonner Altstadt, this concept was then taken to other neighborhoods dealing with similar problems – both in Germany and internationally (Aal et al. 2014; Yerousis et al. 2015; Rüller et al., in press). Living in a socially and culturally very diverse neighborhood herself, Anne Weibert conducted research conceptualizing computer clubs as a method for computational as well as cross-cultural learning and skill-building, providing a combined answer to the widening digital divide, as well as the increasing diversification of neighborhood community (Weibert & Wulf 2010; Weibert 2020). The paper in this volume builds on almost a decade of socio-informatics engagement with a come_IN computer club, covering the appropriation of a variety of different tools in this setting (Weibert, Randall & Wulf 2017). Following the refugee crisis in 2015, the works with the computer clubs then formed a basis for a participatory project that developed a digital platform with refugees, migrants and their professional and volunteer supporters. It is aiding with the resettlement process by providing a set of digital tools helping with initial orientation, overview on language courses, information on cultural aspects, work, housing, and the structure of everyday life in general (Weibert et al. 2019; Krüger et al. 2021).

One of the international sites to explore the come_IN concept were refugee camps in Palestine. In 2006, an old friend, Roman Englert, became the liaison officer of Deutsche Telekom Research Lab at Ben Gurion University in Israel. Over time, Volker Wulf was invited twice to give speeches at the lab. While he was quite impressed by Israel's academic performance and beauty of the lands, at his second visit he decided to try to understand how life is behind the separation wall, in Palestine. Via a Palestinian PhD-student in Siegen, he came in contact with a local University, the Birzeit University, and met Ibrahim Abu Kteish, the then head of Najjad Zeenni Information Technology Center of Excellence who became a friend, local anchor, and cooperation partner for subsequent research in Palestine. Against the background of the German experiences, different ways to make sense of the come_IN concept were explored, in order to contribute to an improvement of the lives of those suffering specifically hard from Israeli occupation. While a linkage between Israeli and Palestinian computer clubs was not viable, the research team looked at those Palestinian refugees still living in camps, considered to be outsiders in their own society, and how to better connect them with the Palestinian society outside the camps. Two computer clubs were founded in Palestinian refugee camps, in which university students worked with refugee families (Aal et al. 2014; Yerousis et al. 2015). Furthermore, a student exchange among Birzeit and Siegen University was established and ran over the course of three years, with social innovation and the addressing of local challenges being its main goal. In the exchange students from Germany and Palestine worked collaboratively on challenges like environmental issues, plastic pollution, fostering of digital literacy, or the preservation of Palestinian culture and history, and tried to develop creative solutions in a participatory manner with locals[1]. In addition, the partnership helped to establish two EU projects with an international consortium trying to improve the entrepreneurship environment in Palestine.

During his first travels to Palestine, Volker Wulf was introduced to Al Masara, one of the villages, which, at that time, staged every Friday non-violent demonstrations against the ongoing construction of the separation wall around the village and the Israeli grabbing of Palestinian land. The researchers got to know the local organizer of the protests, Hasan Breijeih, spent a lot of time at his house and followed his political activities ever since – from a supportive angle. The paper in this volume brings forward early findings by describing the local demonstration movement and its organization as well as the role digital artefacts and material factors play. Over the past decade, many visits to Al Masara followed. The researchers learned, how the demonstrations are also intertwined with the daily life of activists. Here, it became obvious, that activism is not

[1] http://yallah.exchange/

something that starts and stops at a certain time of day, but comes to play a part in the lives of everyone in the activist's household. In terms of demonstrations, the demands this places on those who orchestrate them imply a wide variety of ICT-based collaborative practices and articulation work.

The Arab World is geographically, culturally, and via many migration paths closely related to Europe. When anti-government protests and uprisings unfolded in much of the Arab world as the so called Arab Spring, mass media and academia held the opinion that social media, specifically Twitter, played a major role in organizing these uprisings. To get an understanding of the Arab Spring, Kaoru Misaki and Volker Wulf went to Tunisia in December 2011. They also travelled to Sidi Bouzid, the provincial town in south-western Tunisia where the Arab Spring uprisings started. Visiting the place where the street vendor named Mohamed Bouazizi immolated himself, the researchers met young people and started talking about how the event unfolded during the uprising one year earlier. Obtaining interesting and surprising information about the local uprising and its linkage with the rest of Tunisia, Kaoru Misaki and Volker Wulf stayed longer than planned. One of the most interesting factors to them was the fact that those who participated in the uprising did not mention the use of Twitter with a single word, when now talking about it in retrospect – but they explained that Facebook played a certain role in maintaining their uprising under military siege over a period of six weeks. Colleagues went again to the country some months later to elaborate on this finding. In the paper in this volume, the authors argue that on the ground research is needed to understand the political impact of social media, thus strongly opposing an attitude held at that time in academia and journalism that political developments can be analyzed by just following social media communication mainly on Twitter, without on-the-ground insights from the research setting.

In the case of Syria, Kaoru Misaki and Volker Wulf were concerned whether the Western media would draw an appropriate picture of the then evolving civil war. Since entering Syria was clearly too dangerous, they travelled inside Turkey in December 2012 and January 2013 along parts of the Syrian border. Meeting Syrian refugees, activists, and rebel fighters, they gained an understanding of aspects of the early phase of the Syrian civil war. The paper in this volume describes which role mobile media played as an enabling force for political activities just before and during the civil war. The use of mobile media endangered its users in unexpected serious manners while simultaneously enabling the presentation and distribution of the massive cruelties of this war.

Later on, Irina Shklovski and Volker Wulf had a similar interest – to understand the unfolding of the Donbas conflict, a war taking place in Eastern Ukraine. In 2015 and 2017 they visited both sides of the frontline, trying to understand what was going on the ground, and aligning these insights with the

coverage of the conflict in Western media. While they found that the media-created images were in line with their experiences they came up with some empirical findings they found worth to introduce into an academic discourse. Following accounts on both sides, they learned how much private mobile phones became a crucial but ambiguous infrastructure of life inside the warzone despite their lack of durability in extreme conditions, and their potential to be surveilled and localized. The study sheds light on the lives of ordinary people in the Donbas war. Looking at the use of private mobile phones at the front lines, it shows how badly trained, equipped, and supplied most actors were on both sides of the battle ground. However, they were convinced to fight a just war for their respective people or nation. They believed that the use of their private mobiles offered an important perspective on the characteristics of this war and let even to some implications for the design of mobile devices used in conflict situations (Shklovski and Wulf 2018).

The interest in understanding the living conditions in uprisings and insurgencies and a potential role of technology within led to research in Colombia following the Havanna Peace Agreement between the government and the FARC guerilla. A PhD student, Débora de Castro Leal, before joining the group in Siegen, had already worked in a transition camp to explore the integration of FARC guerilleros into the post-conflict society, which was imagined in the Havanna Agreement. In summer 2018, Kaoru Misaki and Volker Wulf spent a month in Colombia and went with Débora de Castro Leal to the transition camp she had worked at before. The researchers were appalled by the histories they learned about the social practices of decades of living in the armed underground. They documented a particular aspect of these accounts in a paper explaining how the rather low-tech FARC fighters were capable to survive in a high-tech war against the US-equipped Colombian army (de Castro Leal et al. 2019). They also explored the way the FARC fighters tried to integrate under the conditions of a seriously broken Peace Agreement (de Castro Leal et al., in press).

In approximate parallel, an external PhD student, Boris Tadic, followed an interest in understanding the role of social media in shaping political movements. Being from Bosnia-Hercegovina (B-H), a former part of Yugoslavia, he did research in different protest movements in Republika Srpska, the Serbian part of B-H. He describes how Facebook offered political activists more efficient access to their target group, easier information sharing with the general population, and quicker reaction to spontaneous “offline” activities (Tadic et al. 2016). Based on his findings, he started to look for tools which make activists aware of IT-security issues. The Siegen researchers had found similar problems already before in Palestine, Syria, and Ukraine.

Like the Arab World, Africa is closely related to Europe due to its colonial past, geographical closeness, and migration histories. Over the past years, the

Siegen Socio-Informatics group got increasingly interested in better understanding Sub-Saharan Africa and exploring opportunities for post-colonial manners of cooperation. In 2014 Kaoru Misaki and Volker Wulf travelled in Madagascar for four weeks and were impressed, among other aspects, by the public overland transportation based on run-down, cheap, frequent, and overcrowded mini busses. These are being threatened by organized bandits specifically in the south of the country. In their paper, the researchers elaborate on future directions for public transportation and opportunities for IT support in counties with low capital stocks, weak transportation infrastructure, and problematic public security (Wulf et al. 2019). They also take a comparative perspective with regard to their studies in the German countryside.

Beyond transportation, Africa is confronted with many problems and offers interesting learning opportunities from a socio-informatics perspective. In 2018, Volker Wulf and colleagues conducted a first exploration into the issue of e-Waste, repair and recycling in Ghana – a topic they plan to explore more deeply in the future. Travelling in Botswana, they were confronted with another major conflict: the land requirements of a fast growing (rural) population versus the preservation of wild animal's habitats. Kaoru Misaki and Volker Wulf visited Botswana's Okawango delta in 2016 and met, by accident on a camping ground, a German biologist, Florian Weise. Weise was already using GPS-trackers to localize lions. His team had the innovative idea to make cattle herders living in villages next to the national park aware of approaching lions. Without giving the exact localization of the lion (to avoid poaching), the herders could shelter their animals and prepare for attacks of lions. The Socio-Informatics researchers joined forces with Weise's team and refined the tracking application in a way that it went along with the herders' needs and understandings (Weise et al. 2020).

Together with colleagues from media studies at the University of Siegen, headed by Erhard Schüttpelz, the Socio-Informatics researchers were able to acquire one of the most prestigious funding format of the German Science Foundation (DFG): the Collaborative Research Centre Media of Cooperation. Following up on the research interest in the Arab Spring, members of the Siegen Socio-Informatics group started to explore the ways digitalization is shaping live practices and political publics in rural parts of the Arab World, specifically in Morocco. Since 2016, the team works ethnographically in a remote valley in the High Atlas Mountains in Central Morocco, also exploring the opportunities computer clubs offer in these contexts (Aal et al.,2018; Rüller et al., in press). Together with colleagues from Ethnology at the University of Cologne, they focus on the challenges of co-establishing such an intervention in a rural/mountainous region that is already undergoing a process of continuous development and profound transformation. Based on an ethnographic approach, insights show the

changes and unforeseen appropriation of a computer club by the local partners and inhabitants in the valley.

In late 2018 Volker Wulf expanded the research interest in political and societal developments in the Middle East towards Iran, where he spent twelve days and met with very hospitable and open local actors. He took an interest in the lives of ordinary Iranians under the conditions of the harsh sanction regime imposed by the US. For language reasons, he would specifically interact with the urban middle class where he learned about their private use of social media. Iran is a country, which has been filtering internet access since about a decade (since the Green Revolution) and is trying to replace international sites by nationally owned platforms under state control. It was interesting to understand how the wide spread private use of international social media platforms turned into political activities (Wulf et al., in press). The networks built during the stay in Iran were instrumental to investigate later on into the countrywide uprising following a rise in the gas prize (Grinko et al, in preparation).

A view across these works reveals how much of the activities in this research area were driven by the researchers' curiosity to understand 'the world' and their activist conviction to contribute to 'a better world'. There is a need then for researchers in the socio-informatics domain and beyond, to ask themselves: what constitutes 'better'? Scientific discourse has found a number of binaries hindering the peaceful co-existence of people on this earth, in an intact nature. Conflict unfolds – among other reasons – along the lines of Rich and Poor, Modern and Traditional, Political Activism and Political Mainstream, Autochthonous and Migrant, Male and Female. Developing answers to the umbrella question what could and should be done for this world to make it be a place that is equally livable for all has been at the core of an abundance of research across disciplines, intersecting policy and public discourse and inherent social, as well as political and economic action (see for example Castells 2014, Eagle and Greene 2014, Komives and Wagner 2012, Mcgonigal 2011, Trahair 2013). Socio-informatics within takes a strength from its grounded perspective, seeking to develop answers and socio-technical interventions that are rooted in human practice. It speaks from the cases assembled in this chapter, how such 'informatics with a human face' seeks to shed light on actors, neighborhoods and regions from a political point of view and driven by the impulse to understand.

The Siegen Socio-Informatics researchers found an angle to engage first, and thereafter, started to think about whether and how to turn this engagement into an academic endeavor (which, of course, did not always work out). The activities that developed did not follow merely one research theme, though common themes emerged over time and are driven by societal conviction, curiosity, opportunity, and the humble means to have an impact. Such research seeks to hear and understand the voices of the citizens, practitioners and activists it meets and

engages with (for further and related discourse on this strive for a communication at eye-level see for example Wilson et al. 2020, McNaney et al. 2018, Alper 2017), and it can be seen in the papers in this chapter, how this can mean a number of things. It can involve taking the empirical work of Socio-Informatics as a means to bring hidden phenomena and problems to public perception and attention, thus adding voice(s) to domains otherwise influenced by journalism. In fact, a personal impression that journalism was changing and increasingly driven (economically) to prioritize and abandon certain topic areas and regions was a motivation for Volker Wulf to start some of the research engagements that are part of this chapter. To hear and to understand the voices of the citizens, practitioners and activists can also bring about detours and creative modes of expression, as has happened in the case of the computer clubs, who have repeatedly engaged in jointly conducted activities that spanned neighborhoods and topics and created mutual awareness (Weibert et al. 2017), appreciation and social capital (Weibert, Aal, Ribeiro & Wulf 2017).

It is the role of information and communication technology (ICT) and the theme of digitalization that connects the activism to academic discourses and creates visibility in the form of publications in those (international) venues where socio-informatics contributions are appreciated. While this orientation can be understood as a professional deformation in the Siegen Socio-Informatics perception of the world (or better in publishing about the world), the fast expansion of IT artefacts into almost any aspect of human life offers ample opportunity for such an alignment. It may even well be that such a grounded, practice-based view on digitalization and the role of ICTs unveiled important phenomena and offered insight which could not be grasped in different ways.

Over time, the studies in focus here have contributed to an understanding of the emancipatory potential of IT infrastructures, specifically social media platforms, in suppressive regime, for instance in the work in Tunisia, Palestine, Syria, Republica Sprska, and Iran. While the political situation and the means of suppression were quite different in these cases social media platforms offered opportunities to circumvent censorship of mass media as well as surveillance of traditional means of communication (e.g. letters, phone lines, emails). Social media platforms offered new opportunities to voice political opinions, to network with others, and to organize political actions. However, this window of opportunity can close quickly – as soon as secret services learn to access and infiltrate social media platforms. The owners of social media platforms conduct their own policies with regard to legitimate content which can easily become a new way of censorship (see, for instance, how Palestinian activists get treated on platforms controlled by Silicon Valley billionaires). These platforms and their owners have murky relationships with Western security services (Snowdon 2019) which can endanger their users. The studies from Syria and Ukraine also show

how technical opportunities to locate a mobile device's position can threaten the lives of its users. There is a research agenda to better protect users of (mobile) devices from surveillance of state security agencies as well as private companies (Landwehr et al, 2019; Tadic et al., in preparation).

On the other side of geopolitical divides, states restrict (political) publics by filtering access to international social media platforms. Countries like China and Iran try to build their national IT-infrastructures and social media eco-systems – also to avoid dependency on Silicon Valley and Seattle's platforms. It is highly interesting to understand how IT infrastructures change the power balance between activists and (suppressive) state authorities (e.g. in Palestine, Colombia, Iran). De Castro Leal et al. (2019) paper in this volume developed a research agenda on the activists' protective practices against the suppressive use of IT-tools researchers which we have framed conceptually as 'counter-appropriation'.

Sustainability issues will become more pressing in the decades to come, specifically in the Global South. Africa and the Arab World are characterized by a considerable population growth and at the same time desertification and deteriorating lands. Migrations moves and conflicts on land use are getting more important. The study of the human wild life conflict in Botswana shows, how an appropriately designed location tracking is capable of mediating the conflicts between wild game and herders as well as farmers. These IT-artefacts, while currently developed and explored in Botswana, could be, however, meaningful for other parts of the world, and networking with initiatives like the claws conservancy[1] can form an important basis here.

