# Innovation of New IT Use: Combining Approaches and Perspectives in R&D Projects

**Fredrik Ljungberg, Bo Dahlbom, Henrik Fagrell, Magnus Bergquist, and Peter Ljungstrand**
The Mobile Informatics group
Viktoria Research Institute
Viktoriagatan 13, S-411 80 Gothenburg, Sweden
+46 (0) 31 773 27 44
{fredrik, dahlbom, fagrell, peter, magnus}@informatics.gu.se

**ABSTRACT**

This paper describes how Participatory Design has been adopted in a joint academic and industry research program called "Mobile Informatics." The objective of the research program is to produce innovations of new IT use in mobile settings. The particular focus of this paper is the *Mobile Informatics Research Framework*, which is the collaboratively developed research model for the program. The main argument of the research framework is that following four factors are needed: (1) *participatory design* to address the use-oriented focus of the program; (2), *interdisciplinary collaboration* to produce general IT artifacts; (3) *scenario work* to assure an ongoing, future-oriented perspective; (4) *decision points* to address commercial issues. Describing how Participatory Design was adopted in the research framework, and how it is combined with other perspectives and concerns, the paper aims at contributing to discussion of bringing Participatory Design into industrial contexts.

**Keywords**

Participatory Design in industry, research framework, interdisciplinary work, Mobile Informatics.

**INTRODUCTION**

Mobile Informatics is a SITI (Swedish Information Technology research Institute) research program, coordinated by the Viktoria Research Institute (henceforth "Viktoria"), in Gothenburg. It involves researchers both from academia and industry, who work together in applied information technology (IT) projects.

The overall objective of the program is defined as *innovation of new IT use in mobile settings*. More specifically, this means that the projects within the program aim at producing the following results:

- The design of novel IT artifacts for mobile use.
- Elaborated ideas of the overall activity within which the IT artifacts designed would be used.
- Notions of how to reach the new way of acting.

Most participants shared these objectives when the development of the program started in September last year. However, the opinions about *how* to achieve them varied considerably. This was perhaps not a big surprise, bearing in mind *the plethora of backgrounds and competencies of the stakeholders involved* in the program. Nevertheless, the participants of the program found it important to develop a research framework on which everybody involved could agree. Therefore, seminars were arranged for the purpose of addressing the issue, i.e.: *How to conduct joint industry and academic R&D projects aiming at innovation of new IT use in mobile settings?*

During the seminars, of which all but one were held at Viktoria, the stakeholders involved joined together in discussions and other kinds of group activities, to *collaboratively* develop a research framework for the program. The objective of this paper is to report the results of these seminars: *the collaboratively developed Mobile Informatics Research Framework.*

At Viktoria, most researchers have a background in the so-called "Scandinavian School of systems design." They therefore advocated ideas and assumptions behind the Participatory Design movement. However, the development of the research framework was a democratic process; the interests of all parties needed to be taken into consideration. Because additional perspectives were brought to the fore in the discussions, perspectives differing from Participatory Design had to be incorporated as well. Let us give some examples.

The formulation of the objective of the program, i.e., "innovation of new IT use in mobile settings," was by most participants interpreted as concerning IT use *in general*, as opposed to the use of IT in the specific work setting, which has been the main focus of Participatory Design. Furthermore, issues like *originality, time to market* and *cost*, which are not generally considered in Participatory Design, *were* strongly emphasized by the industrial partners. Taking these considerations, and others into account, the result of the seminar series was that Participatory Design principles were adopted in the

In *PDC 98 Proceedings of the Participatory Design Conference.* R. Chatfield, S. Kuhn, M. Muller (Eds.) Seattle, WA USA, 12-14 November 1998. CPSR, P.O. Box 717, Palo Alto, CA 94302 cpsr@cpsr.org ISBN 0-9667818-0-5.

research framework, but also that they were accompanied with other perspectives.

In this paper, we wish to report the collaboratively developed *Mobile Informatics Research Framework*. By describing the ways in which Participatory Design was adopted in the research framework, and how it is combined with other perspectives and concerns, the aim of this paper is to contribute to the growing amount of attempts to bringing Participatory Design into industrial contexts, here industrial R&D on Mobile Informatics.

