

DIWA – Design and use of Interactive Web Applications

Background

In the past few years Web-technology has matured enough to become an attractive platform for business applications and organizational information systems. Indeed, large and small organizations are increasing their investment in Web-based Information Systems (IS) resources, such as electronic commerce, intranets and extranets. And, in the business press Web technology is often presented as a 'revolution' in network and information technologies – propelling change from static, hierarchical structures to more dynamic, flexible and 'knowledge-based' organizational forms.

However, at the present time, organizational models for implementing and managing Web-applications can only be described as emergent. The technology is in a state of flux – with competition among alternative products and technical standards – and organizations designing and implementing Web-based systems are often in the dark with regard to appropriate organizational models and technological solutions. Responding to this situation, in this project we focus on the design, management and use of advanced Web-based applications.

We call these “*interactive Web applications*.” These differ from ordinary Web-sites (a set of Web-pages) in that they mediate interactions among multiple distributed actors who are not only users, but also designers in the sense that they contribute to the system's structure and content.¹ Interactive Web-applications are often tightly integrated with other, non-Web-based information systems, e.g. databases and transaction processing systems. Flexible and integrative by nature, interactive Web-applications serve a range of purposes. They provide a universal multi-modal user interface to business applications, databases and legacy systems, while supporting document and workflow management, cooperative work and distributed knowledge sharing.

In organizational contexts we believe that this type of system will have an increasingly significant impact, particularly on the way people in organizations communicate, collaborate and coordinate their work both internally and externally. This is because interactive Web applications are fundamentally different from traditional information systems. The major differences can be summarized as follows:

- The Web is fundamentally a *new medium of human communication* – not a technology for information processing or computation. As a result, software design will coalesce with media design.²
- Web-based information services will be available at any time and at any place. This *ubiquity of services* will lead to new kinds of organizations and new ways of interacting within existing organizations.³
- The *rate of change* in technologies is unprecedented. The pace at which new tools and techniques are invented is unheard of even in the fast-moving world of computing. This proliferation of new technologies creates an 'interoperability nightmare' for application developers and users and makes it difficult to manage the development process.⁴
- The traditional *division of labor* and definition of work roles in IS development breaks down. The distinction between designers, programmers and users becomes increasingly blurred and new types of specialists – such as graphic designers and communications specialists – enter the design process.

In terms of organizational IS practice, these changes are transforming IS services, associated management processes and therewith IS development itself. The scope of knowledge and skills required to successfully design, implement and manage interactive Web applications transcends those of tradi-

¹ Isakowitz, T., M. Bieber & F. Vitali (1998). Web Information Systems. *CACM* 41(7): 78-80.

² Turoff, M. & S.R. Hiltz (1998). Superconnectivity. *CACM* 41(7): 116. Lyytinen, K., G. Rose & R. Welke (1998). The Brave New World of development in the internet network computing architecture (InterNCA): or how distributed computing platforms will change systems development. *Information Systems Journal* 8: 241-253.

³ Lyytinen, K., G. Rose & R. Welke, op.cit.

⁴ Lyytinen, K., G. Rose & R. Welke, op.cit. Balasubramanian, V. & A. Bashian (1998). Document Management and Web Technologies: Alice Marries the Mad Hatter. *CACM* 41(7): 107-115. Bhattacharjee, A. (1998). Management of emerging technologies: Experiences and lessons learned at US West. *Information & Management* 33: 263-272.

tional organizations. They encompass telecommunications, media design, communication, information organization (library science), and the management of organizational change in a climate where nobody can be an expert in all areas and specialists need to cooperate in the design and use of interactive Web applications.

In sum, development and use of innovative applications of Web technology raise a host of timely, and sparsely investigated, practical, conceptual, methodological, and technological issues. The DIWA project takes its point of departure in these, analyzing Web-technology as a burgeoning platform for collaborative, distributed work, inside organizations (intranet) or between organizations (extranet). The project is based on the assumption that development of such interactive Web-applications represents important organizational and technical challenges with which many organizations have difficulties. Thus, the theme of the DIWA project is design, management and use of interactive Web-applications in distributed work settings.

Purpose and research objectives

The goal of the project is to examine how Web-technology – as a networked, distributed computing platform – is changing organizational IS development and use. The central purpose is to develop conceptual frameworks, implementation models, and best practice guidelines to support the design and management of organizational Web-based information systems based on empirical investigation and interdisciplinary analysis.