(Global) Supply chains will need to be redesigned in a more sustainable manner. Repair and recycling may reduce the ecological footprint of material consumption. West Africa has a long history in reuse and recycling. We started to explore the handling of e-waste by investigating into the lives of people working to reuse, repair, scrap, or dismantle old electric and electronic devices in two quarters inside the biggest cities in Ghana, Kumasi and Accra. While taking place in a highly polluted environment, an understanding of the work practices and appreciation for reuse may inspire us to question given assumptions and expand solution for other parts of the world (see also Wulf et al. 2019 for mobility practices).

The view across the works that assemble here under the headline 'Community and Political Activism' brings to the fore the strength that lies in the bottom-up approach that Socio-Informatics works with. This is what enables the profound and grounded understanding of an issue and its development. This forms a necessary basis for the subsequent balancing of risks and opportunities involved. It forms a basis on which trust can grow which then enables co-creation and

[1] http://www.clawsconservancy.org

collaboration in design and socio-technical intervention. In the topical domain of 'Community and Social Activists', a very particular style of research was developed. It is related to specific challenges emerging from the respective topic(s) but also based on personalities and specific experiences and (political) agendas, and closely linked to and dependant on local partners with whom the researchers jointly try to uncover the hidden and facility change through (participatory) design. For all of these activities the researchers depend on local actors – be it as informants, facilitators, or co-designers. Since such research typically tackles delicate and (politically) sensitive issues, it needs to be developed in close collaboration with local actors with a congruent (political) agenda and with whom a relation of trust was established over time (cf. Rohde 2013).

The Siegen Socio-Informatics group tries to establish personal relationships with key partners and tries to maintain them beyond the local engagement. For instance, in Palestine the researchers have been working with four key people for many years: Ibrahim Abu Kteish, George Yerousis, and later, Iyad Tumar at Birzeit University as well as Hasan Breijeih from Al Masara village. Over the past ten years, the researchers from Siegen visited their offices and homes many times, spending many hours together discussing professional, political, and private matters. They became friends came to visit in Germany as well. The many intimate conversations also helped to develop a deeper understanding of the ever changing situation in Palestine.

Such visits are an important element in the international projects, to make partners better understand the Siegen Socio-Informatics standpoints and personal as well as academic experiences, but also to communicate their local conditions to a broader German audience. For instance, some Russian and Ukrainian informants and artists were invited to come to Siegen for ten days to participate with their works in a temporary gallery that was held by us over that summer 2018 in the centre of Siegen (and that was also exhibiting the work from Palestine). It was intended to hold a joint art exhibition starting conversations across the frontlines of the Donbas war. Unfortunately, the Russian delegation canceled their trip shortly ahead of the event. Therefore, the exhibition just displayed the Ukrainian perspective. In two cases, informants from the research sites were even invited to study the international MA program in Human Computer Interaction (HCI) at the University of Siegen.

When engaging on a more explicit developmental agenda, the situation becomes even more complex. The local research partners need to possess the required resources to facilitate change. Since the researchers are not permanently in the field, they are fully depend on their local partners to conduct the necessary activities. The local situation as well the power dynamics of different stakeholders is often very complex. In order to create a successful intervention and to establish

the intervention without going over someone's head (in other words, preventing conflicts and picking up on potential partners' needs and suggestions) it was necessary to examine very closely the political organization and prevalent power structures that are inseparably embedded in a specific socio-cultural context. This requires trust and an alignment of goals which is not easily created. Therefore, it takes time to understand the situation in more detail and also spend time with potential partners, to build trust and involve them during the first steps of developing the intervention.

Looking at the sensitive, conflict-loaded, and often hidden aspects of communities and societies requires specific skills of the researchers. Being in a zone of conflict (sometimes war), talking to political activists or guerrilla fighters or publishing about sensitive or censored issues can be dangerous for the researchers and more so for their local informants. Following an activist research agenda can be even more of a security challenge and activities need a balance between taking risks and missing opportunities, and high or unreasonable risks should not be taken. However, such an assessment can often not be done beforehand and in abstract but needs to be carried out in a process of constant self-reflection and joint risk-assessment. In the field, things can happen spontaneously or on short notice. Events can unfold in unpredictable ways. Risks are hard to judge – specifically by outsiders to the scene. For instance, when we tried to understand the Syrian civil war, the researchers stayed inside Turkey and deliberately did not follow offers to get smuggled into Syria. However, two auto bombs blasted in the centre of Reyhanlı, a Turkish border town that they had visited on a field research trip four months earlier.

This process of constant reflection, risk-assessment and learning also involves thorough research on what can be known about a topic and site before entering, and it includes mutual learning within the group, where junior researchers learn from senior colleagues. Volker Wulf, for example, likes to be first in traveling to a new region to engage in to get a first grip of the local conditions, opportunities, and risks. The need for constant reflection extends from field work towards publication. Publishing results can be equally dangerous – specifically for the informants. Currently, techniques are explored by the Siegen researchers to avoid publishing potentially endangering parts of the empirical data and the usage of pseudonyms to protect informants. Here again, the danger for informants is often difficult to judge – in some cases they even prefer to be explicitly named in academic publications as a strategy that may serve towards their protection.

It takes time to enculture in such research practice, and it frequently goes against the grain of what is common, project-fuelled practice in the academic field: to see and follow topics where there is not (yet) a funding line for them, to learn how to travel in a socially and culturally attentive and sensitive manner, to work on building sustainable relationships with informants and local cooperation partners,

to keep activities going and let change emerge from this (in a partly remote manner), to see and accept change that does not happen as part of the answer, and to distill scientifically publishable themes, that are grounded in such engagement with local people and communities.

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Extending Value Sensitive Design to Off-the-Shelf Technology: Lessons Learned from a Local Intercultural Computer Club

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Abstract Studying the setup and development of an initiative of computer clubs in intercultural neighbor- hoods, this paper builds on the theory and method associated with value sensitive design to account for the use of off-the-shelf technology in a diverse cultural context, and over an extended period of time. We present three cases from one of these computer clubs, each at a different point in time in the club's development. Central factors are identified that impact the course of a socio-technical initiative. We highlight the challenges inherent in matching existing ICT with the values both explicitly identified in the initiative and which evolve over time. Our study highlights the relevance of open communication structures among researchers and local practitioners, as well as methodological support that is needed to span a wide range of user experiences. Both aspects are key to making value sensitive design a lived experience on the diverse community level.

RESEARCH HIGHLIGHTS

- Extending value sensitive design to the use of off-the-shelf technology in a diverse cultural context, and over an extended period of time.
- Identification of challenges inherent in matching existing ICT with values both explicitly identified in the initiative and evolving over time.

- Relevance of open communication structures among researchers and local practitioners.
- Methodological support that is needed to span a wide range of user experiences

Keywords children; collaborative and social computing; computer clubs; informal education; interculturalism; value sensitive design
ACM Classification Keywords H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

in: Computer Supported Cooperative Work: The Journal of Collaborative Computing (JCSCW), Vol. 20, No. 4-5, 2011, 265-304

Analyzing Political Activists' Organization Practices: Findings from a Long Term Case Study of the European Social Forum

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Abstract Designing ICT support for transnational networks of social activists is a challenge due to diverse organizational structures, cultural identities, political ideologies, and financial conditions. In this paper we present empirical findings on ICT usage in the organizing process of the European Social Forum (ESF) covering a period of almost 3 years. The European Social Forum is a platform for political activists involved in the anti-globalization movement. During our data collection period, the 5th and 6th European Social Fora were held in Malmo (2008) and Istanbul (2010). The paper describes complex social practices in organizing ESF events. We use the term fragmented meta-coordination to denote this type of practice. Mundane IT applications, such as a mailing list and a content management system, play a central role in enabling different aspects of fragmented meta-coordination. The findings also indicate how lacking resources, organizational distribution, and technical limitations hamper the preparation process and reduce the transparency of political decision making. Our analysis highlights central organizational and technological challenges related to ICT appropriation in transnational networks of social activists.

Keywords ethnographic case study, technology and the third sector, community informatics, social movements and ICTs, political organizing, meta-coordination

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The Use of Private Mobile Phones at War: Accounts From the Donbas Conflict

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Abstract Studying technology use in unstable and life-threatening conditions can help highlight assumptions of use built into technologies and foreground contradictions in the design of devices and services. This paper provides an account of how soldiers, volunteers, and civilians use mobile tech- nologies in wartime, reporting on fieldwork conducted in Western Russia and Eastern Ukraine with people close to or participating directly in the armed conflict in the Don- bas region. We document how private mobile phones and computers became a crucial but ambiguous infrastructure despite their lack of durability in extreme conditions of a military conflict, and their government and military sur- veillance potential. Our participants rely on a combination of myths and significant technical knowledge to negotiate the possibilities mobile technologies offer and the life- threatening reality of enemy surveillance they engender. We consider the problems of always-on always-connected devices under conditions of war and surveillance and our responsibilities as HCI practitioners in the design of socialtechnologies.

Author Keywords HMobile Media; ICT Infrastructures; Field Study; Appro-priation; Political Conflict; War
ACM Classification Keywords H.5.m. Information Interfaces and Presentation (e.g., HCI): Miscellaneous.

in: Proceedings of ACM Conference on Computer Human Interaction (CHI 2013), ACM-Press, New York 2013, 1979-1988

Fighting against the Wall: Social Media use by Political Activists in a Palestinian Village

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Abstract We analyze practices of political activists in a Palestinian village located in the West Bank, who organize weekly demonstrations against Israel's settlement policy and the separation wall. Over a period of 28 months, we conducted a field study consisting of eight days 'on the ground' observation and interviewing, and extensive monitoring of Internet communication. We describe the activists' background and their efforts to organize these demonstrations under conditions of military occupation. Over time, we observe the role both digital and material factors play in the organization of protest.

Author Keywords Social Media, field study, appropriation, political protest
ACM Classification Keywords H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

Out of Syria: Mobile Media in Use at the Time of Civil War

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Abstract Social media usage during the recent uprisings in Arab countries has gained increasing attention in CHI research. This study adds to these insights by providing some findings on the use of ICT, specifically mobile media, by opposition forces and political activists during the Syrian civil war. The presented study is based on 17 interviews with Syrian FSA fighters, activists and refugees. A first analysis showed evidence for some very specific use patterns during wartime (compared to media usage of political activists under less anomic conditions). The study also describes a fragmented telecom infrastructure in Syria: government-controlled regions offer fairly intact infrastructures while rebel- controlled regions have been cut-off from telephone and Internet. Moreover, the central and very critical role of mobile video for documenting, mobilization, and propaganda is discussed.

Guerilla Warfare and the Use of New (and Some Old) Technology: Lessons from FARC-EP's Armed Struggle in Colombia

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Abstract Studying armed political struggles from a CSCW perspective can throw the complex interactions between culture, technology, materiality and political conflict into sharp relief. Such studies highlight interrelations that otherwise remain under-remarked upon, despite their severe consequences. The present paper provides an account of the armed struggle of one of the Colombian guerrillas, FARC-EP, with the Colombian army. We document how radio-based communication became a crucial, but ambiguous infrastructure of war. The sudden introduction of localization technologies by the Colombian army presented a lethal threat to the guerrilla group. Our interviewees report a severe learning process to diminish this new risk, relying on a combination of informed beliefs and significant technical understanding. We end with a discussion of the role of HCI in considerations of ICT use in armed conflicts and introduce the concept of counter-appropriation as process of adapting one's practices to other's appropriation of technology in conflict.

CCS CONCEPTS Human-centered computing → Empirical studies in HCI
Author Keywords Infrastructure, Appropriation, Political Conflict, War

Understanding Life on the Ground with Technology

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The diverse case studies in this section all have one thing in common: they are close up and personal ethnographic explorations of how people live with technology and how developers can help improve the fit and usefulness of technology in complex social, economic and political situations.

These studies dare to introduce bold interventions in sensitive and sometimes *"hotspot"* situations based on innovative methods that enable local communities and researchers to meet on mutually comfortable terms. The result is a collection of creative ethnographic understandings of how technology works (and sometimes fails) in situations that are seldom captured adequately either by journalists or by most academic researchers.

These studies all show how principles of human-centered or "value sensitive design" can be applied in settings that make for challenging collaborations between researchers and local communities. We see how research and successful intervention can develop in complex and often chaotic situations such as a Tunisian village during the popular uprising, and a Palestinian town under Israeli occupation. The teams developed by Wulf, Rohde and colleagues at Siegen have created a new model of engaged, activist research. Each of the case studies in this section teaches us something new and interesting about fieldwork in complex situations where technologies and resources are often limited.

"On the Ground in Sidi Bouzid"

This case offers an impressive understanding of how the Tunisian "*Twitter revolution*" was actually a Facebook campaign managed by young, educated activists with high unemployment and few future hopes under the repressive and corrupt regime. More than just a local organizing platform, the Facebook feeds from this village became a reporting link to Al Jazeera, from which the world was informed about the uprising. While the authors point out the possible limitations of themselves outsiders coming late to the scene – they nonetheless offer a remarkable account of how community technology appropriation worked in a chaotic context.

"The Use of Private Mobile Phones at War"

Using creative research methods, this analysis offers a fascinating look at how soldiers used mobile phones to communicate with friends and families during the war in Ukraine following the Russian invasion. The remarkable fieldwork reveals how risky combat conditions faced by the soldiers were humanized by available communication technology, and at the same time made more dangerous due to tracking and surveillance technologies used by both sides in the conflict. The documentation of a formal set of rules and regulations governing personal cell phone use was a revelation about how to allow young soldiers to stay in touch with loved ones without putting themselves and their comrades in undue danger. Another important takeaway from this study is the insight into how soldiers balanced their communication needs with the knowledge that their communication was under surveillance. The findings emphasize how widespread the use of mobile technology has become under extreme conditions and lack of privacy.

"Analyzing Political Activists' Organization Practices"

Here we look at the array of technologies involved in the *"fragmented meta-coordination"* of the European Social Forums. This is a rare study that captures the dilemmas of coordinating collective action across a diversity of issues, organizations, national and local politics, cultures, and languages. Given these challenges, it is remarkable that the mix of email lists, newsletters and appropriated commercial platforms managed to create a meta-structure that drew participants together for meaningful on-the-ground networking and community-building. Similar to many activist gatherings on the left around the world, the technology choices and uses reflect the value schemes of participants: diversity and inclusion.

"Fighting Against the Wall"

This fascinating piece documents the interplay of technology and everyday social practices adopted by residents of a Palestinian village to organize protests against Israeli settlement of their lands. Following two earlier uprisings, the Israeli's built a wall to contain Palestinians and protect new Israeli settlements. The wall and the settlements became targets of protests that often ended with activists being beaten

and jailed. During much of this time, there was no internet service in the village, and the activists felt cut off from sharing their trials with the outer world. When Internet service finally arrived, the activists quickly learned how to post photos and videos of Israeli suppression of the protests on Facebook. The growing social networks spread to other Palestinian communities, and beyond, to publics concerned about the growing oppression of Palestinian citizens. What seemed to me most remarkable is that since these villagers were living with almost daily cycles of protest and military reprisal, the Facebook posts reflected much broader portraits of daily life, combining protest images, music, and family life. This reveals the degree to which, in this and many other situations like it around the world, "*the personal is the political.*" Documenting this delicate interplay of political expression against severe political and technological limits is a remarkable piece of ethnographic teamwork.

"Out of Syria"

Just when I thought that fieldwork conditions experienced by the Siegen teams could not become more challenging, I plunged into this amazing look at the challenges of technology use faced by Syrian rebels during the civil war. This documentation of displaced people trying to find and communicate with loved ones and coordinate survival in a devastating war embodies the core approach of all of the studies in this section: putting people and local context in the foreground and showing how technology use is shaped by immediate constraints. The result is a graphic look at a fragmented media ecosystem in which mobile phones, Facebook videos, and other platforms created communication networks with loved ones scattered across the region. At the same time, the refugees and combatants were able to get the attention of the world with *"shock and awe"* videos of a terrible conflict.