## 2 BACKGROUND

In this section we give a background to the research framework developed. We first introduce the Viktoria Research Institute, followed by a brief description of the Mobile Informatics Research Program.

### 2.1 The Viktoria Research Institute

Viktoria was established July 1 last year, as a joint initiative of Swedish organizations, among them Volvo, the city of Gothenburg, Ericsson, Astra, SKF, and Mölnlycke, and the two universities of Gothenburg: Gothenburg university and Chalmers university of technology. Viktoria is mainly concerned with doing applied research in cooperation with industry, aiming to explore new and innovative ways of using IT. Most of the 25 employees work part time in other places, either at the university or in industry. Together with Gothenburg University, the institute runs a Ph.D. program for its member organizations.

There are three research groups at Viktoria, concerned with media and entertainment, IT and organization, and mobile informatics, respectively. The three groups employ people with different competencies and backgrounds, ranging from informatics and computing science, to computing linguistics, business administration, and ethnology.

### 2.2 The Mobile Informatics research program

The development of the Mobile Informatics research program, was a joint effort between the Mobile Informatics research group at Viktoria and researchers from industry. The program is divided into three main domains and two supporting domains, as illustrated in figure 1.

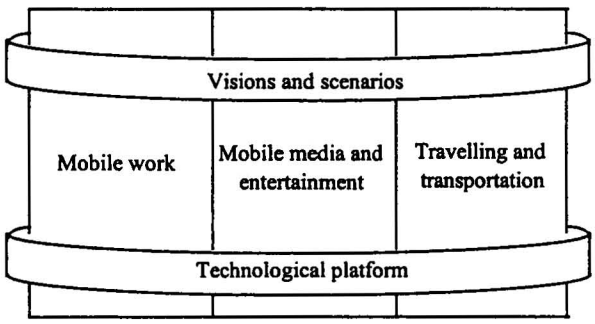


Figure 1: The structure of the Mobile Informatics research program (the figure was developed by Kent Eric Lång at Ericsson Microwave Systems).

Let us now consider the domains in more detail.

*Mobile work* is concerned with the possibilities of IT use in (the growing amount of) work situations where mobility plays an important role, e.g., providing mobile salesmen using lap tops with gateways to office-based document management systems.

*Mobile media and entertainment* explores new kinds of media, e.g., ambient media, in the context of entertainment, e.g., how the Wireless Application Protocol (WAP) can be used to provide mobile actors with web access to entertainment, or how the mobile phone can be used as a device for networked wearable computing.

*Transport and traveling* focuses on how traveling people could benefit from IT, e.g., how travelers could use their mobile phone to re-organize the path of an ongoing journey, and on how IT could be used, e.g., to order and control goods in the transport process.

*Technological platform* was established because most projects within the program will rely on having access to an appropriate technological test bed for implementation and development.

Because the program aims at exploring commercially feasible products and services for future markets, continuous discussions about *visions and scenarios* was considered to be so important that a dedicated domain was needed for that purpose.

The research program involves all together 18 projects, each of them assigned to one of the five domains. So far, nine of these projects have been given the permission to start.

Now when the structure of the research program has been outlined, let us direct the attention towards the focus of this paper: the research framework developed for the projects.

## 3 THE MOBILE INFORMATICS RESEARCH FRAMEWORK

The research framework of the Mobile Informatics program was developed in eight seminars during the fall of 1997. The seminars, which lasted between three and six hours each, involved discussions, workshops, and other kinds of group activities. One main objective of these seminars was to collaboratively explore how to conduct this kind of R&D work. The result of this work was the Mobile Informatics research framework, which is presented in this section. The main argument of the research framework is that:

- *Participatory design* principles should be adopted to address the use-oriented focus of the research program.
- *Interdisciplinary collaboration* is needed to address the commitment of the program to generalize, i.e., to produce innovations that are likely to be useful in many settings, as opposed to the specific work setting.

- *Scenario work* is important in order to assure ongoing discussions in the program about the future of the domain.
- *Decision points* are important to address the commercial perspective of the program, e.g., issues like originality, time to market and cost.

Let us now consider the different parts of the research framework.

