Exploring Interactive Web Applications from a Sociotechnical Perspective

A Research Proposal

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Abstract

This paper outlines a recently initiated research project inquiring into the design and use of interactive Web applications (IWAs). The research builds on existing literature on IWAs coupled with conceptual developments within the field of Science and Technology Studies (STS). Applying a sociotechnical approach inspired by the work of Bruno Latour, particular focus is placed on the ways in which IWA technologies and work practices co-evolve as a collective.

The following presents research issues and the framework for an investigation of interactive Web applications (IWAs). The research was initiated in January 2000 and is expected to span over a three-year period, resulting in a final Ph.D. dissertation and a number of shorter articles for publication. During the last four months I have conducted a survey of relevant literature and clarified research questions and the approach. The paper outlines this work and presents the objectives of my research along with key theoretical concepts and methods to be applied.

1. Background

My study forms part of a four year research program entitled *Design and Use of Interactive Web Applications* (DIWA). DIWA is supported by the Danish Research Council. The participants comprise 17 senior and junior researchers from Roskilde University, The Technical University of Denmark, Copenhagen University, and The IT University of Copenhagen. The overall theme of the research program is the design, management, and use of IWAs in a variety of work settings.

The objective of the DIWA program is, firstly, to examine how interactive Web-applications will change information system development and use, and secondly, to develop conceptual frameworks, implementation models, and best practice guidelines to support the

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design and management of Web-based Information Systems in organizations (DIWA 1999).[1] In depth analyses of development and use practices in five Danish organizations will provide the empirical grounds for the research program. The program is interdisciplinary, spans a wide range of analytical and methodological approaches, and thus represents multiple perspectives on the empirical settings examined.

2. Defining Features of Interactive Web Applications

Interactive Web Applications (IWAs) comprise a relatively new type of information systems based on Internet standards and protocols such as HTTP and TCP/IP. Such IWAs - also referred to as Intranets, Extranets or Web-based information systems (WIS) - are currently being implemented in many larger commercial corporations, in governmental organizations, in schools, universities, hospitals etc.[2] Compared to the proliferation of this type of system, very little academic literature on the topic exists. Very few empirical studies of IWA use and development are available (e.g. Balasubramanian & Bashian, Cecez-Kecmanovic et.al. 1999, Damsgaard & Scheepers 1999), and the only literature providing a relatively comprehensive overview of the topic is an issue of the journal *Communications of the ACM* (1998 41(7)).

In the *CACM* journal various authors discuss the differences between Web-based information systems and previously existing information technologies. Isakowitz et.al. (1998), for example, defines a WIS through its negation - as fundamentally different from both Web pages and traditional information systems.

> "There is a clear difference between a set of Web pages and a WIS. The latter supports work and is usually tightly integrated with other non-WISs such as databases and transaction processing systems. WISs are also different from traditional information systems. They require new approaches to design and development, have the potential of reaching a much wider audience, and are usually the result of grass-roots efforts." (Isakowitz et.al. 1998:79)

The articles in *CACM* - as well as the DIWA research program - underline the fact that these differences present new and urgent challenges for system developers and designers, organizations management as well as individual users (e.g. Isakowitz, Bieber & Vitali 1998, Balasubramian & Bashian 1998, Turoff & Hiltz 1998, DIWA 1999). The three aspects of *application integration, interactivity between human actors,* and possibilities for *user-design* are three new and interesting features of IWAs that will be focal points of the research proposed.

As noted above by Isakowitz et.al. (1998), IWAs allow for organizations to *integrate* different applications and join these in multi-modal Web-based user interfaces. An IWA may thus potentially function as *the* basic platform for many aspects of communication, coordination, cooperative work, and distributed knowledge sharing inside an organization (Intranets) as well as between organizations (Extranets). My project intends to explore the ways in which tools and applications that are being applied in work become integrated in, incorporated, and

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[1] DIWA research program – including my research project - applies the term Interactive Web Application (IWA) synonymously with Web-based Information System (WIS).

[2] IWAs or WISs also include e-commerce systems which are, however, not included in the DIWA program.

"remediated" (Bolter & Grusin 1996: 340) by a new IWA.

Furthermore, IWAs also potentially mediate a very wide range of interactions among human actors. This aspect is also emphasized in *CACM* and discussed in detail by Turoff and Hiltz as "superconnectivity" between humans (Turoff and Hiltz 1998:116). WISs can thus be approached as *interactive* information systems that potentially actualize many contemporary demands for supporting distributed and dynamic work patterns in networked, knowledge-based organizations (DIWA 1999). Human interaction and collaboration supported by IWAs will therefore also be examined.