"Extending Value Sensitive Design to Off-the-Shelf Technology"

This article nicely summarizes another guiding principle of this entire section: instead of imposing arbitrary standards of neutrality or objectivity, observers must become participants in the development of value sensitive research and design standards. Those standards must be informed by understandings of the interpersonal, educational, cultural, social, political, and economic conditions that shape uses of technology. The first half of this piece is an excellent overview of how to apply value sensitive design principles in complex real-world settings. The case study that follows applies those principles in developing a network of cross-cultural computer clubs in Germany. The clubs were based in highly diverse neighborhoods with the aim of building cross cultural understandings, while helping families and neighbors apply technology skills in improving their everyday lives. By looking at one of the most typical clubs in depth, the analysis shows how immigrant populations that are often separated by language, culture, and technology divides can become active agents of personal and community transformation. The

analysis identifies the myriad issues that emerge in different the three important areas of: startup, stakeholder engagement, and technology use. Through the entire analysis and discussion, the dominant message is that in order for diverse community values to emerge and become reconciled in the process of participation, power hierarchies and communication differences must be leveled. At the same time, the organization of the clubs must include enough structure and process to produce satisfying outcomes for the community members. Such blending of the political, cultural and technical makes this an intellectually rich ethnography. And, like all of the cases in this section, we learn a great deal about designing appropriate methods and interventions to understand and develop appropriate technologies in complex human settings.

1 QUESTIONS AND CONCERNS

As I read these studies, I was prompted to think more broadly about what they tell us about human technology use, particularly how researchers can help people in diverse communities with limited resources. The starting points for all of these studies are principles of Value Sensitive Design, but there is no one-size-fits-all guidebook for applying those principles. These studies help us see how researchers must improvise their access practices, documentary methods, and technology interventions to suit local conditions. In developing these context- specific strategies, researchers constantly face questions of interpersonal comfort and moral choice. I recall here a personal experience from many years of fieldwork in war zones of Central America, where gaining access, securing personal acceptance, and managing risk were often negotiated on a daily basis. I recall helping NGO workers in a Guatemalan refugee camp improvise chimneys to help families cook inside their shelters without suffering serious lung and eye damage due to the smoke. Although this was a simple bit of technology, it required negotiations with the villagers who had no need of such technology in their traditional houses. During this same period in the 1980s, I also visited Miskito Indian villages on the Nicaraguan Atlantic. During an early trip, I was given several beautiful long needle pine baskets to take back to the US. Before returning to the region, I met with a colleague who was a leader of a North American Indian tribe. She gave me a box of colorful beads and bright sequins to give to the women who wove the baskets. I was initially reluctant to intervene in what seemed to me a traditional native practice. However, when I returned to one of the villages, the women who made the baskets were thrilled to have new objects to weave into their work. In the process, I also learned that what I assumed was a "*traditional*" craft actually resulted from fairly recent missionary teaching. My introduction of new materials actually helped the women make the work more their own. Similar lessons apply to communication technologies in the sense that fieldworkers can offer new training or technology, while leaving the process of appropriation open to local innovation.

At the same time, researchers should resist taking too strong a position on how the outcomes should look. It is also wise to avoid rigid expectations about whether our interventions will be productive all. To paraphrase a Silicon Valley motto: sometimes failure leads to new insight. I recall here an interesting collaboration with technology developers from Occupy Wall Street in the US in 2011-2012. This was part of a larger project on community technology development with Alan Borning and a team of graduate students. After months of protests and occupations of public spaces across the US, the physical occupations finally ended with police removal of Occupy camps and the onset of winter weather. However, many of the activist developers with whom we collaborated felt that continued communication and connectedness in the movement were desirable, even if based on technology platforms rather than physical proximity. We agreed on building a virtual assembly platform that would be more secure than available commercial options and have more desirable functionalities. A working platform was developed by Travis Kriplean and our team, with the participation and approval of a number of the Occupy technology developers. However, adoption of the platform was rejected by activists who attended the last national gathering of Occupy in 2012. Our understanding was that many of the core activists demanded physical sacrifice and face-to-face meetings as principles of commitment to the movement. It would have been easy for us as researchers to judge this as an imposition of values by a minority faction on the far larger movement. However, we also understood that building a more sustainable and coherent national movement was a point of division among the activists (which echoed similar divisions in the Social Forum movements earlier in the century). Similar platforms later became common among technology-enabled parties and movements such as various Pirate Parties, the early days of Podemos in Spain, Barcelona en Comu, and the Italian 5 Star party. However, there is growing evidence that they often fail to generate large scale or coherent engagement.

In closing, I hope that these pieces can somehow be shared more broadly across often-fragmented academic fields. Indeed, these studies have strong relevance beyond computer science audiences, with potential interdisciplinary appeal in anthropology and political science, among other fields. The isolation of academic fields is a problem for much of our work these days. As I read these pieces, I thought of the many similarities with work of John Gaventa in his book *Power and Powerlessness*, and of James Scott and his *Weapons of the Weak*, among other far flung scholars. At the same time, I recognize that these studies are only partly academic in nature and are importantly aimed at learning how to help people use technologies to improve often difficult life conditions. In this sense, these studies may serve best as reminders to their own heavily commercialized technology field that such public interest teaching and research can be greatly strengthened and better supported by government policy and research funding.

Introduction to End User Development

Thomas Ludwig, Volkmar Pipek, Gunnar Stevens, Volker Wulf

From the very beginning of our work in the computing domain, we followed an emancipatory guiding principle. We believed that IT artefacts ought to be developed in support of human capabilities – not in restricting or even worse replacing them. Such a normative position had implications for the way, we assumed, software should be developed and applied in practice. We believed that the users perspective ought to become part of the development process, but additionally, software needs to stay flexible in use. IT artefacts are immaterial in nature and their software, in theory, should be changeable to a high degree with little efforts. In practice, we experience that software is often perceived to be rigid and restricting users' activities. So, we tried to explore "*how to make software softe*r" in support of always differentiated and changing social and organizational practices. This lead to a vision to understand IT artefacts as boundary objects in support of its cooperative appropriation within use.

When starting our endeavor, we were strongly influenced by the Scandinavian School of Participatory Design (Bjerknes et al. 1987; Floyd et al. 1989a; Greenbaum and Kyng 1991; Bodker et al. 1993) and Christiane Floyd's related work, specifically the STEPS framework (Floyd et al. 1989). However, we believed that co-design activities should not end when a development cycle is finished and the IT artefact is handed over into practical use. Software ought to be designed in a way that it could be flexibly appropriated by practitioners during use time (Wulf 1994). Henderson and Kyng (1991), Nardi (1993), and Oberquelle (1994) had already started to explicate a similar vision. In this regard, our perspective is driven by the users' in-situ design work, consisting of activities of technology configuration, tailoring and the development of conventions.

We looked at this problem first of all from a software technical angle. 'Tailorability' became a key design concept already in our work in the PoliTeam project when we developed groupware for the political administration. It became clear that functionality rigidly implemented in the shared workspace application often did not

fit the user differentiated needs. When designing tailorable applications, we distinguished three problem dimension:

- Interfaces which would enable to handle the complexity when tailoring IT artefacts in use,
- Software architectures which would allow to tailor the IT-artefact's runtime behavior while being in use,
- Support for collaboration which would support sharing of tailored artefacts and knowledge within communities of users.

With regard to interface concepts, we suggested to structure the user interface of a tailorable IT artefact in a way that the interface location to tailor a certain function would be closely attached to the location at which the function itself could be activated. In the paper in this collection, we describe this design principle, 'Direct Activation', and explore empirically its effectiveness. Direct Activation support tailorability by making its realizations easy to be found at the interface level. For groupware, we postulated a second design principle which we called 'Exploration Environment' (Wulf 2000; Wulf und Golombek 2001). It allows users to understand the state of a tailorable groupware function by simulating its effects on other users' interfaces.

Over time, we explored different software technologies with regard to their potential to serve as a basis to implement tailorable applications. Some of these technologies, we had to extend to allow for runtime reconfiguration of the software modules. Traditional components and service architectures did not allow to recompose the software modules after compile time.

In the context of the PoliTeam project, we started to investigate how to apply rule-based programming to implement tailorable functionality, e.g. access control. The rule-based software architecture was equipped with a natural language interface to explore which access regulation the active rules were implying (Wulf et al. 1997).

Based on the experiences gained in the PoliTeam project, a PhD student, Oliver Stiemerling, developed a platform which allowed to tailor component configurations at runtime. The EVOLVE platform allowed to tailor multi-layered compositions of component implemented according to the FLEXIBEANS component model. A 3D interface enabled users to manipulate the multi-layered component configuration (Stiemerling 2000). To support users in finding appropriate configurations of components, a second PhD student, Markus Won, developed a constraint-based approach to check the composition's integrity interactively (Won 2004). The paper in this volume describes the overall approach of component-based tailorability.

Being able to recompose components at runtime, we started to think about how to decompose an application's functionality into components and to define different component layers to create the technical flexibility anticipated to be needed (Stevens et al. 2006). Technical flexibility in use was always challenged by the argument that not every user is able and willing to tailor its application. We always believed that tailoring, as much as appropriating, an IT artefact needs to be understood as a collective endeavor. In the context of the PoliTeam project, we

experimented with different approaches to support cooperative tailoring activities. Wulf (1999) developed a search tool which offered layered tailoring complexity by means of a hierarchical component language. Users created and shared alternative search tools and higher-level components in their work practice. To ease cooperative tailoring activities, we implemented features, which allowed users to structure, describe, and explore shared components and search tool alternatives. Kahler (2001) developed an add-on to a word processor which provided a public and a private repository for adaptations as well as a mailing function for users to exchange adaptations. Some notification and annotation mechanisms were also provided.

By the early 2000s, we had elaborated on a rather unique research agenda to enable technical flexibility in practice. Via our engagement at Fraunhofer FIT, we were lucky enough to become a coordinating partner of a newly stated Network of Excellences (NoE) – funded by the EU commission to foster technical flexibility in use. The NoE framed the concept of End User Development (EUD) and connected us with the leading US research groups. The paper included in this volume is the introduction chapter for a book which defined the field of EUD (Lieberman et al. 2006). The definition of End User Development goes beyond that of tailorability in the sense that it also included end-user programming and (semi-) automatic adoption of IT artefacts. From the NoE a vibrant international community emerged in the field of End User Development, we hosted the first International Symposium (IS-EUD) in Siegen (Pipek et al. 2009). Later, the initial book about EUD (Lieberman et al. 2006) received a new edition in 2017, in which we address a strongly practice-based conceptualization of EUD (Paterno & Wulf 2017).

In the following years, our own work moved from a purely technical understanding of flexibility in use (tailorability) towards a rather socio-technical perspective which additionally addressed flexibility resulting from users' appropriation work. In the context of his dissertation, Volkmar Pipek looked at what forms of collaborative appropriation exist and what technological support for such appropriation practices might look like (Pipek 2005). To this end, he derived the concept of appropriation infrastructures, which provide functionalities directly within the software itself in order to discuss usage practices and use discourses with the corresponding software. In doing so, he showed that by building appropriation infrastructures it may also be possible to capture and support social, organizational, and communicative aspects of a software use.

Following work by us (Stevens et al 2009) made use of the concept of appropriation infrastructures to support innovation processes between users of a software and its developers. By capturing a variety of contextual parameters and allowing them to be discussed in relation to actual usage, user-driven innovation processes on the part of software users were triggered, which directly resulted in software improvements and new functionalities. One of our PhD students, Sebastian Draxler examined appropriation frameworks for software-centered domains and how participative feedback tools might support implementation activities (Draxler et al. 2012). Another PhD student, Christian Dörner, investigated how the concepts of EUD can be applied to the modeling of business workflows. For this purpose, he

designed graphical user interfaces that support the simple, modular nesting of business processes by means of underlying micro-service infrastructures.
While our work aforementioned mainly suggested ways of supporting EUD and appropriation of software environments, the emerging developments around the internet of things as well as a more material, hardware-related ecology of cyber-physical technologies need to consider physical-material issues in the context of the challenges end users encounter. Especially the materiality poses a new dimension for EUD research too, as it is not clear in how far insights from software can be easily transferred or adapted to the hardware domain. For this reason, we used 3D printing to conduct studies on the appropriation of such hardware-centered application contexts. Within the paper in this volume (Ludwig et al. 2017), we revealed the different levels of appropriation of a 3D printer and coined the term "*Sociable Technologies*", which encompasses hardware-centered appropriation infrastructures. Sociable technologies include ways of communicating and coordinating usage practices within the hardware itself. Based on the uncovered challenges in the appropriation of hardware-related systems, we showed that new user interfaces are needed to provide not only the actual use of the hardware, but also so-called "*second layer*" functionalities directly on the hardware itself. Based on concepts of augmented reality, we developed within the paper in this volume (Jasche & Ludwig 2020) new interfaces that supported not only the onboarding of a technology, but more importantly its use and exploration in usage practice.
Research in End User Development was typically a part of almost all our design work – implicitly or explicitly mentioned and discussed. While crucially important, we received only in the 2000s some research funding to build a coherent research agenda. While we were able to explore the design and appropriation of many highly flexible functionalities, we were not (yet) capable to build an application which would offer a consistently designed level of technical flexibility and appropriation support. Especially the context of use, which cannot be planned in advance, and changing practices of use require detailed case studies and new concepts around appropriation infrastructures. So, there is still some way to go!

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END-USER DEVELOPMENT: AN EMERGING PARADIGM

HENRY LIEBERMAN, FABIO PATERNÓ, MARKUS KLANN, AND VOLKER WULF

We think that over the next few years, the goal of human-computer interaction will evolve from just making systems easy to use (even though that goal has not yet been completely achieved) to making systems that are easy to develop. By now, most people have become familiar with the basic functionality and interfaces of computers. However, developing new or modified applications that effectively support users' goals still requires considerable expertise in programming that cannot be expected from most people. Thus, one fundamental challenge for the coming years is to develop environments that allow users who do not have background in programming to develop or modify their own applications, with the ultimate aim of empowering people to flexibly employ advanced information and communication technologies.

Current trends in professional life, education and also in leisure time are characterized by increasing change and diversity: changing work and business practices, individual qualifications and preferences, or changes in the dynamic environments in which organizations and individuals act. The diversity concerns people with different skills, knowledge, cultural background and cognitive or physiological abilities, as well as diversity related to different tasks, contexts and areas of work. Enhancing user participation in the initial design of systems is part of the solution. However, given that user requirements are diversified, changing, and at times hard to identify precisely, going through conventional development cycles with software-professionals to keep up with evolving contexts would be too slow, time-consuming and expensive. Thus, flexibility really means that the users themselves should be able to continuously adapt the systems to their needs. End-users are generally neither skilled nor interested in adapting their systems at the same level as software professionals. However, it is very desirable to empower

users to adapt systems at a level of complexity that is appropriate to their individual skills and situations. This is the main goal of EUD: empowering end-users to develop and adapt systems themselves. Some existing research partially addresses this issue, advocating casting users as the initiators of a fast, inexpensive and tight co-evolution with the systems they are using (Wulf 1999; Arondi et al. 2002; Mørch 2002 ; see also the "Agile Programming" techniques of Beck 1999 and Cockburn 2002))

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Component-based tailorability: Enabling highly flexible software applications

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Abstract Component technologies are perceived as an important means to keep software architectures flexible. Flexibility offered by component technologies typically addresses software developers at design time. However, the design of software which should support social systems, such as work groups or communities, also demands 'use-time', or technically spoken, 'run-time' flexibility. In this paper, we summarize a decade of research efforts on component-based approaches to flexibilize groupware applications at run-time. We address the user as a 'casual programmer' who develops and individualizes software for his work context. To deal with the challenges of run-time flexibility, we developed a design approach which covers three levels: software architecture, user interface, and collaboration support. With regard to the software architecture, a component model, called FLEXIBEANS, has been developed. The FREEVOLVE platform serves as an environment in which component-based applications can be tailored at run-time. Additionally, we have developed three different types of graphical user interfaces, enabling users to tailor their applications by recomposing components. To enable collaborative tailoring activities, we have integrated functions that allow sharing component structures among users. We also present different types of support techniques which are integrated into the user interface in order to enable users' individual and collaborative tailoring activities. We conclude by elaborating on the notion of 'software infrastructure' which offers a holistic approach to support design activities of professional and non-professional programmers.