### 3.1 Combination of perspectives

To meet the overall objective of innovation of new IT use, we suggested a research approach which takes its point of departure in "the new informatics" [4]. According to Dahlbom [4, p. 29], the new informatics is "a theory and design-oriented study of IT use, an artificial science with the intertwined complex of people and IT as its subject matter." It is important to notice that adopting the perspective of the new informatics does not imply a research process that only involves informaticans. On the contrary, it calls for *cooperation between people with different competencies and backgrounds* [see, 1].

The discussions concluded that besides informaticans, the project in the research program should also involve

- users,
- social scientists, and,
- computing scientists.

While social science often is oriented towards describing and understanding practice, informatics seeks to explore how it could be changed by means of new IT. Computing science, on the other hand, is more technologically oriented, focusing on the technology as such. Obviously, potential users of new IT artifacts are very skilled when it comes to inform and evaluate new IT use in a particular kind of activity from which they have experience.

#### *3.1.1 Users*

One very important competence to incorporate and guide R&D that seeks to produce innovation of new IT use, is *users*. The users' competence does not generally suffer from technological bias; neither is it driven by a commercial profit agenda. In Scandinavian countries, users are often brought into design because of their democratic rights to control organizational change affecting their jobs [3]. Another reason to bring users into design is that their contribution is very likely to improve the outcome of the design [8]. The Collective Resource Approach emphasized the firstly mentioned reason for user driven design, where later projects, such as Utopia, also took into consideration the latter [7].

Bringing in users in projects aiming to produce innovation of new IT use in a *general* sense, gives rise to a dilemma: namely to find "the typical user," a person who has been argued not to exist [9]. This is not to say, however, that people who spend their working day in mobile settings cannot provide this kind of R&D work with valuable input. On the contrary, we believe that mobile personnel can provide very valuable knowledge about mobile work, and the use of IT in such settings, even though the *specific* working conditions cannot be generalized. By involving mobile staff from various settings, we could, furthermore, obtain a valuable body of knowledge about the more general aspects of mobile work. And this is exactly what is needed in this kind of systems design: the aim is to produce general IT artifacts, thus it should be informed by general features of the use context. Besides, the IT artifacts developed would anyway need to be tailored to the specific working conditions to be useful.

#### *3.1.2 Informaticans*

Informatics is an artificial science concerned with *the use of IT*. The knowledge interest of artificial sciences, such as informatics, is innovation of the use of artifacts [17, p. 7]— IT use in general in the case of informatics, IT use in mobile settings in case of mobile informatics. Such a knowledge interest goes beyond the classical distinction between the social and the natural sciences, with their ambition to interpret and explain respectively [6]. Simply put, informatics takes a dualistic perspective of social practices and technology, which thus are claimed not to be studied in isolation from each others. The research would typically start out from the possibilities of the technology, in what seem to be the needs of different user communities, or both. The output of informatics research, i.e., innovation of IT use, is the design of novel IT artifacts with a particular focus on the overall activity of which the technology will be a part of and form, but also conceptions of how to implement this change.

#### *3.1.3 Social scientists*

Social science is, indeed, a large and complex area involving many different and sometimes conflicting interests. One particular kind of social science that was discussed in the seminars was the ethnomethodologically oriented schools [11]. The main method of this school is fieldwork (interviews and observations) and qualitative analysis of the meaning and content of human activities. The main reason is that the detailed analyses of practices provided by this particular kind of social *science have been demonstrated to be very useful* for the purpose of design [1]. This is not to say that other social science perspectives should be excluded, only that the ethnomethodological school has been documented to be very successful. Accordingly, the point here is, firstly, that social scientists, with their analyses of human action, could contribute considerably to the design of useful IT artifacts, and secondly, that this should be considered in the projects of the research program.

#### *3.1.4 Computing scientists*

Computing science is also a large and complex field without any generally agreed upon focus and agenda. The understanding of computing science adopted here is very much how the discipline has been enrolled in multidisciplinary CSCW research [1], i.e., as the part of the design project concerned with the construction,

implementation, and technical evaluation of IT artifacts. Such a perspective is very much focused on the technology *per se*, and research contributions are typically made on technical issues, such as toolkits and architectures. Such knowledge is not only important for implementing designs, but also as a valuable input to discussions of the possibilities of different technologies.