The project has four objectives:

- To examine how the scope, content, and organization of IS design and use processes change as information services become ubiquitous and software development coalesces with media design.
- To analyze the accompanying implications of this for the division of labor, skills, and knowledge in IS development and use.
- To identify key organizational and technical factors that facilitate or impede successful implementation of interactive Web applications.
- To develop and evaluate concepts, methods and tools for guiding both the design of interactive Web applications and the development of distributed and networked organizational forms.

Research approach

The research approach adopted in the proposed project is both *analytical*, seeking to understand the complex social processes of design, management and use of these applications, and *constructive*, striving to develop concepts, methods, and tools to support practice.

The research is based on a combination of action research and different types of field studies. By combining a variety of qualitative research methods and sources of data-collection (e.g. observation, participation, document analysis, and interviews), we seek to ensure not only the practical relevance and applicability of the research, but also the validity and reliability of the results. The real challenge for practice-related research is to carry out studies that are both relevant for practice and analytically rigorous.

The complexity and dynamics of the field of study necessitates bringing a number of theoretical positions into play. These include:

- Information systems development and participatory design.
- Computer supported cooperative work.
- Human Computer Interaction.
- IT and organizational change.
- Media Studies and reception analysis.

These approaches and related ‘reference disciplines,’ such as computer science, sociology, psychology and media studies, constitute the project's theoretical foundation. To promote synergy and integration among the various disciplinary backgrounds represented in the research group, all research activities will be carried out in interdisciplinary teams.

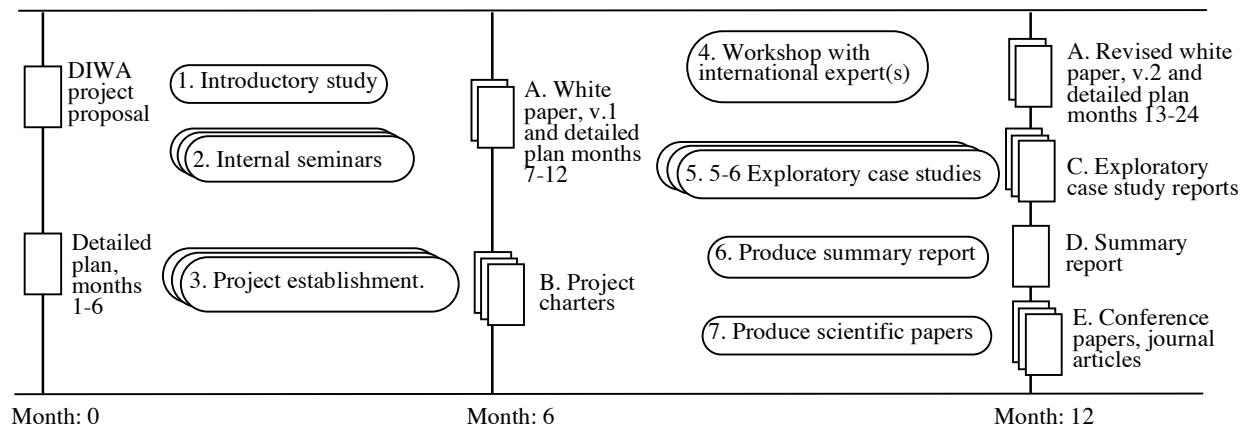
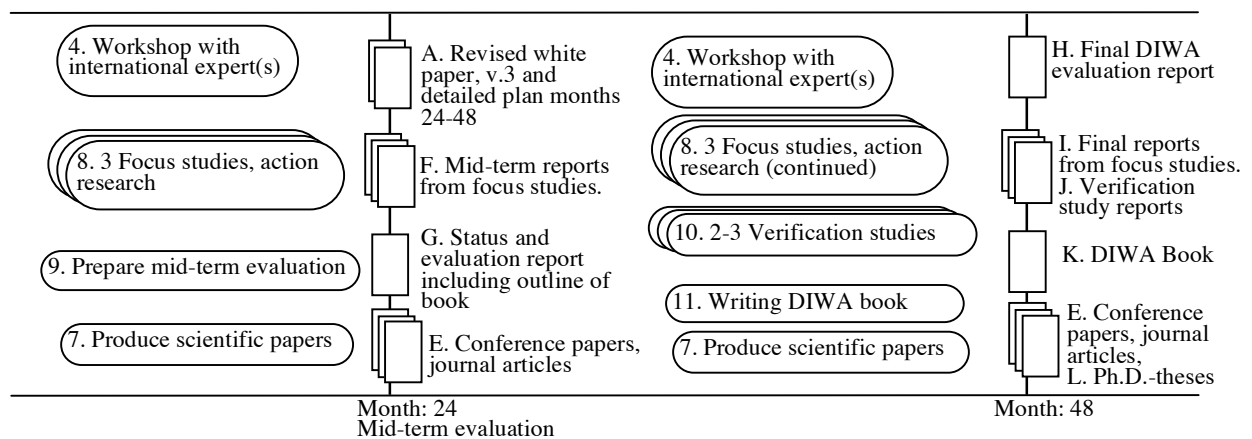
Project organization and plan