Keywords Tailorability; End user development; Component-based systems; CSCW

in: Journal of Organizational and End User Computing (JOEUC), Vol. 22, Issue 2, 2010, 58-81

Appropriation Infrastructure: Mediating appropriation and production work

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Abstract End User Development offers technological flexibility to encourage the appropriation of software applications within specific contexts of use. Appropriation needs to be understood as a phenomenon of many collaborative and creative activities. To support appropriation, we propose integrating communication infrastructure into software application that follows a “easy-to-collaborate“-principle. Such an appropriation infrastructure stimulates the experience sharing among a heterogeneous product community and supports the situated development of usages. Taking the case of the BSCWeasel groupware, we demonstrate how an appropriation infrastructure can be realized. Empirical results from the BSCWeasel project demonstrate the impact of such an infrastructure on the appropriation and design process. Based on these results, we argue that the social construction of IT artifacts should be tightly integrated in the material construction of IT artifacts in bridging design and use discourses.

in: Behaviour & Information Technology, Vol. 20, No. 4, 2001, 249 - 263

Direct Activation: A Concept to Encourage Tailoring Activities

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Abstract The design of the user interface plays a major role in encouraging users to tailor an application. In this paper, we focus on a particular design issue. The question is how to support users in finding those functions, which allow to tailor an application. An empirical investigation shows that this is a major problem when users try to tailor applications. In order to tackle this problem we develop the concept of direct activation, which simplifies to find a tailoring function at the moment a tailorable function needs to be modified. To evaluate the effectiveness of the concept of direct activation in supporting tailoring activities, we have implemented the concept and carried out an evaluation study. The results of this study support our assumption that direct activation eases tailoring activities. Finally, the potentials and limitations of this concept are discussed.

Keywords Tailorability, User Interface, Direct Manipulation, Field Study, Empirical Evaluation

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What Happened in my Home?: An End-User Development Approach for Smart Home Data Visualization

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Abstract Smart home systems change the way we experience the home. While there are established research fields within HCI for visualizing specific use cases of a smart home, studies targeting user demands on visualizations spanning across multiple use cases are rare. Especially, individual data-related demands pose a challenge for usable visualizations. To investigate potentials of an end-user development (EUD) approach for flexibly supporting such demands, we developed a smart home system featuring both pre-defined visualizations and a visualization creation tool. To evaluate our concept, we installed our prototype in 12 households as part of a Living Lab study. Results are based on three interview studies, a design workshop and system log data. We identified eight overarching interests in home data and show how participants used pre-defined visualizations to get an overview and the creation tool to not only address specific use cases but also to answer questions by creating temporary visualizations.

Keywords Smart Home; Qualitative Study; Data Visualization; domestic routines; Living Lab; Interface Design
ACM Classification Keywords User interfaces - User-centered design

ACM Transactions on Computer-Human Interaction (TOCHI) 24(2), Article No.: 17, 1–28

3D Printers as Sociable Technologies: Taking Appropriation Infrastructures to the Internet of Things

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Abstract 3D printers have become continuously more present and are a perspicuous example of how technologies are becoming more complex and ubiquitous. To some extent, the emerging technological infrastructures around them exemplify ways how digitalization will change production machines and lines, in general, in the Internet of Things (IoT). From an End-User Development perspective, the main question is how users can be supported in managing those complex digital production lines. To reach a better understanding, we carefully analyzed 3D printers as an example of highly digitalized production machines with regard to the creative activities of their users that help them to make these machines work for their practices. In our study of appropriation processes, we are concerned with situational and social aspects of the configuration and practice challenges associated with making digitalization work and how IoT technologies can support these collaborative appro- priation activities of end users by making these machines more "sociable." We therefore conceptualize the idea of "Sociable Technologies" and implement a prototype that provides hardware-integrated affordances for communicating and documenting practices of usage. Based on the findings of our evaluation, we derive lessons learnt when aiming at making complex technologies more usable.

Keywords (User Interfaces): User-centered design, Sociable Technologies, End-User Development, Appropriation Infrastructure, Infrastructuring, 3D Printer, Internet of Things, User-Centered Design, Design Case Study

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PrintARface: Supporting the Exploration of Cyber-Physical Systems through Augmented Reality

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Abstract The increasing functionalities and close integration of hardware and software of modern cyber-physical systems present users with distinct challenges in applying and, especially, appropriating those systems within their practices. Existing approaches to design for appropriation and the development of sociable technologies that might support users seeking to understand how to make such technologies work in a specific practice, often lack appropriate user interfaces to explain the internal and environment-related behavior of a technology. By taking the example of 3D printing, we examine how augmented reality can be used as a novel human–machine interface to ease the way for hardware-related appropriation sup- port. Within this paper we designed, implemented and evaluated a prototype called PrintARface, that extends a physical 3D printer by incorporating virtual components. Reflections upon the evaluation of our prototype are used to provide insights that foster the development of hardware-related appropriation support by encompassing augmented reality-based human–machine interfaces.

Keywords Human–machine interface, 3D printing, augmented reality, sociable technologies, appropriation
CCS Concepts • Human-centered computing → Mixed / augmented reality

End-User Development: From Creating Technologies to Transforming Cultures

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This section of the book consisting of seven papers documenting the activities focused on the theme *End-User Development (EUD)* of the research team at the University of Siegen over the last two decades.

Beyond specific contribution discussed in detail in the individual papers, the *fundamental contribution* of the team consisted in (1) framing the concept of End User Development (EUD), (2) hosting the first International Symposium (IS-EUD) in Siegen in 2009, and (3) serving as the focal point of an international community focused on exploring a great variety of different aspects of EUD. The IS-EUD symposia are a bi-annual event for researchers and practitioners with an interdisciplinary approach to EUD, including interactions with researchers and conferences in Human-Computer Interaction, Software Engineering, Computer Supported Cooperative Work, Computer Supported Collaborative Learning, Design of Interactive Systems, and other related areas. The edited book "*End-User Development*" [Lieberman et al., 2006] represented another milestone to establish and promote EUD as a fundamental topic. In addition to the global impact, EUD research issues were explored locally in several PhD theses at the University of Siegen.

The seven papers address specific themes of EUD describing concepts, prototypes, and empirical studies. Developments and concepts include

- paper-1: *direct activation* simplifying to find a tailoring function, when needed;
- paper-2: *component-based tailorability* as an important means to keep software architectures flexible, not only at design time (by software professionals) but at use time (by domain expert or end-users);

- paper-3: the introduction to the already mentioned *book "End-User Development*;
- paper-4: the use of *augmented reality* to support the exploration of cyber-physical systems;
- paper-5: a smart *Home Data Visualization environment* featuring both pre-defined visualizations and a visualization creation tool;
- paper-6: an infrastructure for *appropriation* stimulating knowledge sharing among users and between users and developers; and
- paper-7: extending EUD aspects from software systems to *hardware technologies* in the context of Internet of Things.

The selected seven papers provide an *excellent overview of important EUD topics*. In the spirit that EUD transcends the information given, I would like to contribute two things:

- to add a couple of themes (some of them being mentioned also in the seven papers) that I consider relevant to the objective to understand EUD not only as a technology but as a cultural transformation; and
- to give my views and expectations addressing the challenge of articulated in the last sentence of the introduction of the authors to this section of the book: "*there is still some way to go!"*

1 EUD — Visions and Developments beyond Making Software Modifiable and Extendable

The focus of the seven papers is on prototypes of software systems and empirical studies developed in the framework of the Siegener research team. Their unique approach is grounded in *socio-informatics* [Wulf et al., 2018] with the objective to investigate the design of computer applications in support of social systems, including the particular consideration on ethical, legal and social aspects. The developments were done in the context of real world problems by analyzing the practice of all involved stakeholders, and their empirical studies were conducted not in the ivory tower of isolated research labs, but in *living laboratories*.
To support my personal belief [Fischer, 2021] that EUD visions and developments are critical for a future in which people and communities have control over decision and tools that affect them and support them in acting creatively by coping with change, I will briefly mention some other sources that I consider foundational for EUD research activities:

- Ivan Illich in his book "*Tools for Conviviality*" [Illich, 1973] illustrates the relevance of convivial tools for EUD by ascribing the following characteristics to them: "*Tools foster conviviality to the extent to which they*

can be easily used, by anybody, as often or as seldom as desired, for the accomplishment of a purpose chosen by the user."

- Eric von Hippel in his book "*Democratizing Innovation*" [von Hippel, 2005] provides convincing evidence from different domains for the desirability of EUD by stating "*Users that innovate can develop exactly what they want, rather than relying on manufacturers to act as their (often very imperfect) agents*".
- Yochai Benkler in his book "*The Wealth of Networks: How Social Production Transforms Markets and Freedom*" [Benkler, 2006] explores the importance of incentive mechanisms behind common-based peer production by stating: "*People participate in peer production communities*," they write, "for a wide range of intrinsic and self-interested reasons....basically, people who participate in peer production communities love it. They feel passionate about their particular area of expertise and revel in creating something new or better.
- Richard Thaler and Cass Sunstein in their book "*Nudge — Improving Decisions about Health, Wealth, and Happiness*" [Thaler & Sunstein, 2009] define and explore a framework derived from behavioral economics and introduce interesting metaphors for EUD such as "*liberterian paternalism*" and the role of "*choice architects*" who define the paternalism part by organizing the context providing features and support for the liberterian part by allowing all people to make decisions in problems that affect them.

A concise definition of EUD does not exist but grounded in the contributions of the seven papers in this section and the descriptive and prescriptive frameworks provided by the mentioned books, the following descriptions can be used to characterize EUD: (1) it represents the objective to empower all stakeholders (designers, users, workers, learners, teachers) to actively participate and to make their voices heard in personally meaningful problems and (2) it is instrumental for the ability to reformulate knowledge, it allows people to express themselves creatively and appropriately, and it empowers stakeholders to produce and generate information rather than simply to comprehend it.

Our own work centered on EUD (inspired over a couple of decades by our close collaboration with the Siegener research team) focused on two approaches:

- Meta-Design. Meta-design is "*design for designers*" [Fischer & Herrmann, 2015]. It represents an emerging conceptual framework aimed at defining and creating social and technical infrastructures in which participatory cultures can come alive and new forms of collaborative design can take place. It complements and transcends participatory design being focused on the design time of systems by extending design beyond the original development of a system to allow users become co-designers and co-developers [Binder et al., 2011]. It is grounded in the basic assumption that future uses and problems cannot be completely anticipated at design time,

when a system is developed. Users, at use time, will discover mismatches between their needs and the support that an existing system can provide for them. These mismatches will lead to breakdowns that serve as potential sources of new insights, new knowledge, and new understanding. Meta-design addresses the following features of socio-technical environments: (1) it allows them to be flexible and evolve because they cannot be completely designed prior to use; (2) the end-users are the primary agents to drive the evolution; and (3) the meta-designers design systems explicitly for evolution.

- Cultures of Participation. The rise in social computing (based on social production and mass collaboration) has facilitated a shift from consumer cultures (specialized in producing finished artifacts to be consumed passively) to cultures of participation (in which all people are provided with the means to participate and to contribute actively in personally meaningful problems) [Fischer, 2011]. These developments represent unique and fundamental opportunities, challenges, and transformative changes for EUD as we move away from a world in which a small number of people define rules, create artifacts, make decisions for many consumers towards a world in which everyone has possibilities to actively participate by creating widely accessible artifacts. These transformations will create foundations for a different kind of society than one where citizens, workers and learners are confined to the role of consumers. Cultures of participation are facilitated and supported by a variety of different technological environments (such as: the participatory Web ("*Web 2.0*"), table-top computing, domain-oriented design environments); all of them contributing in different ways to the aims of engaging diverse audiences, enhancing creativity, sharing information, and fostering the collaboration among users acting as active contributors and designers. They democratize design and innovation [von Hippel, 2005] by shifting power and control towards users, supporting them to act as both designers and consumers and allowing systems to be shaped through real-time use.

2 The Future: "*there is still some way to go*"

While it is important to understand *"how things are*" (as explored in empirical studies of existing artifact and socio-technical environment), the central objective of design is to envision *"how things could or should be"* in the years to come. I hope that some of my reflections will be of some value and will stimulate further developments for the researchers and communities who will explore the future of EUD.

In a world that is not predictable, improvisation, evolution, and innovation are more than luxuries: they are necessities. The challenge of design is not a matter of getting

rid of the emergent, but rather of including it and making it an opportunity for more creative and more adequate solutions to problems. *Future developments* in EUD should provide the enabling conditions for putting owners of problems in charge by defining the technical and social conditions for broad participation in design activities by fostering new mindsets, new sources of creativity, and cultural changes to create foundations for innovative societies.

While the growth of technologies such as EUD is certain, the inevitability of any particular future is not. In a world facing wicked problems the aim is not to find truth, but to improve the quality of life for all humans. A serious commitment to EUD will not happen by itself but will require facilitating cultural transformations that will empower all stakeholders and creates the foundations for mindsets in learners and workers to see themselves as active contributors rather than passive consumers.

A fundamental attribute of wicked problems such as EUD is that there are no best unique solutions (especially without defining particular contexts). The identification and analysis of design trade-offs is critical for being aware of potential *pitfalls* associated with EUD. The following short list provides some examples of design trade-offs associated with EUD:

- Division of Labor versus Empowerment of Individuals. Democratizing design by putting owners of problems in charge does not mean that there is no place for professionals in the future. By arguing for the independence of owners of problems from high-tech scribes, a legitimate question to ask is whether this will reverse the division of labor that has been a major driving force in advancing our societies. Professional designers play an important role in our society: most persons are not able to and do not want to build their own houses, design their own cars, or write their own software systems or sorting routines. People do not have the time to participate equally in all aspects of human life in order to become fully engaged and informed, and therefore they rely on intermediaries to act in their interests.
- Participation Overload and Personally Meaningful Problems. Information overload has been discussed as a fundamental problem for the information society. I claim that participation overload will be one of the most serious problems for future societies. Two pitfalls need be avoided: (1) individuals should not be forced to act as active contributors in situations where they want to be consumers (this is mostly the case in the context of problems and activities which are irrelevant to people); and (2) they should not be restricted to consumers where they want to be active contributors and decision makers (this is mostly the case in personally meaningful situations). Many people expiring a lack of time, being overcommitted, and feel guilty about not participating enough. This design trade-off creates the fundamental challenge to develop criteria and to be judicious about one's participation and how to develop a culture that respects a person's choices about when and how to participate.

- Tension between Standardization and Improvisation. EUD creates an inherent tension between standardization and improvisation. Software companies argue to reduce the number of customer modifications because they imply costs for maintaining them. To reduce the costs of customer-specific changes, one of the key objectives during reseeding phases of systems should be to return to a new standard which they in return can undergo further modifications. Finding the right balance between standardization (which can suppress innovation and creativity) and improvisation (which can lead to a Babel of different and incompatible versions) for example has been a challenge in open source environments in which forking has often led developers in different directions.

3 Beyond Technologies: Cultural Transformations

To deeply understand the potential transformation of human lives enriched rather than limited by EUD technologies, discourses and investigations must not only be focused around technological issues but explore motivation, control, ownership, autonomy, quality of life, and cultural transformation. In the spirit of the Siegener framework of socio-informatics [Wulf et al., 2018], changes in complex environments are not primarily dictated by technology but they are the result of a shift in human behavior and social organization. The design of socio-technical environments requires the co-design of social and technical systems. While the growth of technologies such as EUD is certain, the inevitability of any particular future is not. In a world facing wicked problems the aim is not to find truth, but to improve the quality of life for all humans.

The most prominent example of a wicked problem in the year 2020 and 2021 is COVID-19. The pandemic requires that we practice new ways to live and learn together by facing the challenge “to learn when no one knows the answer”. COVID-19 is one instance for a wicked problem requiring all stakeholders “to think outside the box”. It illustrates the need to deal with unexpected challenges which will occur in today’s fast-changing world, in which people are facing increasingly increasing numbers of unknown, unexpected, and unpredictable situations. It also points to the necessity of iterative experimentation to gain new knowledge. Many of these requirements have been explored in EUD research efforts.

4 In Summary

Providing all citizens with the means to become co-creators of new ideas, knowledge, and products in personally meaningful activities presents one of the

most exciting innovations and transformations with profound implications in the years to come. This objective characterizes the vision behind EUD as a cultural transformation. To make this vision a reality, the EUD research community needs to establish new discourses and shared languages about concepts, assumptions, values, stories, metaphors, design approaches, and learning theories. All citizens by claiming ownership in personally meaningful problems should be empowered to design, build, and evolve their own artifacts and choice architects and meta-designers should create environments to situate computation in new cultural and material contexts, with socio-technical environments that democratize design.
As documented in the seven articles in this section of the book, the research team at the University of Siegen has been a leader *to move EUD from barely noticed to center stage* — a place that it deserves to be by representing one of the most exciting innovations and transformations for the digital age.