#### *3.1.5 Combining the perspectives*

Based on the idea that *interdisciplinary collaboration* is vital for the projects in the research program, we thus suggest the combination of four perspectives. This in turn derives from the idea of dialectics, i.e., that the four competencies *jointly enrich* each other, thus helping us to achieve the objective of the program. The focus on IT use in general, as opposed to IT use in the particular setting, would therefore arguably disqualify an approach that "only" involves users and designer. The combination of the latter with rich social science analyses, as well as deep technological skills, thus aims at helping the projects to address the focus on *general* ideas of new IT use.

The four competencies proposed are:

- Informatics competence, i.e., the use of technology,
- User competence, i.e., how it is to act in a particular setting,
- Social science competence, i.e., analyses of how people act, and
- Computing science competence, i.e., development and potential of the technology.

These four areas of competence are outlined and contrasted to each other in figure 2.

| Competence area | Interest | Approach | Perspective | | Objective |
|---|---|---|---|---|---|
| Users | guide the design of future IT use, i.e., future work or leissure activites. | involvement in R&D (participatory design) | "use domain" experience | → | The design of useful IT artifacts to be incorporated in work or leissure activites, i.e., IT use. |
| Social scientists | understand practice (interpretation) | qualitative research (description) | Practice | → | Collect a rich body of empirical research on the role of mobility in work (and life in general). |
| Informaticans | innovation of new IT use<br>- idea geneation<br>- evaluation | idea generation and evaluation of new IT use based on empirical experiences and technological potential | IT use | → | Suggest new ways of IT use in mobile situations by exploiting the potential of technology and conduct empirical research (here: innovation on mobile informatics) |
| Computing scientists | engineer artifacts | construction | IT | → | Construct and implement new applications. |

Figure 2: The four competencies of the mobile informatics research framework.

### 3.2 Research approach

The research approach suggested involve two basic steps, which should be seen as an iterative process rather than a sequence. The first step, "idea generation," would start out from empirical studies, technological possibilities, or both, and produce ideas on new IT use, here called "innovations," which are evaluated in the second step. Based on the evaluation, the innovation is either transferred to the next step in the R&D process, or re-considered in the "idea generation" step. Furthermore, the research cyclic can be informed by or request advises from people doing scenario work.

Let us now consider the two steps in more detail.

#### *3.2.1 Idea generation*

Empirically informed idea generation primarily involves two kinds of studies: (1) analyses of practice, and (2) design-oriented studies. The first kind of empirical study is done by social scientists, exploring the everyday practices in a certain domain with the objective to produce rich and detailed analyses. Such analyses typically involve an ethnographic research method. Providing informaticans, and sometimes computing scientists with such analyses is one way of informing the process of idea generation. This way of transferring empirical studies to design has been called "ethnographically informed design" [12]. The second kind of empirical study is conducted by informaticans, and differs from the first kind in the sense that it is

design-oriented. In such studies, the researcher explores a certain domain with the ambition of IT innovation, investigating what new kind of IT use that would enable a new and more appropriate way of acting within this specific domain. This is done by trying to combine knowledge about the possibilities of the technology with what seems to be an appropriate new way of acting within the particular domain. This kind of empirical studies has been called "archaeology of the future" [5], since the researcher is concerned with exploring the implications of different technologies for the activities in which it would be enrolled. Opposed to "traditional archaeology," which simply put is concerned with reconstructing ancient cultures by examining the artifacts left behind, archaeology of the future seeks to explore possible scenarios of the future by exploring the changes in action enabled by different kinds of IT artifacts.

Based on the empirical studies informaticans, computing scientists, social scientists, and users can join together in *design sessions*, where different kinds of design options are discussed. Design sessions can exclusively involve future users of the innovation in question, e.g., using techniques such as *future* workshops [13] and prototyping [2].

Technologically informed idea generation will be the other main approach to the idea generation step. The starting point here is the seemingly potential of a particular technology, which clearly is an important way of exploring innovations of new IT use. For example, the empirically oriented approach may suffer from not making the R&D process innovative enough, since the idea generation very much is derived from how things are being carried out currently.