DIWA is a sizable, multi-institutional project involving a number of researchers, which requires careful coordination. Finn Kensing at Roskilde University will act as project manager. The project manager, in collaboration with two senior researchers representing The Copenhagen University and The Danish Technical University, form a management team of the project. In coordinating the activities of DIWA's researchers, this management team will consult periodically with an advisory panel composed of representatives from the organizations involved in the project in order to ensure the maximum transfer of knowledge back to industry. Study elements will be conducted in inter-institutional groups, thus equally ensuring maximum benefit of the project's topic and multidisciplinary nature for the research world. Similarly the project's Ph.D.-students will be offered supervision from more than one of the institutions involved.

DIWA is designed to run for four years and is organized in two phases. During *phase one* (lasting 1 year), 5 to 6 ongoing Web-related initiatives in participating organizations will be studied as preliminary cases. Each study will be carried out in cooperation with team members from these organizations. The aim of these studies is to explore design practice and use patterns in order to identify key issues for the focus studies in phase two. Each of the studies will be documented in a report. These reports will provide a basis for selecting issues to be addressed in more detail in phase two. In addition, they will provide feedback to participating organizations – supporting future development through an analysis of their design work, use of interactive Web-applications, and internal work organization. At the end of phase one we will produce a report summarizing the results from these preliminary case studies. This report will compare and integrate results across the organizations, enabling benchmarking amongst them while providing a foundation for establishing the focal topics for research in phase two.

During *phase two* (lasting 3 years) we will focus on selected organizations and themes based on their relevance for understanding the theoretical issues surrounding interactive Web applications and for supporting the development of new practices, organizational structures, and competencies. An important criterion for selecting the participating organizations will be their commitment to experimenting with new organizational forms, conceptual frameworks and development methods. Organized in focus studies, the second phase will primarily consist of action-oriented research with three organizations. In addition, verification studies will be carried out to establish the degree to which findings from focus studies can be generalized across organizational contexts. This research will again result in reports based on each of these as well as conference papers, journal articles, and a book. The book will give a comprehensive picture of the challenges met by the participating firms, while providing further recommendations on how to harvest the potentials of interactive Web-applications in other settings. In conjunction with teaching and consultancy, the researchers will offer to participate in the organizations' implementation of improvements suggested via detailed study in phase two.

In both phases, we will arrange workshops featuring internationally acknowledged experts for researchers (including our international collaboration partners) and designers and users from participating organizations. The aim is to create synergy between the Danish and international research communities and between research and industry locally. An important part of these workshops will consist of developing scenarios for improving design and use of interactive Web applications. Anchored in the concerns of the organizations involved, these scenarios will aim to be both innovative and realistic for future development. A baseline plan for both phases is given below.

DIWA research plan, first year. Baselines at project start and after 6 and 12 months.**DIWA research plan, second through fourth year. Baselines after two years (mid-term) and at project end.****Activities:**

1. Introductory study including survey of literature, establishing cooperation with other international research groups, preparing and organizing white paper, etc.
2. Internal seminars for the DIWA research group, for presenting and discussing the different research backgrounds represented by the group and finalizing a detailed research plan for the project.
3. Project establishment planning and negotiating DIWA's cooperation with each participating organization to be documented in a project charter with each organization.
4. Workshops with internationally acknowledged experts and designers and users from the participating firms and attended by our international collaboration partners. Cross-organizational feedback will be provided via evaluation and comparison of results from the field studies. Revising the white paper and making detailed plans meeting the next baseline in the DIWA project concludes each workshop.
5. Exploratory multidisciplinary case studies by DIWA researchers in close cooperation with project team members from participating firms. These case studies map the organization's utilization of the potentials of interactive Web applications. Following evaluation, an exploratory case study may lead to an in-depth focus study.
6. Produce summary report comparing and benchmarking exploratory case studies, and establishing the focal themes for phase two.
7. Produce scientific papers for presentation in international conferences and publication in central journals.
8. Three interdisciplinary focus studies conducted by DIWA researchers in close cooperation with project team members from participating firms. These studies will develop themes selected from phase one. As action research, these studies will include experiments with new conceptual frameworks, methods, and organizational forms, resulting in the development of effective core competencies.
9. Prepare mid-term evaluation of the DIWA project, including project status, evaluation of results, detailed plans for the continuation of the project, etc.