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Commenting on EUD section of Siegen group's research summary volume

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I have commented on the papers in the EUD section in the order they were published and "*weighting them*" according to how the work has intersected and influenced my own work. This commentary is therefore a "*subjective impact analysis*" rather than the one we get by automated systems. Volker Wulf and I started to communicate on topics in end-user development in the spring of 1996. At that time, I was a visiting researcher at CU Boulder in Gerhard Fischer's research group. I sent Volker an email and later a letter with some papers and in return I received papers from him. We exchanged information on tailorable systems, end-user tailoring and software engineering models, which became important precursors the field of end-user development (EUD) we know of today. For example, I received a paper Volker had written with Markus Rohde on extending the STEPS methodology (originally developed by Christiane Floyd at Hamburg University) with tailoring support, while I was working on my PhD at University of Oslo with Kristen Nygaard and sent Volker papers on tools for end-user tailoring of object-oriented applications. Volker had just finished his PhD at University of Dortmund with Thomas Herrmann, and he now led a research group on HCI and CSCW (ProSEC) at the Institute for Computer Science at the University of Bonn. Our email conversations on EUD lead to a workshop on *"Tailorable systems and cooperative work"* in Phoenix, AZ in may 1997 (Group'97 conference), in which Helge Kahler and Oliver Stiemerling were co-organizers. A few years later (2000) we edited a special issue of jCSCW on Tailorable systems and cooperative work. I have stayed in contact with Volker since then as well as with Markus, but I have lost contact with Helge and Oliver. One of the topics we discussed was the precursor to the

concept of "*direct activation*," or direct access to tailoring functionality from the normal (default) user interface of a computer application. Direct activation (DA) is the topic of the first paper in the EUD section in this volume and written by Volker Wulf and Bjorn Golombek (Wulf & Golombek, 2001). Direct activation builds on and extends the notion of direct manipulation in HCI. The authors developed a conceptual design based on a review of previous work, and carrying out two empirical studies that explores DA as enabler for tailorable systems. In the same way as DM became a key concept in HCI, the authors argue, and with good reason, DA is a key concept in EUD. DA means to access the multiple levels of a system's functionality from the point of main use of the system (e.g. user activity; practice situation) which is a primary concern in EUD. The authors cite a work of mine in which I suggest using event-handlers (e.g., option, alt, or control) on visual objects (called application units) to access the different levels of a system's functionality (e.g. Mørch, 1995; 2003). One of the user experiments carried out by Wulf and Golombek is based on a model of event transmission (creation and display). A system instance (sample, practical application) for testing the experimental hypothesis of different ways of finding out about tailoring functionality did the authors create. The empirical studies found of this experiment prototype showed that visual interface objects can provide "*handles*" for much of the functionality one needs to access when tailoring a system, thus corroborating and strengthening a previous working hypothesis.

In 2006, the first edited volume on EUD was published, a Springer volume containing works from many of the members of the EUD-Net project. EUD-Net was EU network of excellence in 2002-3, during which Volker Wulf was a seminal person to organize. In the book, the first definition of EUD was proposed, "*as a set of methods, techniques, and tools that allows users of software systems, who are acting as non-professional software developers, at some point to create, modify or extend a software artifact."* (Liberman, Paterno, Klann & Wulf, 2006, p. 2). Other definitions have been proposed before and after (e.g. Costabile et al. 2003; Batalas, et al., 2021). For example, Costabile and colleagues (2003) emphasize the role of domain-expert users (rather than non-professional developers), and Batalas and colleagues (2021) emphasize the distinction of technical development and EUD. Personally, I have found all the three definitions useful, but perhaps most useful is the 2006 definition. as it emphasizes modification and extension of existing software, which is the type of EUD I focus on in my research. Moreover, in the opening chapter of the EUD book, the authors make a distinction between two levels of tailoring: 1) parametrization or customization of the user interface, and 2) program creation or modification of program code. They also refer to some other techniques that fall in-between the two levels, such as model-based development, incremental programming and programming by example. The authors did not highlight and name a 2nd level between customization and programming, which was perhaps the strongest contribution of the Bonn group to EUD, namely component-based development to tailorability. They had already worked on this topic for some years and the third paper in this volume summarizes their efforts. It should be mentioned that two precursors to the "*middle level*" are Henderson &

Kyng (1991) who called it "*constructing new behaviour from existing pieces*" and Mørch who call the 2nd level, integration (Mørch, 1995).

The components approach to EUD pioneered by the Bonn group differs from the "*programming approach*" in that end users interact with components in visual builders to select, modify and connect components using high-level operations rather than writing program code in a text editor. However, components must be programmed before they can be deployed in visual builders; they might even be end-user programmable, making it difficult to draw a straight line between the two approaches. In Wulf, Pipek & Won (2008), the authors suggest an approach to component-based tailorability consisting of three levels, software architecture, user interface and collaboration support, where the last level (collaboration support) is an organizational element, thus extending tailoring into user organizations. The architecture level is to describe the flexibility of the tailorable system, and this is supported by a component model called FlexiBeans. The model is aimed at tailorability for casual users, not CS professionals, which means an architecture to be modifiable with simple commands and accessible tools for component integration (composition). The user interface is a graphical user interface that represent the components as graphical boxes and connections between them by movable arrows (e.g., visualizing data flow) with input and output ports for connecting two components. The challenge with this approach is to make port (replicating object-method calls) and component names meaningful for domain expert users (casual programmers). The FreeEvolve platform developed by Wulf, Pipek, and Won (2008) provides a user interface based on the architecture, which consists of a palette of basic search application functionality for composing small database applications within the domain. A user study of the system revealed the strength of direct activation of tailoring functionality but showed also a weakness of manually connecting two components. User-assistance techniques such as 3D visualization and organization (part/whole structures) were added to resolve the weaknesses. An interesting avenue for further work based on this pioneering work is to compare CBD in EUD with parallel efforts of block-based programming but based on another component model (i.e., jigsaw puzzle metaphor).

The work on component-based tailorability paved the way for subsequent work at the University of Siegen by the emerging group of PhD scholars, many of who finished their PhDs elsewhere and later secured faculty positions at the University of Siegen and have established labs with own research agendas in CSCW, HCI and virtual reality, among others. Two key concepts for the joint endeavors are appropriation infrastructure and collaborative tailoring. To the best of my knowledge these terms were fist coined in Volkmar's PhD thesis at the University of Oulu in Finland and Helge Kahler's at the Roskilde University in Denmark, respectively. Gunnar Stevens extended the appropriation infrastructure concept in his PhD at the University of Siegen by integrating appropriation support and the IT artifact (a successful demonstration system, BSCWeasel was developed for this purpose). Thus, the work of Prof. Wulf, his research students and later colleagues have moved in somewhat different directions by extending and harnessing the early

work on tailorable systems and direct activation. Therefore, the Wulf group's success is to a large extent a result of Volker's ability to attract talented researchers and integrating them with an expanding network of external collaborators to join forces in developing interesting ideas for EUD and related areas and publishing them in reputable outlets while also securing funding for these activities.

A word on collaborative tailoring. Kahler (2001) introduced the concept to mean the involvement of a small group of end users to work together during end-user tailoring (local development). Kahler suggested the following characterizations: 1) Provide objectification, 2) allow sharing of tailoring files 3) allow browsing through tailoring files 4) provide awareness of tailoring activities 5) make annotations and automatic descriptions possible 6) allow for exploration of tailoring files 7), make administration and coordination easy, and 8) supporting a tailoring culture. For example, 'tailoring awareness' can help end-user developers share information, form communities and divide the work. Active annotations mean critical or explanatory notes added to a tailoring file in order to provide contextual information (Kahler, 2001). Tailoring cooperation does not come for free because not everyone likes to share a work before being credited for it. Kahler (2001) suggests that end-user development communities need to establish a "*tailoring culture*" for sharing to catch on.

Outside of collaborative tailoring, appropriation is perhaps the foremost concept I associate with the Siegen group, where the latter (EUD) is characterized as the technical system and the former (appropriation) an approach (a conceptual framework) toward it. Pipek describe appropriation as "*an ongoing design process that end users perform largely without any involvement of professional developers*" (Pipek, 2005, p. 5). Based on two long-term empirical studies using a groupware tool developed by Stevens (BSCWeasel), the authors (Stevens, Pipek & Wulf, 2006) identified advanced user activities with this tool in different workplace settings and proposed appropriation support to aid the activities. However, appropriation in the Siegen group's work is closely connected with collaborative tailoring, as the authors characterized appropriation as "*a collaborative effort of end users ... to make sense of the software in their work context*" (Pipek, 2005, p. 5). The appropriation support combines communication, demonstration, negotiation, and tailoring. For example, in the BSCWeasel system communication is embedded in the IT-artifact as a communication channel for collaboration with developers and users, which was implemented as a requirement tracking system based on the Eclipse IDE. The communication system in effect became a plugin to the main system and thus exemplifies the usefulness of component-based development (i.e. they follow their own prescription). Stevens, Pipek & Wulf (2006) provide some interesting recommendations for further work on appropriation infrastructure based on the results of the evaluation study reported in the article. Namely to distinguish personal scope, group scope, and public scope of EUD purposes. The authors argue focusing on multiple scopes will ensure a tighter integration of the infrastructure with the software artifacts it

supports, which is necessary for optimal support of flexible runtime behaviour, according to the authors.

The appropriation infrastructure (AI) concept is connected with the notion of sociable technologies proposed by Ludwig, Boden & Pipek (2017). In this paper, published in the prestigious ACM Trans. on HCI, the authors accomplish multiple goals: 1) extending the EUD concept of AI to HCI with the notion of sociable technologies and 2) carrying out a rigorous empirical study consisting of two rounds of design case study, one identifying design challenges by conducting interviews and the other implementing the challenges into the IT artifact. The IT-artifact in this case is the 3D printer and its software, and the challenges pertain to making this artifact reveal better affordances for interaction and collaboration with end users. The authors identify about 10 design challenges and they are well justified as important features to address an improved version of the 3D printer. The new functionality of the 3D printer is simulated by Arduino board and Raspberry Pi programmable devices connected to the 3D printer environment, i.e., connecting them with sensors to monitor environmental variables deemed important for the printer's users to make sense when they print with expensive materials that may fail (e.g. temperature, humidity, vibration). The discussion of the findings goes into considerable depth and provides convincing arguments for transforming the 3D printer into a sociable technology, or in the authors' own words, turning Internet of Things (IofT) into an Internet of Practices.

The "*practice turn*" toward EUD in the Siegen group is also evident in their later research where the aim is to bring EUD into different practice situations, one being smart home data visualization. In their CHI paper, Castelli et al. 2017, investigated smart home devices from two perspectives, usage and appropriation. The authors carried out empirical in two rounds, using interviews as data collection technique for both. First they gathered requirements for an improved dashboard for giving overviews of sensor-based data gathered in the informants' homes (N=12) and in the second round gathering data on the use and appropriation of the refined prototype referred to as open.DASH. The background for the study is a very comprehensive literature survey in the research fields comprising smart home data visualization., e.g., visualization in HCI, rule-based formalisms in EUD, and programmable systems to collect environmental data through sensors. The authors make use of empirical methods to support their findings combined with deployment of low-cost technological devices such as Arduino and sensor for measuring temperature, electric consumption and so on. The paper is very well written and the topic aligns with current trends in society for households to be more energy consumption aware and energy efficient to contribute to global climate change concerns. The authors do not include any theoretical perspective in their work and they do not contribute to or analyze knowledge building to follow up on the socially relevant issues that is brought up in the interview data. These are areas (e.g., theory and research methods) for follows up work

The last paper is related to the previous, sociable technologies and appropriation of 3D printers. Jasche & Ludwig (2019) add a new element to the previous work by employing augmented reality (AR) to support appropriation. The AR interface achieves a better match with 3D printer because the spatial relationship between physical objects is maintained across the two systems. A disadvantage is that it is more complex (cumbersome) to use an AR system for explanation and help because it requires use of 3D glasses. The paper is well written and consists of a rigorous empirical study, and literature review is meticulously undertaken also here, in particular high level in terms of knowledge-based and comprehensive. The authors argue that the novelty of the paper outside of using AR as user interface is to use appropriation on a physical system (3D printer), as appropriation in previous work has mainly focused on software appropriation. A critique, or rather a suggestion for further work seen from my perspective is that the appropriation concept has lost some of its meaning as design concept, as the distinction between appropriation and the (advanced) use of a 3D printer is not clear to me. In return, the notion of sociable technologies is very relevant. The authors suggest different avenues for expanding their work on appropriation by capturing larger parts of the technological use context (inner working, social context, task structure). Another suggestion is to use design rationale, or to capture the design context to supplement the other contexts, thus supporting appropriation as a design concept to more depth. Design rationale is the process leading up to a designed artifact and useful for redesign and further development. If the design rationale can be represented in ways that are less complex than the three context descriptions, it can provide added value to appropriation.

In Summary

The research group led by Volker Wulf at the University of Siegen has contributed strongly to the progress in EUD over the past 25 years. This is tangible in the form of a large number of high-quality, highly-cited papers in prestigious conferences and journals in IS, HCI and CSCW, making the group top-tier of research labs in Europe in these areas. The group has advanced key concepts in EUD, most notable component-based tailorability, collaborative tailoring, appropriation infrastructure, collaborative appropriation, and sociable technologies. Their conceptual work is supported by innovative system building efforts and rigorous empirical studies. Challenges for further work seen from my point of view is to find a coherent theoretical framework (independent of requirements by conferences, journals, and funded research programs), remain focused on appropriation as a EUD concept, e.g., do not lose sight of the hard problems, and continue to to carry out rigorous empirical research with qualitative methods in multiple rounds, but consider more established methodological approaches like design-based research (DBR) from the educational sciences and ethnomethodology from the social sciences rather than home grown design cases studies.

Introduction to Conceptual Foundations and Contributions

Volker Wulf, Gunnar Stevens, and Markus Rohde

Over the past 25 year our conceptual stances and commitments have evolved. In the following, we want to describe the theoretical discourses which influenced our thinking as well as the conceptual and methodological contributions which we have developed to position the field.

Our work originally emerged out of the Informatik und Gesellschaft (I&G) discourse on computers and society in Germany (Coy et al. 1992). The German I&G was a rather diverse, multidisciplinary community which thrived to understand the societal consequences of an increasing digitalization. These phenomena were discussed with the underpinning that the shape of technologies is not an inherent necessity but ought to be designed. The I&G community dealt with a wide range of research topics such as privacy, IT security, software development, technical flexibility, computer supported work, and gender (Brunnstein 1985 und 1987; Kubicek and Rolf 1985; Floyd et al. 1992, Friedrich 1990; Oppermann 1994, Brödner 1985, Friedrich and Rödiger 1991; Schinzel and Schmitz 2004). In all of these research areas, it turned out that the traditional understand of computing was too narrow to ground societally acceptable designs.