Lastly, a feature that makes WISs – or IWAs – particularly interesting is the flexible and emergent character and the *active user role*, noted above by Isakowitz as "grass roots" characteristics (Isakowitz 1998:79). IWAs allow users to publish and organize information as well as alter and construct aspects of the underlying systems – for example database or work flow content and structure. These malleable features imply an array of new challenges for system designers and users. And they may well also serve to blur the distinction between the two since users can also contribute to system development and design (Lyytinen et. al. 1998).

3. Research Objectives

As a contribution to this broader field of inquiry, my project primarily aims to provide an empirically grounded study of one particular interactive Web application - an Intranet in a Danish pharmaceutical company. The study seeks to examine work practices surrounding the Intranet during a period of approximately one year, hereby yielding an in depth understanding of an IWA as part and parcel of an organizational context in which it is situated and put to use.

Three research questions will be explored concurrently. These questions investigate issues of application integration, interactivity, and the role of users as discussed above:

How does an IWA integrate and reshape applications, tools, and other elements that form part of work practices?

How is human interaction and collaboration supported and effected by an IWA?

In what ways do users participate in the construction and re-construction of an IWA – or IWA elements - through their appropriation, use, mutual interactions or otherwise?

Answering the research questions above thus aims to provide new empirical insights on IWAs as a new organizational technology as well as contributing to broader conceptual reflections on how work practices and contemporary technologies shift and interconnect.

4. A Sociotechnical Approach

My research thus builds upon existing literature concerning IWAs as well as on more theoretically oriented debates occurring at the nexus of computer science and the social sciences. A growing dissatisfaction with technological determinist accounts on one side as well as social constructivist approaches on the other, has led to ontological and epistemological discussions on how to re-think the relationship between technology and the social, between machines and humans (eg. Monteiro & Hanseth 1996, Walsham 1997, Suchman 1999).

Developments within the field of Science and Technology Studies (STS), and the work of Callon (eg. 1987, 1991), Law (eg. 1986, 1994), and Latour (eg. 1987, 1993) to name just a few, have fed this debate, emphasizing the necessity of developing new theory and methods pertaining to the study, design, and management of technology. During the past decade prevailing assumptions and categories have been radically questioned and somewhat displaced in favor of new frameworks and vocabularies.
Following this lead, my research project assumes that a sociotechnical perspective may in fact open up for at beneficial analysis of IWA technologies and surrounding work contexts, their mutual involvement, and their situated and constructive character.

The concept of a "sociotechnical" approach derives partly from the Tavistock Group and the school of socio-technical systems development and partly from the field of Science and Technology Studies (STS). The socio-technical systems approach of the Tavistock Group re-inserted the user, issues of work quality and skill enhancement into the debate on information systems in the 1960s providing an alternative to top-down, technology centered approaches to information systems. Light was cast on the importance of "social issues" as a sub-system of organizations co-functioning with a parallel technical sub-system.[3]

STS studies have likewise emphasized social issues and have generally speaking underscored the importance of social, political, economic, and cultural contexts where technologies are developed and used, as well as the ways in which such social factors are closely interconnected with the technological. In contrast to the Tavistock approach, STS does not however treat the social as a separate sub-system of organizations but as an inseparable part of technology - and vice versa. Human and technological elements will therefore be viewed as entangled in one another – as opposed to inherently different in characteristics and capabilities. IWAs and work practices will be approached as interwoven in *collectives*, and as *hybrid* forms - where properties always are relational, continuously interchanged and redefined (Latour 1993, 1999a).

4.1. Approaching IWA Technology *and* Social Context as a Collective

In order to clarify the analytical framework of the study, the distinction between "social" and "technical" will briefly be clarified as a constructed and contingent boundary that may differ at various times and places. Firstly, the social will be discussed as a performative, and secondly, technology will be pinpointed as a relational entity enmeshed in the performative social.

Many analyses and discussions on "the social" assume as a point of departure that social structures exists as an ontological entity or macro level within which human actors act and think. Society - or culture - can be studied as an existing entity and consequently referred to as an explanation for why people act as they do, why social relations and institution take the shape and form they do. Rooted in a tradition of ethnomethodology (Garfinkel 1967), a "performative" perspective on the social radically challenges the notion of society or a social structure existing as an entity in itself (eg. Latour 1986). Instead, society is viewed as performed, and hereby constructed, through the interaction of individuals. Both micro and macro, whole and parts, beliefs and behavior are conceived of as *relational entities*, existing through the associations of humans (and non-humans) and their efforts to define these entities.