10. Verification studies consisting of interdisciplinary research in close cooperation with project team members from participating organizations. These studies aim to verifying results from the DIWA project, investigating the generalizability of concepts, models and solutions derived from DIWA's activities while seeking similarities and/or differences between situations analyzed and other implementation contexts. Note: Some of verification studies may be conducted abroad (USA).
11. Writing of a book that offers descriptive case analyses of the challenges met by participating firms and insights for harvesting the potentials of interactive Web applications gained through DIWA's activities.

Products:

- A. White paper constituting a periodically updated handbook for the DIWA project, which clarifies central practical and methodological principles across disciplines for the purpose of furthering conceptual and methodological coherence among the competencies represented by the research group members. The white paper includes an outline of the research theme, research questions, and overall approach; conceptual framework; practical issues (organization of contacts, collaboration, guidelines for field study and data analysis, feedback to firms, publications, etc.); along with an updated and detailed plan for meeting the next baseline.
- B. Project charters describing the cooperation with each participating organization to be included in DIWA's activities.
- C. Reports describing each exploratory case study, which identify themes for focused studies and provide feedback to participating organizations.
- D. Summary report from all exploratory case studies. This report compares and synthesizes the results from these studies and establishes a basis for developing benchmarks and choosing themes for subsequent focused studies.
- E. Scientific papers and articles reporting findings from the DIWA project for submission to international conferences and academic journals.
- F. Mid-term reports documenting status, preliminary results, and planned activities from the focus studies.
- G. Status and evaluation report presenting results obtained by the DIWA project to date with plans for the continuation of the project and an outline for the DIWA book.
- H. Final evaluation report presenting results obtained by the DIWA project.
- I. Final reports from focus studies.
- J. Reports from verification studies conducted in parallel with focus studies.
- K. Book reporting findings from the DIWA project. The book will offer descriptive case analyses of the challenges met by participating firms and insights for harvesting the potentials of interactive Web applications gained through DIWA's activities.
- L. Four Ph.D. theses based on research carried out within the context of DIWA's activities.

Intended results and their dissemination

The DIWA project is designed to provide new and timely knowledge for both the research community and for design practitioners and users of interactive Web applications. The intended results can be divided into four broad categories:

Empirical studies. The project will produce a number of detailed empirical case studies that examine the design and use of interactive Web applications within organizations. These studies will focus on design practices and use patterns as well as how these activities are structured in organizational contexts. They provide the empirical basis for the development of new theoretical frameworks as well as concepts, methods and tools for improving practice.

Theoretical frameworks. An important goal of the project is to create dialogue and synergy among the multiple theoretical perspectives and vantage points represented by the four research approaches. The result of this goal will be the development of theoretical frameworks for interdisciplinary IS research. While not attempting to integrate the different perspectives into one theory, we will focus, rather, on increasing the capacity of each to make appropriate and positive use of a diversity of perspectives on design, organization, communication and IT.

Concepts, methods and tools to support practice. The project contributes to practice by developing and testing conceptual frameworks, organizational models, design methods, tools and guidelines. The

aim is to guide organizations in (1) designing interactive Web applications, (2) managing design and use processes, and (3) integrating interactive Web applications in collaborative work processes in distributed, IT-based organizational forms.

Research methodology. The project will explicitly address methodological issues in interdisciplinary research and provide a thorough analysis of major problems confronting this type of broad-based research. Given both the focus and the composition of the DIWA research group, we anticipate that the project will contribute substantially to the understanding of how practice-based, interdisciplinary IS research can be conducted.

In the current research arena, visibility and rapid information dissemination is critical. Dissemination of results from the project will therefore take a number of forms. First, the participating firms will have direct access to information through their involvement in research studies and their participation in internal workshops. Second, results will be disseminated through international workshops and research seminars attended by our international collaboration partners, invited internationally acknowledged researchers, as well as designers and users from the participating firms. Third, results will be published in various conference papers and scientific journal articles along with a book presenting both the analytical and constructive results of the project. Fourth, selected information will be available to the public directly via a World Wide Web site, which will also be used to support internal communication.