In an attempt to widen the understanding of the computing field, the I&G community was questioning the traditional monopoly of mathematics, specifically computability theory, in defining the conceptual foundations for the research discipline (Coy et al. 1992; Schinzel 1996). Inspired by the work of Weizenbaum (1977), Dreyfuss and Dreyfuss (1986), and Windograd and Flores (1986), this partly German-centric discourse of bright and critical thinkers came up with interesting perspectives. Various theoretic lens has proposed to understand and study these phenomena including system theory, semiotics, action regulation theory, phenomenology, and constructivism. However, they did not develop a coherent conceptual foundation of IT design, partly because they were not capable to institutionalize their field and discourses in German academia. In particular, the

German discourse was characterized by a certain lack of empiricism - partly due to the rejection of quantitative, positivist research paradigms.
When we started our design work in practice, we were influenced by constructivist thinking, specifically by our cooperation with Christiane Floyd (1992, 1996) and Michael Paetau (1991, 2013). They drew on (different versions of) system theory, specifically the constructivist ideas of second order cybernetics. Social systems are seen as self-organizing which are operationally closed, self-referential, and self-reflective. Interventions, such as the introduction of an IT-artefact, would not determine the social systems' reactions. Reactions occur in self-organized manner and depend on the system's actual structure and internal state. Such an understanding has far reaching implications for the design, introduction, and use of IT-artefacts. If the *appropriation of IT artefacts* could not be anticipated, *technical flexibility, an evolutionary understanding of software development, and participation* are required (Wulf 1999).
In the paper in this volume, we suggest that a specific integration of organization and technology development could provide a framework to facilitate change when developing and introducing IT-artefacts into organizations. We expanded Floyd's et al. (1989) STEPS model of evolutionary and participative software development by addressing organizational and personal development explicitly as well as to add a focus on technical flexibility.
So, *constructivist thinking* can lead to conceptual guidelines for an emancipatory research agenda in the IT domain. However, the theoretical concepts were not empirically grounded in organizational practice and on a too generic level to ground the concrete design of IT artefacts. To understand the different actors' specific manners of constructing reality, we needed methods which were more directed towards an analysis of social practices in the field of application.
At that point, the European community of Computer Supported Cooperative Work (ECSCW) had emerged, and we became increasingly involved. Bannon and Schmidt (1989) defined ECSCW "*as an endeavor to understand the nature and characteristics of cooperative work with the objective of designing adequate computer-based technologies*". ECSCW drew importantly what Jörg Bergmann called *Vollzugswirklichkeit* stressing that social order in general and cooperative work in particular is an ongoing accomplishment. To get a grip on cooperative work, therefore, methods are needed to capture this *reality-in-the-making* to reconstruct the situated methods of doing cooperative work. This also implies to make appropriate protocols of what's going on (such as field notes, audio and video recording, and transcriptions) as they where needed to analyze this kind of situated reality in their natural sequential order. Ethno-methodological studies and other qualitative empirical research methods become popular to understand the nature and particularities of cooperative work. However, empirical findings were not used to purely describe the collaborating actors' work practices and constructions of reality with the goal to derive theoretical constructs in a social science sense. In the European CSCW tradition, appropriate analysis of empirical data is seen as foundations to a *design-oriented research paradigm* (Schmidt and Bannon 1992).

So, we were on the way to find fellow travelers on our way to explore the societal potentials of IT design (though these colleagues did not necessarily share (all) our normative commitments). With regard to social science grounding and empirical research methods, the ECSCW community introduced us to Harold Garfinkel's work on Ethnomethodology and the micro sociologists of the Chicago School, specifically Herbert Blumer and Anselm Strauss. Gunnar Stevens was additionally inspired by Ulrich Oevermann's work on Objektive Hermaneutik. Both Garfinkel's and Oevermann's work have an anti-mentalistic attitude in common, focussing on actors' doing and saying where their expressions are public. They both argue that academic observers can only speculate about subjective meanings and actors' mental models.

Given our design (and activist) orientation we developed a specific interest and sensitivity in the doing of things and the accomplishment of social order.

One of our first area of concept development took place in the domain of *access control.* Maintaining our focus on technical flexibility, we investigated into *access control* – a functionality which was flexibly implemented in the sense that it could be configured at run time of an application. However, it turned out that the traditional models of access control would not fit with the differentiated needs of cooperated work. We investigated empirically into the way access to documents was handled in two organizations: (a) a federal ministry while working administratively (Stiemerling and Wulf 2000) and (b) a technical archive of a steel mill when conducting maintaining engineering (Stevens and Wulf 2002, chapter 1). Comparing the empirically described practices with the access control models implemented in data sharing applications, such as data bases or shared workspace applications, we found that the implemented functionality did not support appropriately the existing practices. Based on these empirical findings, in the paper included in this volume, we suggested a new conceptual model for the design of access control. We broke with the generally held assumption that access rights need to be specified before an access could be carried out. Drawing on Wulf (1996) PhD thesis which suggested mechanisms to negotiate conflicts when activating functions in groupware, we added mechanism for *ex-post* as well as *for uno-tempore* access control.

Oevermann impacted our work in two more ways. First, we were influenced by Overmann's (2001, 2016) openness towards the future, where order is not the perquisites for action, but its outcome. As analysts, we can reconstruct the production of social order based on the documents, records, and transcription we made of the process. In reflection, the outcome often seems to be evident. Yet, from the point of view of the actors, however, history is not yet written - by its very nature they have the opportunity of doing otherwise. Situated action is therefore the locus of social change.

Second, we were inspired by Oevermann's reflections on "*clinical*" professions where doctors and psychotherapeutists present the paradigmatic examples. However,he also elaborates on other professions such as lawyers, teachers, social workers, or architects. All these professions have in common that they work in a case-based manner and are practically involved in creating reality On the other hand

these professions are also academically constituted, so that the practical action becomes an object of scientific reflection. Oevermann (1990) points out in his manifest for a practice-oriented social science: "*Only the reference to the individual case opens up the possibility of doing justice to a concrete practical problem which can only be grasped in its typicality and peculiarity in the concretion of the individual, case-specific manifestation*".So, in these disciplines action research and reflective learning are essential methodological elements for their knowledge creation practices. Similar arguments about knowledge building in action research communities can be found in Donald Schön's idea of the Reflective Practitioner, but also in the Scandinavian School of Participatory Design or the Anglo-Saxon Research Through Design or Critical Design movements.

Based on these considerations, we *radicalized* the ECSCW research paradigm. In the origins of the ECSCW community, there was a rather loose coupling between empirical investigations, conducted by social scientists, and IT design, carried out by computer scientists. The social scientists described and conceptualized empirical findings, often concluding with a section on 'implications for design'. However, their research rarely led to the implementation of an IT artefact drawing on the empirical findings and evaluating the 'implications for design', definitively not in the field of application they were derived from. We found a too loose coupling dissatisfactory from an academic point of view. If an academic community claims that its research paradigm is practice-based and design-oriented the validity of its technological claims has to be evaluated in the real world. So, we wanted to understand how innovatively designed functionality would support the social practices from where the design ideas were derived. Also, from an ethical (and activist) point of view, we found it an appropriate research strategy to design for and with those who had allowed us to understand their social practices.

Assuming that the quality of IT design could only be evaluated in social practice, we developed a research paradigm of a close coupling between empirical and design-oriented work. We explored the close coupling in a couple of these design engagements (Hinrichs et al. 2005; Reichling and Wulf 2009) and later on called the resulting framework *Design Case Studies* (Wulf et al. 2011 and 2015). A design case study documents the results of empirical studies, participatory design activities, and the implementation and roll out of the resulting artefact into the (same) field of investigation. So, empirical studies and design activities are taking (ideally) place in the same field of application. So, empirical findings and the generated design solutions can be directly referred to each other, the creative transition between them can be evaluated in practice.

The close coupling let to some conceptual and methodological innovations. First, we turned (participatory) design research into a long-term engagement in practice. This required to turn design concepts into IT artefacts which ought to be implemented in an algorithmically viable, technically stable, and usable manner (Rohde et al. 2017). Second, we needed to take the creative and non-anticipated manner into account in which users made sense of IT-artefacts. Already in our first design engagement in practice, we experienced that the way users made sense of an IT artefact could neither be determined at design time not at the moment of the

artefact's introduction into social practice (Pipek and Wulf 1999 and 2006; Wulf 1997). The way users made sense of an IT artefact was a creative, mostly cooperative, and open-ended activity which had to be understood over a longer period of time. We framed the concept 'appropriation' to describe and analyses the learning process which made (potential) users learn to use a new function which supports, and in doing so, often even changes their social practices. Volkmar Pipek and Gunnar Stevens elaborated in their PhD thesis upon the concept of appropriation and developed technical features which would support users in appropriating IT artefacts (Pipek 2005; Stevens 2009).

The paper in this collection develops our concept of appropriation out of cultural–historical (Hegel, Marx, Leontiev) and post-structuralist (de Certeau) origins. It emphasizes the importance of technical and interpretative flexibility in enabling appropriation work (see section 'End User Development'). Finally, the paper presents different approaches to technically support users in (collaboratively) appropriating their IT artefacts.

Thomas Ludwig and Volkmar Pipek expanded the concept of appropriation support beyond merely software artefacts. The semi-material nature of software makes it rather easy to implement communication channels for collaborative appropriation and participatory design directly within the artefact and its interface (Stevens et al. 2010). However, the distinct nature of hardware and the related processes inside the artefacts are of a different kind. New concepts are required in support of appropriation. In the paper in this volume, Ludwig et al. conduct an empirical study to explore how the appropriation of hardware could be supported. Investigating into the use of 3D-printers, they discuss how users could be supported in appropriating these mainly hardware-based artefacts. They propose the concept of 'Sociable Technology' for those hardware artefacts which would support their appropriation. Lateron, these concepts has been implemented in evaluated on practice (Ludwig et al. 2017).

From a practice perspective, innovations are not merely created by technology designers, they rather prepare (semi-)material conditions for users to appropriate these artefacts –both design and usages present creative activities which can only be anticipated in a heuristical manner. We developed the concept of 'infrastructuring' to describe the mutual relationships between the activities of designers of information technology and those of local innovators who enhance technology supported practices. In the paper in this volume Volkmar Pipek and Volker Wulf elaborate on this concept which relates the various activities relevant in the context of design case studies towards each other.

The authors draw on the literature on infrastructure in Science and Technology Studies (STS), but specifically on the practice-oriented interpretation of the term introduced by Star and Ruhleder (1996) and Star and Bowker (2002). Infrastructuring can be understood as reconceptualizing a user's work in the context of existing, potential, or envisioned IT tools which is an integral part of her activities. From a design perspective, infrastructuring ought to prepare technical infrastructures and organizational development towards the point of infrastructure – the creative moment when appropriation happens. The concept of infrastructuring

broadens our focus of investigation beyond the individual (IT-) artefacts. It rather points to the wider eco-systems of networked and partly hidden artefacts being relevant to the social practices which are to be analyzed and supported.

In the following, we have introduced Grounded Design as a framework which elaborates on our experiences when carrying out Design Case Studies (Rohde et al. 2017). In the paper in this volume, we put Grounded Design into the tradition of design research and clarify its epistemological positioning. We characterize the three types of activities to be conducted while researching in the framework of design case study: context studies, design studies, and appropriation studies. The paper also defines quality criteria when conducting design case studies. Finally, the question arises how to document design case studies, how to preserve and share the insights gained, and how to make the engagement in practice sustainable. This is a crucial issue for design research in general and different schools of design thinking came up with different answers.

Grounded Design tries to systematize the two ends of design research – namely the constructive, open-ended process on creating reality, where designers, users, infrastructures etc. are all part of – and the reconstructive, methodologically guided process to understand what was emerging in the co-evolution of design and usage.

Grounded Design is taking place in a very specific setting and interventions are based on very specifically designed artefacts. So, the question arises how to make these highly context specific insights relevant for other cases of design and appropriation. In the paper in this volume, we argue for a detailed and broad documentation of the particularities of the different design case studies – beyond the mere publication of academic papers. We call the repository for multifaced documentation 'ePortefolio' (Li et al. 2021). We argue that a comparative analysis of well documented design case studies allows for comparative analysis and design-oriented concept building. The ePortefolio should enable the linkage between the comparatively created concepts and the data they are grounded in. So, the ePortefolio should help to maintain the relationship between the level of doing things, empirical findings and the conceptual abstractions grounded there. An ePortefolio should also have 'windows' for different types of actors to share the design-related knowledge among them, e.g. a window supporting communities of researchers, professional designers, users/practitioners, design students, etc..

We have a long tradition in analyzing, understanding, and supporting knowledge sharing activities from a practice perspective – far beyond that of design related knowledge (Fischer et al. 2007, Pipek et al. 2012; see section one of this reader). Taking a critical stance towards the mainstream in knowledge management, we have developed a particular perspective on how actors communicate and co-construct their knowledge cooperatively (Ackerman et al. 2003). In the paper in this volume, we have summarized and conceptualized the findings of the CSCW community in knowledge and expertise sharing. We distinguish historically between an object- and a people-centric research perspective to discuss concepts such as boundary objects, common information spaces, assemblies, and the localization of expertise.

To sum-up, we believe that design-oriented expertise is highly context specific and needs very particular modes to be shared. Therefore, we have developed a particular research paradigm which is driven by in situ, micro level findings. In our conceptual contributions, we try to stay humble with regard to claims for external validity. However, the results of these and those of much less contextualized design processes, IT artefacts and infrastructures, may 'travel' across various contexts for different reasons. These reasons are often related to the economies of scale, marketing efforts, and (quasi-) monopolistic behavior. While these artefacts and infrastructures will be appropriated in manifold creative manners, still, their design influences their societal effects. In the future, a socio informatics perspective will need to find techniques to mediate between the micro and the macro level in a world which is increasingly penetrated by IT artefacts and infrastructures.

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Towards an Integrated Organization and Technology Development

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Abstract Nowadays organizations are seen as self-organizing social systems. To cope with dynamics of a continuously changing environment they have to be able to react flexibly. To support organizational change we will work out the concept of integrated organization and technology development. This approach offers a framework to deal with organizational and technological change jointly in an evolutionary and participative way. We will investigate on methods to organization development, work psychological guidelines, approaches to software development and tailoring in use. Based on these results we will develop an integrated approach to organization and technology development.

Keywords: Organisation development, work psychology, software development, tailoring in use

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Infrastructuring: Toward an Integrated Perspective on the Design and Use of Information Technology

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Abstract In this contribution, we investigate how results from the ongoing discussion about e Infrastructures can be used to improve the design of IT infrastructures in organizations. We first establish a perspective on organizational IT as work infrastructure that focuses on the infrastructural nature of organizational Information Systems and describe challenges for designing within and for this type of infrastructure. Then we elaborate on possible use of concepts from the e-infrastructure discussion, in particular on the concept of infrastructuring as it was developed by Star and Ruhleder (1996) and Star and Bowker (2002). Using their "salient characteristics of infrastructure" we describe the methodological approach of Infrastructuring to develop methodological and tool support for all stakeholders' activities that contribute to the successful establishment of an information system usage (equivalent to a work infrastructure improvement). We illustrate our ideas by drawing on a case in which new work infrastructures are introduced into an organizational context and by mapping out existing and possible tool support for infrastructuring.

Keywords Infrastructure, Infrastructuring, Design, Software Development, Information Systems

[1] Paul Edwards, Geoffrey C. Bowker, Steven Jackson, and Robin Williams were the guest editors.

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Making use: Understanding, Studying, and Supporting Appropriation

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1 INTRODUCTION

"In autumn 2001, I bought my first mobile phone. I want to point out that the technology did not change very much in the five years between total denial and actual use of the technology; the technology designers had little influence on the buying decision. It was rather my notion of interesting usages that evolved over the years." (Pipek 2005, p. 16)

Appropriation – to set apart for or assign to a particular purpose or use (Webster) – is, refers to the establishing of new social practices in the light of new technologies. So, roughly speaking, appropriation is closely related with change, while, in everyday life, such transformations may be a slow, unnoticed, quiet, and evolutionary. The world, in other words, continues to look stable and ordered to those undertaking routine activities. Technologies, as is often said, are made 'at home in the world'. Moreover, in an epoch of rapid change we take innovations for granted, so that is hard to imagine how to life e.g. without Electricity, Washing machines, Road networks or even Smartphones. Because of this power of the present, it is the role of stories and vignettes to bring once familiar situations and practices into explicit consideration. This is true not just for the past, but also for future and otherwise alien practices. In this respect, reports of historians, ethnographers, visionaries, and design researchers face the same challenge and what appropriation studies are all about – namely helping the reader to familiarize themselves with unknown practices and their (emerging) nature. This brief outline suggests that established orders are quite malleable, which is one of the reasons why emergence and structure are of theoretical interest, even when these issues pose no problems in everyday life.

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Towards Sociable Technologies: An Empirical Study on Designing Appropriation Infrastructures for 3D Printing

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Abstract Over the last years, digital fabrication technologies such as 3D printers have become more and more common at universities and small businesses as well as in communities of hobbyist makers. The high complexity of such technologies, the rapid technological progress and the close link between hardware and software in this field poses challenges for users and communities learning how to operate these machines, especially in the contexts of existing (and changing) practices. We present an empirical study on the appropriation of 3D printers in two different communities and derive design implications and challenges for building appropriation infrastructures to help users face those challenges and making technologies more sociable.