In the projects, idea generation will probably most often be based on a mix of the technological and empirical approaches. Independent of how the idea generation is initiated, it would also involve important aspects of creative activities that are difficult to formalize and put in words. Examples are tinkering, creative thinking, reading, individual researchers analyzing empirical data, and the use of metaphors to come up with novel ideas. That is, how the idea generation of innovation actually is done will partly be unknown in advance, furthermore difficult to isolate to one single factor.

Development and implementation is crucial in idea generation. One reason why is that these activities reveal important limitations and possibilities that are difficult to discern in advance. Development and implementation will thus give important feedback for design sessions. Development sessions, where the design ideas are transformed to development, will also be an important way of confronting design ideas with constraints and potential of the technology. The very construction of the IT artifacts will also give rise to new insights, and in doing so, form the IT artifact being implemented.

The idea generation step will deliver more or less implemented IT artifacts to be evaluated in the second step of the research process, called evaluation.

#### 3.2.2 Evaluation

Evaluation will be concerned with more or less implemented innovations, ranging from pure sketches to fully implemented IT artifacts. Three kinds of evaluations are primarily involved. These are, first, evaluation of usability, second, evaluation of change in practice, and third, technical evaluation.

*Evaluation of usability* can be done on everything from sketches of design and mockups to fully implemented IT artifacts being evaluated in a real use situation. Early in the research process, usability evaluation would primarily be based on design sketches. The aim would be to derive implications for how to continue the design, e.g., what seems to be valuable features of an application. In later parts of the research process, this kind of evaluation is more likely to be concerned with implemented systems. Usability evaluation can be done in various settings, including a laboratory and real work situations.

*Evaluation of change in practice* would typically be done by social scientists, exploring the ways in which new technology is integrated, and thus forms, an activity such as work. This kind of evaluation would typically rely on the innovation of IT use being implemented in a real work situation. Evaluation of change is therefore likely to take place in the latter parts of the research process.

*Technical evaluation*, aiming at evaluate different aspects of the IT artifact being researched and engineered, can be integrated in early parts of the research process, but would primarily be done when the technology in question is fully implemented. This kind of evaluation has the objective to certifying IT artifacts but also to give implications for further technological implementation.

#### 3.2.3 Scenario

Scenario work will be a continuous activity in the research program. The objective is to transcend the current conceptions of Mobile Informatics and to assure a vital, ongoing discussion of "what might take place?" [14] in the field in the future. The scenario work will interact with the projects in two ways.

- Guide the work in ongoing projects and the process of deciding what projects to establish in the program. This will be done by continuously offering scenarios of the future of mobile informatics in general.
- Work out scenarios based on requests from projects. The projects will also request scenarios for a particular kind of aspect of the future of mobile informatics. These requests will be taken as input in the scenario work, worked on and returned to the project in question.

The scenario work, both the ongoing and the work based on requests, seeks to assure a vital, ongoing discussion of the future directions of mobile informatics. In the seminars, the future oriented perspective of the program

was argued to be the main argument for the central position of scenario work in the research framework.

### 3.2.4 Decision points

Each time a project has completed the two steps of the research process, it is evaluated based on commercial issues like originality, time to market and cost. The outcome of such an evaluation, called a decision point, can be: first, the project need yet another loop in the research process, second, that the results should be brought forward in the R&D process, or third, that the project, for commercial reasons, should not continue.

### 3.2.5 Results

The research approach suggested has been designed with the objective of producing innovation of new IT use. The result of this kind of applied IT research would therefore be:

- *The design of novel IT artifacts for mobile use.* Since the design is done with a focus on the overall activity of which the technology will be a part of, and form the design, is not concerned with the technological artifacts only, by rather with...
- *The designed "new way of acting,"* i.e., elaborated conceptions of the integration of the designed IT artifact in the practice concerned, e.g., a new way of working. Furthermore, since the aim is to conduct research that is applied, a third kind of result would be...
- *Notions of how to migrate to the new way of acting,* e.g., how to change an existing way of working to the situation enabled by the innovation.