In addition, the project will result in the production of 4 Ph.D. dissertations and a number of master theses.

Participating organizations and research partners

DIWA will cooperate with industry partners in Denmark and the US as well as internationally recognized researchers in Scandinavia and the US.

Through letters of intent the following Danish firms have expressed an interest in being involved in the project: *Net Bureauet*, *NET-Medier*, *Novo Nordisk*, *Royal Arctic Line*, *Statens Information*, and *Unibank* (see “Letters of Intent” in attachments B-F, L). These can be seen as representing two types of organizations involved in the design and use of interactive Web applications.

- *Net Bureauet* and *NET-Medier* are examples of a new type of organizations that has emerged recently and that offers integrated services that includes what previously was provided by software houses and advertising-agencies. The skills of their employees, the technologies they use, the ways in which they cooperate with their customers and how they organize the production of their services are among issues of central concern to DIWA.
- *Novo Nordisk* and *Unibank* represent large firms that are in the process of introducing interactive Web applications for building up and sharing knowledge within a distributed organization. Their awareness of the organizational challenges involved in this type of endeavor is of special interest to DIWA. *Royal Arctic Line* and *Statens Information* are smaller organizations, which have started to use interactive Web applications in interactions with external partners, government agencies, and the public. These four firms are typical customers of the first type. Their internal organization and their cooperations with these kinds of service providers with respect to the design and use of interactive Web applications is, again, of central concern to DIWA. To supplement studies in Denmark experience from the US will be collected through extended visits by a few DIWA researchers.

Cooperation with internationally acknowledged researchers will be established at two levels.

- We will develop close cooperation with the *Interactive Institute* at the School of Art and Communication, Malmø, Sweden (led by professor Pelle Ehn), The internet group (led by professor Bo Dahlbom) at *Victoria Institute*, Göteborg University, Sweden and Department of Informatics, University of Oslo, Norway, and with *Computer Information Systems Department* at City University of New York, USA (led by professor Joan Greenbaum). Researchers at each of these institu-

tions are carrying out studies that, in terms of purpose, concerns, and research methodology, are related to those of DIWA. (See “Letters of Intent” in attachments G, M, and N).

- We will invite one or two experts to each workshop in order to share international experiences and to exchange views and concerns with the DIWA research group and the participating firms.

The applicants

The applicants represent four research groups from three universities in the Copenhagen area. The senior applicants have conducted internationally recognized research for almost 20 years. The scientific background of the group comprises computer science, sociology, organizational theory, psychology, communications, and media studies. Their core competencies are described in attachment H. Each brings relevant theoretical orientations, conceptual frameworks and empirical methods as well as an eagerness to explore how these may be challenged, revised, and combined through practical experiments and reflections on real-life interactive Web applications.

The team from Roskilde University has a long record of internationally acknowledged research carried out in close cooperation with the IT industry and user organizations. The team covers research areas such as Participatory Design, Computer Supported Cooperative Work, Systems Development, and Human-Computer Interaction. Its contribution to DIWA are many years of experience in conducting action-oriented research on design and use of information systems, conceptual frameworks, and design methods. In DIWA, the primary focus of the team will be on the design of interactive Web applications and on emerging practices as they unfold in the participating organizations.

The team from Danish Technical University has a strong cross-disciplinary background within the research on Computer Supported Cooperative Work and Systems Development. Its team members have conducted internationally recognized research, based upon in-depth studies of cooperation and coordination in real-world settings. The team brings to the project extensive experience with studies of the interplay of organizational and technological change and with the design of advanced computer-based systems for cooperative work and distributed organizational coordination. The team's contributions to DIWA will primarily focus on the uses of interactive Web applications as a medium of communication and coordination in highly distributed work arrangements.

The research tradition in Human-Computer Interaction at the Psychological Laboratory at Copenhagen University is firmly rooted in cognitive psychology, in occupational psychology, and in computer science. A particular point of interest is bridging the gap between theory and practice. An essential contribution to the DIWA project made by this team will be the mediation and integration of traditions from the humanities and computer science.

The researchers from the Department of Film and Media Studies at the University of Copenhagen bring a background in theoretical and empirical media and communication research to the project. Conducting reception studies, their contributions will derive from the empirical analysis of designers' and users' meanings, contexts of application development and use, and interface discourse. A central result of this effort will be means by which to evaluate organizational design processes and goals as correlated with the reception of prototypes and implemented applications.