Author Keywords Appropriation infrastructure; sociable technologies; infrastructuring; empirical study; user-centered design; 3D printing; hardware-related context.
ACM Classification Keywords H.5.3. Group and Organization Interfaces

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Grounded Design: A Research Paradigm in Practice-based Computing

Gunnar Stevens, Markus Rohde, Matthias Korn, and Volker Wulf

1 INTRODUCTION

Computer science is a young, but extremely successful academic discipline. It has developed into a discipline which nowadays has its organizational instantiations in almost every academic area. At one time, the hardware of mainframe computers needed to be run in specific (parts of) buildings and interaction with machines was restricted by specific coding devices such as punch cards. How-ever, computers today are radically different. They are mobile and ubiquitous and along with this a multiplicity of interaction techniques have been developed. Looking at the various fields of application, the origins of computer science were strongly related to scientific applications during the Second World War and the Cold War. In the business world, computing rose to importance in the al-ready well formalized world of book keeping and accounting. However, computing technologies today, as we all know, are on their way to supporting all aspects of life.

Given this fundamental transformation in the nature of computing and its high societal relevance to all aspects of life, we argue that the academic field of (applied) computer science needs to develop its epistemological paradigm and research methods accordingly. Originally emerging at the intersection between mathematics and electrical engineering, computer science has for a long time under-stood itself in terms of a structured science: applied computer science followed a positivistic paradigm, viewing itself as a formal discipline which creates generally valid knowledge, independently of the context of its application. In this tradition, quality criteria were established such as formal proofs, algorithmic efficiency, or structural elegancy. However, with the increasing societal relevance of applications, computer science arguably needs to define itself as a socio-technical discipline which contributes to the solution of social problems

in context. This is a process which, while underway, is a long way from completion (YOU PROBABLY NEED A REF HERE, SUCH AS BANNON, HUMAN FACTORS TO HUMAN ACTORS). While computing relies on formal methods to transform users' input through a number of state transitions into certain outputs at the user interface, the products of this formal core of computing, as is argued throughout this book, are embedded in social practices. Therefore, the quality of formal techniques and their application is finally determined by their impacts on those practices. Since social problems and social practices are contingent on the particular context of their emergence, the knowledge derived from such a research paradigm will be local and context-specific. Consequently, knowledge gained on the interaction between computing artefacts and their impact on the social practices in the fields of their application are context specific, as well. ironically, the success of computing has meant that the question of the scope of the formalistic defined and positivistic applied discipline of computer science has become more pressing. Our position is that a design-oriented discipline of practice based computing is needed, one where methods and techniques can deal with the context-specificity of local knowledge more seriously.

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Practice-based Computing: Empirically-grounded Conceptualizations derived from Design Case Studies

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1 INTRODUCTION

The introduction of IT has changed the way we live in many ways. Historically, it can even be argued that socially embedded applications of information technology challenge and change practices to an extent rarely seen before with any other type of technological artefacts. If these IT artefacts have strong and recurrent impacts on people's lives, we need to reconsider design practice artefacts which allow for anticipating use practices and bring together inspirational creativity with evaluative methods.

Approaches such as Participatory Design (Greenbaum and Kyng 1991) and User-Driven Innovation (von Hippel 2005) have already significantly increased the level of involvement of users and their fields of practice into IT development and have strengthened the role of ethnographic methods as well as the importance of methods providing direct user feedback. But even a strong component of domain analysis or user participation does not warrant an accurate anticipation of the changes in social practices resulting from new technological artefacts or infrastructures. Moreover, the immaterial nature of software contributes to its application beyond the originally intended context. The material and social foundations of IT usage have significantly changed over the past two decades. Technologically, the standardization of communication interfaces, the increase of

bandwidth and speed of internet connections and their ubiquitous availability have connected more and more devices with each other. At a social level this has also created stronger connections between professional and private domains and practices, offering new room to adapt these practices and re-negotiate their relations and compositions. These developments have made us now look at ecosystems (Draxler et al. 2015) or infrastructures (Star and Ruhleder 1996) of technology-based practices.

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Sharing Knowledge and Expertise: The CSCW View of Knowledge Management

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Abstract Knowledge Management (KM) is a diffuse and controversial term, which has been used by a large number of research disciplines. CSCW, over the last 20 years, has taken a critical stance towards most of these approaches, and instead, CSCW shifted the focus towards a practice-based perspective. This paper surveys CSCW researchers' viewpoints on what has become called 'knowledge sharing' and 'expertise sharing'. These are based in an understanding of the social contexts of knowledge work and practices, as well as in an emphasis on communication among knowledgeable humans. The paper provides a summary and overview of the two strands of knowledge and expertise sharing in CSCW, which, from an analytical standpoint, roughly represent 'generations' of research: an 'object-centric' and a 'people-centric' view. We also survey the challenges and opportunities ahead.

Author Keywords knowledge sharing, expertise sharing, CSCW, collective memory, organizational memory, expertise location, expert finder, expertise finding, knowledge management, sociotechnical, collective intelligence.

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Designing for Collaborative Infrastructuring: Supporting Resonance Activities

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Abstract 'Infrastructuring' as a concept draws attention to the way in which a designed artifact or system is not the end of the development process. Rather, technology development takes place up to, and including, its successful establishment in a practice context. In this way, the role of end users as designer comes into focus. Based on the so-called 'point of infrastructure' as the moment that initiates a breakdown or an innovation-driven reconsideration of the current infrastructure use, end users themselves start configuring, tailoring or developing new conventions until the point has been reached in which a new technology usage has been successfully established. But points of infrastructure do not only provoke end-user driven in-situ design activities and make visible prior preparatory activities, but it also create so-called resonance activities that encompass all observing and communicating aspects of what has become visible within the work environment or to other work environments. Examining these (collaborative) resonance activities can be starting points for capturing the (social) appropriation activities of certain technology usages and the relations between different points of infrastructure. But how to capture those resonance activities and if this can be done, how to design technological support for them is still an open question. Based on previous work outlined in literature and experiences made within an empirical study around appropriation activities during 3D printing processes, we therefore outline the concept of sociable technologies as a technological approach for capturing as well as supporting resonance activities and therefore enabling collaborative infrastructuring activities.

Author Keywords Infrastructuring, Appropriation, Resonance Activities, Sociable Technologies, CSCW

Visioning a future world of CSCW design

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The papers in this section span more than two decades of research work. They have been published in a variety of forums: from first-class journals (CSCW, JAIS) to new journals (PACM/HCI) to proceedings of fringe conferences (DIS) to sections in edited books. Despite the variety of publication channels they have all been decently referenced to, and the most cited paper – Pipek & Wulf 2009 paper on infrastructuring – is a well-established reference on the topic. The papers discuss with research communities in at least four distinct research areas – information systems (IS), computer-supported cooperative work (CSCW), human-computer interaction (HCI), and design research. Interestingly, three of the papers are titled as "*towards x*", and the topics discussed in the papers have not been mainstream topics for any of the research communities. All of this indicates that the group believes that it has developed a position that is novel, interesting, and important, and it has been casting the net wide to find discussion partners. There is a clear evolution in terminology in the papers: the oldest 1995 paper talks on integrated organization and technology development, then the emphasis moves to infrastructuring of work, and the last papers introduce practice-based computing and finally grounded design. But significantly there is also a clear thematic continuation in the papers: interest in "*design*" with a small "d" – local grassroot co-development of both work and computer technology together.

Such perspective is indeed somewhat rare, and in the IT design field I know only a handful of earlier attempts in the same direction, mostly in the fringes of the IS community. In software engineering, Bruce Blum's *Beyond programming* (1996) is based on an rather extreme experiment in real-life end-user-development, where the system development was intimately connected and led by work process

development, and the actual development and use of the system in case dates back in 1970s. This ambitious and visionary work is largely forgotten. Pelle Ehn's PhD thesis, a theoretical account on participatory design, was titled "*work-oriented design of computer aritifacts*" already 1987, and the original PD aimed for integrated development of systems and work. Steven Alter (2003) has worked long to define and refine a systematic way of using "*work systems*" as the unit of analysis for system development, but his efforts have not gained wide popularity. Two Finnish research groups, prof. Markku Nurminen's Work Informatics group (Nurminen 2006), and prof. Mikko Korpela's group (Mursu et al 2007), have developed Activity Theory-inspired approaches to combine technology development with work development, and with Anna-Liisa Syrjänen we touched the subject in a 2011 paper entitled "*From System Development toward Work Improvement: Developmental Work Research as a Potential Partner Method for EUD*". None of these attempts has, however, generated a wider interest.

Although it is not openly manifested, and most of the papers are published in other than CSCW venues, together the papers establish a position for CSCW design research, and outline – as far as I know – the first attempt for formulate a CSCW design method. This is a bold move, given the long reluctance of the CSCW community to engage any design methods endeavour. The position is firmly grounded in European CSCW tradition, and it is very ambitious: it does not limit itself to the design of an individual system, but it ends up in sketching arrangements, organizing, and tools for both national and international R&D network for sharing the experiences and best practices.

During the 20 last years spanned by the papers the group has gained momentum and it has become one of the major CSCW centers in Europe and in the world. One cannot but appreciate the persistence and coherence how the direction of a research line has been maintained over the years, and how the growth of the group has added and not dissipated the energy and momentum. While it is fruitful to sometimes look back, like in this book, the most important direction is forward, and in this spirit I will provide some comments, in a hope that they might stimulate further development.

1. The group has taken "*practice-based computing*" as their leading theme. The concept of practice has been gaining ground in social sciences already since 1980s, to the extent that there has been discussion on "*practice theory*" and practice has gained popularity during the last years also in various areas related to IT design. The idea of a practice theory, and the coherence of practice as a concept in social science, and correspondingly the interest in practice concepts in IT research, have also been sharply criticized (for instance Schmidt 2018). Such criticism with respect to social science is largely justified and very useful, because it cautions us to not blindly lean on what the social science has here produced; it is a small wonder that the concept of practice used over decades by a large number of researchers coming from different backgrounds and different interests lacks conceptual coherence, and a discussion on a "*practice theory*" clearly pushes the envelope too

far. But the criticism a bit misses the forest from trees with respect to research on IT design. The people interested in concept of practice in IT are searching answers to practical challenges in research and development.

During the couple of last decades there has been a rising interest in what happens in "*real life*", that has led to explorations on topics such as materiality, agency, history, and emergence. These seem to be important in understanding what actually happens in real life, but bringing them to bear in design has been found problematic, and even the thirty years of fieldwork-based research under the category of "*cooperative work*" has not been able to provide a coherent conceptual apparatus to deal with them. Perhaps the scope of "*cooperative work*" is just too broad: maybe one would need a smaller unit of analysis, or the delineation of an object of intervention, where such issues could be usefully connected together. And this explains why interest in "*practices*" has risen not only in CSCW but also in IS and in HCI. This bears some resemblace to the situation in social sciences that has led to the interest in the concept of practice: it seems to offer a potential way to deal with personal and social, material and cultural, historical and emergent, all together. But unlike social science, IT disciplines are looking "*practice*" as potentially useful device for frameworking design, and unlike social sciences they have a possibility to use interventions, a more powerful research approach than just observations. Thus the practice approach in IT disciplines is not and should not be "*applied social science*", but an approach of its own, still "*in the making*" and finding and defining its own ground and own interpretation of the practice concept. And "*practice*" is even not the only alternative; "*activity*" from Activity Theory is capable to deal with about the same issues without any reference to – or ballast of – various social science approaches on practices.

I think that it was philosopher Stephen Toulmin who has talked about the usefulness of "*porridge words*" in research. Porridge words are placeholders, working concepts during the research process. They contain enough stuff that participants agree that they are useful, but they do not yet have solid structure or clear content, so they can fit and fill any hole or need. At this moment, I see "*practice*" in the CSCW context as such porridge word, a temporary placeholder whose real content has yet to be worked out. A critical reflection of the practice concept – why it is needed, what is the interpretation and connotation that is useful for group's purposes, what it is not, what are the alternatives – would be a way to proceed.

2. In developing their position the group makes a serious effort to ensure, that they cannot be accused on "*theorizing*". While there certainly is a Scylla of empty grand theorizing to be avoided, one should also be wary of a Charybdis of fruitless empirism, unwilling and incapable of rising above the mass of empirical details. Empirical data should be respected, but not awed so that it leads to a paralysis. Design portfolios may indeed serve as sources of inspiration to other designers, but as the only results of research they feel somewhat impoverished. While empirical data is the foundation of research, it advances through forming of concepts, models, and theories, that are then tested and corrected against new empirical data. In a

critical design paper with Netta Iivari (2017) we teased the Gaver & Bowers portfolio approach used as inspiration in later papers as too "*Laputian*"; in Gulliver's Travels Swift satirizes Laputian scholars, who in their efforts to avoid language distortions in communication end up carrying sacks of objects and showing them to each others, instead of discussion... There is no reason to be afaird of (some!) conceptual work.

3. A potentially fruitful way to ease some of the tensions between the demands of research and design might be to separate the "*basic*" and "*clinical*" side of research like in medicine, as suggested for instance by the practice-oriented philosopher Stephen Toulmin (1996, 2001) already mentioned. While the basic physiological and biochemical research tries to understand how human bodies function and misfunction as a complex system at a number of levels, and how the body develops, grows and decays, the clinical research is, based on that understanding, developing various methods of intervention to change or maintain a particular aspect of the functioning of a body, and experimenting with those interventions in real life. In doing so, the clinical research has developed a wealth of knowledge of its own, and is capable continuously ask new questions and push the basic research further. Moreover, the relevance of new physiological and biochemical knowledge developed in basic research is dependent of the needs of timely clinical practice.

4. If design-oriented research of IT and work practices is seen as ”*clinical*” what would be the area of the ”*basic*” research, as medical science has in the studies of human body? Such research would not need to be directly related to design, but anyway provide knowledge that could feed to ”*clinical*” actions, just as in medicine. What would be the object of such studies – one not yet in the focus of any other discipline? My candidate is “dynamics *of computer artifact-practice evolution*”: how computer artifacts and human practices where they are embedded influence each other and evolve together. Artifacts alone are too limited, they get life only when used in practices, where people get something done with them. Evolution (and sometimes revolution) needs to taken into account, because that is what artifacts-practices do all the time; dynamics puts the focus on the moments where evolutionary (or revolutionary) changes take place, either by design or without it.

5. To study such field one would need longitudinal studies what happens in everyday practices during design and appropiation of computer artifacts to create a corpus, exactly as the group is suggesting. But this could be further complemented by looking backwards in history, and doing historical studies how computer artifact-practice amalgams have evolved together. Such research would tell why and how changes in the artifacts and practices took place. Social studies of technology (STS) has been doing something like this already a while, but largely without any design perspective analysis. There is, however, some interesting work in this direction done in STS-inspired IS under the label "*biografies of systems*" by Williams & Pollock (2012). Together such studies might eventually lead to recognition of regularities, connections, patterns, and eventually concepts, related to evolutional threads of artifact-practices, and these might feed back to design.

6. In the Grounded Design paper an interesting and very ambitiuos clearinghouse system to store and distribute design knowledge is devised. It is naturally an utopian vision, impossible to be realized and maintained in the current situation because of contradicting business interests, time scales and cultures. The idea itself is very promising, and one can ask, if here the current relations of production, under which the improvement of existing or development of new systems for work practices must take place, have already become obstacles for the development of forces of production. It is possible to imagine, under different relations of production, a situation where a national IT service provider would be responsible of delivery, maintenance and development of "*work infrastructures*" in the sense the group is here using the word, and that the funding of the service provider would have been made dependent of the effectiveness and efficiency of the user organizations. Thus the service provider would have a strong incentive to make the work infrastructures as successful as possible. Then the service provider, that would have feelers at each workplace, and whose majority of employees would be working in user organizations, would naturally need a system to share design experiences and knowledge, and incentive, funding, and continuation for such system would automatically be available. Finally, let's imagine, that then also every computer related department in universities would automatically receive a permanent funding for a research group devoted to basic research on practice-based computing and work infrastructuring, to cooperate with the local branch of IT service operator and to support the advance of the operation further...