Even though the informatics perspective in many ways is the starting point for the research approach suggested, the quality of the results is clearly very dependent on the combination of perspectives. That is, without being accompanied and informed by users, social scientists and computing scientists, neither of the results stated above are likely to be delivered, at least not with a sufficiently high quality. Figure 3 summarizes the research approach.

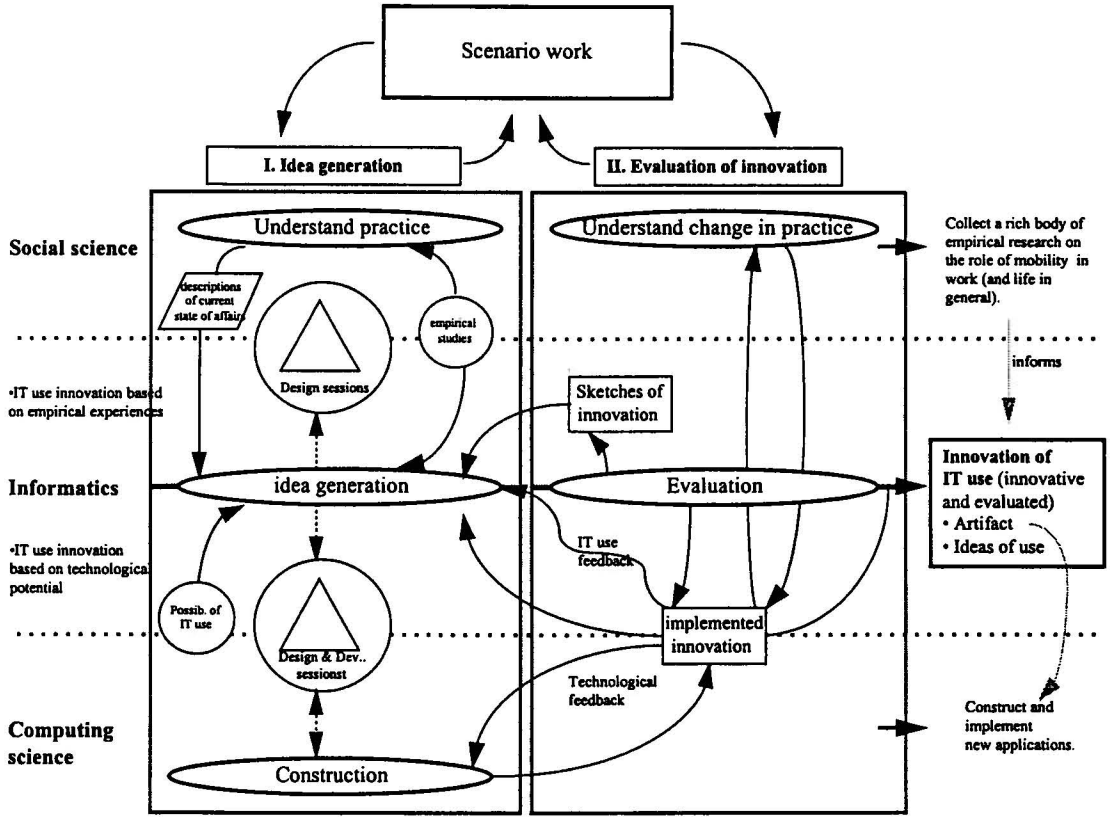


Figure 3: The mobile informatics research framework.

There are many candidates for methods to be involved in the projects. For example, to investigate practice we could use participant observation [10], interviewing [15], etc., to come up with design ideas we could use future workshops [13], archaeology of the future [5], etc., to evaluate innovations we could do formative and summative evaluations [13], usability test [16], technological evaluation, etc. Exactly what methods to adopt in a project will depend on, for example, who participates, duration, and resources.

## 4 SUMMING UP

In this paper, we have described how Participatory Design has been incorporated in the Mobile Informatics research framework. The objective has been to join the discussion of how to bring principles from our community to industrial R&D contexts.

Focusing on the use of IT, the specific approach taken as point of departure for the program was "the new informatics" [4], a Scandinavian-oriented research approach which owes much from Participatory Design. To address the objective of the program to generalize, the Participatory Design principles were accompanied with interdisciplinary collaboration. In particular, we have argued for cooperation between people trained in informatics, social science, and computing science. Scenario work was incorporated in to the research framework to assure ongoing discussions in the program about the future of the domain, while decision points aim to address the commercial perspective of the program.