I would like to thank the group for all the intellectual stimulation its work has provided over the years; expect that it will continue also in the future. Vivat, crescat, floreat!

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Understanding and shaping socio-technological transformations

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Current societies are characterized by a multiple crisis (Demirovic et al. 2011) that consists of manifold crises which interrelate. Climate change, the Covid-19-pandemic, economic and financial crises, as well as an increase in flight are only some of the crises that are interdependent – either causing or reinforcing one another.

Information technologies (IT) play a crucial role in many of these crises: IT is either *contributing* to certain crises (e.g. the production, use and disposal of IT contributes to global warming because of increases in carbon emissions), or it is used to *overcome* (more or less successfully) certain crises (e.g. mobile applications are used to reduce the number of Covid-19-infections by tracking the infected and warning the non-infected).

Therefore, IT research can, on the one hand, help to understand the roots and character of crises and in the form of action research can aid the resolving of the challenges and problems these processes imply and lead to. And it is both tasks of IT research – understanding *and* shaping current socio-technological transformations that are currently characterized through the multiple crisis – which the authors of the texts in this book and particularly in this section confront. Theoretically conceptualizing empirical results as well as developing new empirical approaches, as the articles in this section do, can help to understand the current multiple crisis and general socio-technological transformations. It is socio-technological change that drives the authors as they explain that their research "*is driven by new technologies as much as by societal problems and potentials*" (Wulf et al. 2015, 143).

Being a scholar of Media and Communication Studies, I will take the chance here to reflect from a social science perspective on the concepts used and developed by the texts in this section. Reading the texts, many of the theoretical approaches are familiar to me although sometimes used differently. Thereby, differences between academic disciplines come to the fore but it is the interdisciplinary perspective of the authors in this section which makes the conceptualizations in the texts charming, and which leads to innovative IT research.
In the following, I will share the thoughts I had when reading the texts integrated in this section. The associations I had while reading can be structured along three terms which I perceive as the core concepts that can be identified across all articles: practices, materiality, and values.

1 Practice

"*Practice*" is the main concept which is used in all the texts and which is also one of the main contributions the research group of the University of Siegen brings to Informatics. "*Practices*" is even more than a concept but rather a perspective that shifts the focus from the IT artifacts to the ways these technologies are designed and used. According to Morley's (2009) call for a non-media centric perspective in my "*home discipline*" Media and Communication Studies, the authors of the articles in this section take a *non-technological* perspective to IT research and thereby enable us to not only understand the ways IT artifacts are produced and appropriated but also comprehend the way the technologies are shaped. Moreover, while developing and applying the approach of Grounded Design (Stevens et al. 2018), the authors at the same time analyze *and* shape technologies themselves, thereby contributing to reflecting *and* molding current socio-technological transformations and even some of the crises mentioned above. In the methodological approach of Grounded Design, the authors use the sociological perspective of practice research to stress the relevance of humans and their practices in the design and appropriation of IT.
Following the "*practice turn*" (Schatzki, Knorr-Cetina & Savigny 2001) it is probably not surprising that practice also became a category in IT research, nevertheless, it still seems to be a minor concept in this still often techno-centric field. This is rather astonishing, as "*there can be no machines without humans to make them*" (Jasanoff 2015, 3), and it is humans that in the end use and appropriate technologies.
When having a closer look at the practices which are the research objects in the texts of this section, it can be helpful to further divide the theoretical concept of practice into those practices in which actors *use* technologies as supporters or mediators for social practices and those practices in which technologies are in focus of the practices themselves. The differentiation between acting *with* and acting *on* media (Kannengießer & Kubitschko 2017; Kannengießer 2020), or here more

specifically IT, can be helpful when analyzing how IT *supports* social practices when people *act with* IT or how IT can be the object of social practices themselves. In the authors' perception the approach of Grounded Design can be described as a process of acting *with* IT as they state that the "*central quality criterion [of IT design] is its fit with the social practices to be supported*". Here, IT is used to mediate and support social practices. But Grounded Design can itself become a practice of *acting on* IT as technologies themselves become an object of research practices. Using the approach of Grounded Design the researchers therefore act *on* IT and "*take an active part in the molding of [...] infrastructures and technologies that are part of the fabric of everyday life*" (Kannengießer & Kubitschko 2017, 1). Acting on media the researchers "*consciously and actively seek to transform [...] technologies and in doing so try to change not only the devices but also society*" (Kannengießer 2020, 178). Hence, the research group in Siegen does both: research practices of acting with and on technologies and at the same time acting on technologies themselves by putting IT at the center of their research practices and designing IT themselves.

The in-depth analysis of IT practices and contextualized IT design is realized in "*Design Case Studies*" (Stevens et al. 2018), which allow a deep understanding of phenomena and the design of suitable IT. Insisting on the relevance of qualitative methodologies, the researchers oppose the current trend of computational methods and big data analysis but rather personally get involved with different actors and in social processes. This methodological insistence is again political as it shapes academic practices and systems in disobeying trends.

Putting the focus on practices, the technologies still matter, not only because of the affordances (Hutchby 2001) they imply but because of their materiality, which, on the one side, matters in designing and appropriating the artifacts and, on the other side, has crucial socio-ecological effects, which also have to be acknowledged in the design and appropriation of IT. While practice theory stresses the materiality of practices (Reckwitz 2003, 291), what also has to be stressed is the materiality of the IT artifacts that are used and molded through social practices and analyzed and shaped in IT research.

2 Materiality

Among the first approaches that stressed the materiality of media (technologies) was Medium Theory (Innis 1951; McLuhan 1964). Since then, we perceive an interdisciplinary debate on the (im)materiality of IT (e.g. Chudoba et al. 2005; Blanchette 2011; Parikka 2012; Gillespie, Boczkowski & Foot 2014; Allen-Robertson 2017) in which the materiality of IT was emphasized since the "material turn" (Bennett & Joyce 2010) at least.

It is crucial to stress, deconstruct and reflect the materiality of technologies in IT research not least because of their role in some of the above mentioned crises, e.g. contribution to climate change, which is also caused by an enormous increase in

carbon emissions that are produced in the development, appropriation and disposal of IT. While digital technologies "*appear to be green because they seem more immaterial, and because they can make processes more efficient*" (Gabrys 2015, 5), they are definitely *not* sustainable. Rather, the severe working conditions under which technologies are produced in global capitalism (e.g. Pun, Andrijasevic, & Sacchetto, 2019), the carbon emissions which are produced during the use of IT, e.g. by activating huge data centers in which server farms and cooling systems that are needed are run using fossil energy (Maxwell & Miller 2012; Hogan 2015), or the threatening and deadly effects of the disposal of IT devices (e.g. Kaitatzi-Whitlock 2015) need to be acknowledged in IT research. The concept of infrastructuring, (Pipek & Wulf 2009; Stevens & Pipek 2018, 155ff.) offers the opportunity to address these socio-ecological impacts of IT infrastructures not from a science perspective that measures the socio-ecological footprint of IT infrastructures but rather by "*mapping actors and activities, to acknowledge their contributions to infrastructure development*" (Pipek & Wulf 2009, 455), and thereby allows to take into account how practices of infrastructuring contribute to or prevent sustainability. The approach of Grounded Design might imply the possibility to shape IT production, appropriation and disposal more sustainably and thereby, confront some of the crises mentioned above.
In shaping the materiality of IT artifacts and analyzing as well as influencing IT practices, the researchers in Siegen follow a normative perspective.

3 Values

The authors of the articles in this section take a normative perspective in their research when analyzing and developing IT, either questioning values which materialize in IT or constructing certain values in designing the artifacts themselves – thereby allowing alternative practices. While norms are concrete rules for behavior, values are aims behind individual or social developments, they are "*immaterial goods*" which individuals or society strive for (Funiok 2016, 322). Values materialize in both concepts discussed so far, in practices and the materiality of IT: practices always imply values; practices are always normative as "*there is a right and wrong way of doing things*" (Nicolini 2017, 22). And values also materialize in IT as "'*[m]edia things' are much more than technics. To a significant extent they are also cultural properties that may be appropriated or rejected on the basis of cultural values as much as functional assets*" (Jansson 2014, 284).
When analyzing and designing IT, the authors of the articles follow an *ethical* perspective in their research. Ethics "*is concerned with how one should live one's life […, and] addresses questions about what is right or wrong, good or bad, fair or unfair*" (Arneson 2007, xiii). Following this understanding, the research group in Siegen takes an ethical perspective in IT research as the members are concerned about how we should develop, design and appropriate IT devices to shape current

socio-technological transformation right, good, and fair. In general, their research is concerned with "*practices for a 'good life'*" (Kannengießer 2022).
Appling a transformative approach in their research, the authors of the texts in this section are not affirmative in analyzing socio-technological transformations but rather critical. In the etymological sense of the word critique, the authors *judge* current practices and transformations and following Foucault's (1992[1978]) understanding of critique they develop alternatives through the design of IT. Critique questions societal values, practices and institutions by following the assumption that these do not have to be the way they are (Jaeggi & Wesche 2009, 7). And this is actually what the authors do: question current social values that can be identified in practices and the materiality of IT devices and develop alternatives through "*practice-based computing*" (Wulf et al. 2015).
With their transformative approach, the researchers create "*sociotechnical imaginaries*" (Jasanoff 2015) which are "*'visions of desirable future' (or of resistance against the undesirable), and […] instruments of the co-production of science, technology, and society in modernity*." (Jasanoff 2015, 28)
But what are the values the authors construct in their research? In the articles of this section at least two values become obvious that interrelate: participation and democracy. Wulf and Rhode (1995) ask how organizational development can be shaped in a more democratic way by enabling participation through the use of IT, and participation lies at the core of the methodological approach of Grounded Design as it "seeks to make the voices of practitioners heard and relevant to future developments" (Stevens et al. 2018). Supporting participation in IT design, the authors stress a practice perspective which brings me back to the beginning of my text. Allowing participation in IT design, unequal power relations can be deconstructed and practices of resistance supported (Stevens & Pipek 2018).

4 Self-reflection

When analyzing and shaping socio-technological transformations IT research has to self-reflect one's own norms and role in these transformative processes, also the own contributions to the crises mentioned at the beginning of my text. E.g. IT action research has to reflect one's own socio-ecological impact: what does it actually mean for Grounded Design when the artifacts that are developed and produced contribute to the climate crisis, e.g. producing and supporting an increase in carbon emissions? And how can the misuse of IT (e.g. anti-democratic or exploitive use) that was developed in Design Case Studies for specific contexts be avoided when artifacts are de-contextualized?
Practice-based computing, analyzing and design of IT, allows phenomena of socio-technological transformations to not only be understood but at the same time to shape these processes – hopefully for the "*good life*" and a just society.

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Grounding Design

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One of the pleasures of going to an artist's retrospective exhibition is that one gets the chance to perceive at once a unity to their work and a sense of its development which it is otherwise hard to garner through stray visits to random galleries in different cities. I experienced similar revelations whilst reading the work in this section. The integration of rich social theory, design praxis and sociological methodology is impressive, especially when combined with a generous, appreciative understanding of a number of intellectual traditions. As I read through the chapters, I found myself wondering if the work collectively constituted a School.

The thematic of grounded design is explored in the eponymous work where the authors argue that: "Grounded Design can be understood as writing a 'grounded theory' from design case studies by means of a comparative analysis of individual cases in their contextualized complexity". Let's unpack the statement a little. Susan Leigh Star, trained in grounded theory by one of its founders Anselm Strauss, used to regularly complain that few people who averred they practiced it actually took the core concept of constant comparison seriously. The phrase 'contextualized complexity' is central here: one keeps revisiting rich case studies with questions that only occur through juxtaposition with others until one reaches generalizations across them which account for these details. The result is a vision of a 'context specific' computer science far removed from the apodictic generalizations of much of the field, which get continually disproven yet also reproduce themselves to beguilingly. This vision is both grounded

and rigorous: it produces generalizations built on variation rather than on universal laws.

The chapter 'Practice Based Computing' develops the concept of grounded design – following its precepts in the first instance by working across examples ranging from design of care for those with dementia to developing an archive of drawings in a steel mill. One central theme, which is interwoven in several of the papers is 'computer supported access control'. A naïve thinker – largely my own category before I read the work – might think that access is about read/write permisisions delegated in advance by designers who know the needs, rights and privileges of ideal users of their system. This argument breaks down whenever you get into the details of use practice: there always need to be allowances for local exceptions. Just as the concept of 'implications for design' was justifiably excoriated by Paul Dourish as something which cannot be 'mechanically derived' (12:11) so implications for practice need to be sensitive to 'wicked problems' – there are no rote solution for either. I am reminded here of Michel Serres' wonderful essay on the Northwest Passage (an essay sadly becoming less accurate by the year …): he writes that there is always a passage between the natural sciences and the humanities, but one that is always shifting as the ice floes move about. Similarly, there is no simple route between design and practice – there are principles of navigation which can be learned.

I think of the concept of computer supported access control in apposition with the development of 'infrastructuring' in this and other chapters. To infrastructure is a transitive verb; it points to the activity of rendering something infrastructural through conjoint design and practice. In the chapter entitled 'Infrastructuring', Pipek and Wulf argue that: "… traditional design methodologies in IS prioritize the designers' perspective in a way that obstructs the perception of the users' contribution to the improvement of infrastructures. However, the users' perspective … is actually broader. It includes the transition from old to new routines and usage patterns". I quote this at length since it points to an ontological commitment that I perceive across this body of work: a commitment to process ontology (as developed notably by Whitehead). Whatever the domain of the case studies, all of these papers make the salutary move of taking us away from fixed categories (nouns) such as 'problem', 'design', 'user' into the far richer territory of problematizing, designing and using.

The chapter 'Making Use' has a wonderful discussion of infrastructuring, including a rich chart (25) of the difference between a noun- and a verb-based reading of the term. It discussed the rubric of 'appropriation' by using it to bring activity into the verbal fold: "This is not just a complexity issue. But represents a fundamental worldview problem, based on the conflation of real world practices with (formal) descriptions of those practices. It includes a wonderful treatment of activity theory – another strand,

like science and technology studies, that they have explored creatively. And this work naturally brings us back to grounded design. Taking away the designerly perspective of 'unanticipated' use, Stevens and Pipek argue that we should understand this as 'orderly use': this is just the way design gets done in practice.

The chapter on Sharing Knowledge and Expertise again takes us our attention away from the bright shiny object of the chunk of knowledge, so beloved of early expert systems, into the realm of expertise – knowing how rather than knowledge that. There is a rich, somewhat rueful, description of the failure e of knowledge management systems to understand this.

The chapter Towards Sociable Technologies is again strong on infrastructuring and grounded design. I loved the move from the Internet of Things (abstracting away all human process) to the Internet of Practices. The study of the difficulty of use of 3-D printers was both personally resonant and a wonderful evocation of the problems first uncovered by Lucy Suchman in Plans and Situated Actions. Which brings me to a theme a collection such as this must address: what is it that lasts of the analysis when all of the technology being described is outdated now or soon will be? Why should we be reading this all ten, twenty years afer the event? It is rare to think of academic work as evanescent – many fields cast back to the founders and then race for the contemporary reference, and don't mess with Mr. Inbetween1. By moving us away from the technology as object to the technology as process, these papers deliver insights with a far longer use-by date than our average.

Wulf and Roluie's chapter on Integrated Organization and Technology Development, the earliest in this section, illustrates the point. The title gives us a theme which resonates throughout; and the concluding sentence is both a statement of the then state of the art and a promise of further valuable developments: "… we need additional case studies in different organizations to be able to judge whether this approach is a reasonable way to cope with increasing dynamics of the environment". The response, as the works here display, is a resounding yes.

I have been associated with two possible schools: actor network theory (which was and wasn't: it vacillated between being a methodology and an ontological commitment) the putative Irvine School of Social Informatics (which wasn't really; we were just folks who liked each other and appreciated what the others were doing without integrating). What is impressive about these works is that they have coherence over time while constantly addressing different traditions and new work and computer environments. They don't give us a single message; they do offer a way of fruitfully generating new

[1] An admittedly obscure and askance reference to Bing Crosby's Ac-cent-chu-ate the Positve: https://mojim.com/usy164981x1x1.htm

messages – and along the way they convince us that computing is not peripheral to social and organizational theory, it is of its very essence. Sign me up to the Siegen School.