Our future work involves evaluating the research framework developed. The evaluation will, among others, be concerned with:

- In what ways it actually has been adopted in the projects,
- How the Participatory Design principles have been possible to integrate,
- How well these have been aligned with the other perspectives of the research framework, and not the least,
- Whether or not the combined approach seems to contribute to more useful IT artifacts.

**ACKNOWLEDGEMENTS**

The research for this paper was supported by the Swedish Information Technology Research Institute (SITI) under the Mobile Informatics research program. We would like to thank all participants of the Mobile Informatics program, in particular Kent Eric Lång at Ericsson Microwave Systems, and Steinar Kristoffersen at the Norwegian Computing Centre.

**REFERENCES**

1. Bentley, R., J.A. Hughes, D. Randall, T. Rodden, P. Sawyer, D. Shapiro, and I. Sommerville (1992) "Ethnographically-informed systems design for air traffic control," In *Proceedings of ACM 1992 Conference on Computer-Supported Cooperative Work*, edited by M. Mantei and R. Baecker, pp. 123-129, Toronto, Canada: ACM Press.
2. Bødker, S., and K. Grønbæk (1991) "Cooperative prototyping: Users and designers in mutual activity," *International Journal of Man-Machine Studies*, vol. 34, no. 2, pp. 453-478.
3. Clement, A. (1994) "Computing at Work. Empowering Action by "Low-level Users"," *Communications of the ACM*, vol. 37, no. 1, pp. 53-63.
4. Dahlbom, B. (1996). "The New Informatics," *Scandinavian Journal of Information Systems*, vol. 8, no. 2, pp. 29-48.
5. Dahlbom, B. (1997) "Going to the future," in *The Ethical Global Information Society. Culture and Democracy Revisited*, edited by J. Berleur and D. Whitehouse, London: Chapman & Hall.
6. Dahlbom, B. and L.-E. Janlert (1990). "An artificial world: An invitation to creative conversations on future use and design of computer technology," *Scandinavian Journal of Information Systems*, vol. 2, no.1, pp. 85-100.
7. Ehn, P. (1988). *Work-oriented design of computer artifacts*. Falköping, Arbetslivscentrum.
8. Ehn, P. (1992) "Scandinavian design: On participation and skill," in *Usability. Turning Technologies Into Tools*, edited by P. Adler and T. Winograd, pp. 96-132, New York: Oxford University Press.
9. Greenbaum, J., and M. Kyng (ed.) (1991) *Design at work: Cooperative design of computer systems*, Hillsdale, N.J.: Lawrence Erlbaum Associates.
10. Hammersley, M., and P. Atkinson (1993) *Ethnography. Principles and practice*, Second edition, London: Routledge.
11. Hughes, J., D. Randall and D. Shapiro (1993). "From ethnographic record to system design. Some experiences from the field," *Computer Supported Cooperative Work. An international journal*, vol. 1, no. 3, pp. 123-141.
12. Hughes, J., V. King, T. Rodden, and H. Andersen (1994) "Moving out from the control room: Ethnography in system design," In *Proceedings of ACM 1994 Conference on Computer Supported Cooperative Work*, edited by T. W. Malone, pp. 123-141, Chapel Hill, NC: ACM Press.
13. Kensing, F., and K.H. Madsen (1991) "Generating visions: Future workshops and metaphorical design," in *Design at Work: Cooperative Design for Computer Systems*, edited by J. Greenbaum and M. Kyng, pp. 155-168, Lawrence Erlbaum Associates.
14. Lindgren, M. (1996) *Scenarioplanering*, Uppsala: Konsultförlaget i Uppsala AB.
15. Patton, M.Q. (1990) *Qualitative Evaluation and Research Methods*, New York: Sage.
16. Preece, J. (1994) *Human-computer interaction*, Wokingham, England: Addison-Wesley Publishing Company.
17. Simon, H. (1981). *The sciences of the artificial*. Cambridge, MA, MIT Press.