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[3] For more on socio-technical systems approach see, for example, Morgan (1986).

The order of society, power, knowledge is thus constructed - created and maintained - through actors' strategic efforts to negotiate and maneuver one another into networks of aligned allies.

> "Social order, the ethnomethodologists argue, is not a given but the result of an ongoing practice through which actors, in the course of their interaction, elaborate ad hoc rules to coordinate activities. The actors are helped of course by precedents, but those precedents are not in themselves sufficient to cause behavior, and they are translated, adjusted, reconfigured, invented (in part) to make do in shifting and unexpected circumstances. We collectively elaborate an emerging and historical *event* which was not planned by any participant and which is not explainable by what happened before the event or what happens elsewhere." (Latour 1994: 50)

The exploration of social practices such as IWA use must subsequently start from "below", from the local sites where events unfold, where negotiations and alignments take place.

Latour furthermore emphasizes the essential role of material resources (non-humans) in the reproduction and stabilization of definitions and relationships. Besides language and symbols, technologies can be viewed as a central means applied to build and fix associations and hereby attempt control of meanings, resources, and power relationships (Latour 1994). Technologies can thus not exist as a pure or neutral object in a context, but intrinsically intersect with, and are folded into, surrounding practices. Diffusion processes are, for example, analyzed in terms of *translation*, where both technology and users are continually reconfigured and aligned in order to "work" together (Latour 1999). The very boundaries between technology and context can therefore be viewed as constructed in fluid and shifting ways.

Acknowledging that the difference between social and technical issues may be blurred and contingent opens for an alternative analysis of technology in organizations in which neither technological nor social forces are defined a priori or pinpointed as the driver of change. Instead boundaries and definitions as well as change are viewed as the outcome of open-ended and continual building of associations and relations across networks – thus analyzed as a properties of *collectives*, not the individual entities (Latour 1999a). Such *collectives* – encompassing both IWAs and context – comprise the focal point of my project.

4.2. Delineating a Research Setting

The empirical setting selected for this study is a multinational corporation engaged in the research, development, production, and sales of various pharmaceutical products. An internal IT division implemented Web technologies in 1994 followed by an official Intranet platform two years later. The Intranet has since grown to include both a number of centralized sites and services that coordinate communication and work across all departments in the organization as well as a large number of Web sites developed and maintained by individual departments. Various departments in this company have been particularly active in developing and maintaining their own Web sites, primarily for internal departmental or project oriented use.

Focus of my study will be placed employees, their interactions and daily work practices, and how these relate to the use and development of the application. This work may well cross departmental boundaries as well as involve people working in different laboratories and offices in geographically dispersed organizations, universities, and research institutions. Focus will therefore be on a specific group and their work.

Based on a preliminary pilot study, a specific project group developing a new clinical drug will be selected and studied over a period of one year. Projects like these may involve up

to hundreds of people, and the sharing of documents and coordination of activities is a central issue. This work relies on IWA facilities as well as a many other technologies such as e-mail, telephones, or traditional publishing and mail systems. The work, communication, and cooperation of the participants in such a development project will be examined in order to understand how the IWA becomes integrated in different ways in existing work routines.

These sites of use – or work practices - will be examined as networks of heterogeneous entities including people, work routines and rules, documents, and technologies (Latour 1987, Berg 1999). Each entity in this ensemble will be investigated as acquiring meaning, characteristics, and the ability to work as a part of the collective it constitutes. The Intranet applied in work will thus be analyzed as mediating – and in part constituting – the work practices, relationships and events of which it is a part, and, at the same time as gaining identity, functionality, and shape from this work.

Actor-network theory (ANT) provides a comprehensive vocabulary for exploring the relations between elements in a collective such as work practices.[4] It is my hope that drawing on concepts such as *inscription, translation, alignment, black boxing* etc. (eg. Latour 1987) can serve to deepen and sharpen a detailed analysis of how an IWA and its context interrelate - how Intranet facilities and elements integrate and evolve, how work routines and collaborative relationships adjust, and how positions and skills of "users" undergo change over a period of time.

Although IWAs and *collectives* are the object of study, a primary focus will be placed on human actors. Central to the empirical study will be the employees' own perspectives, assumptions, and practices - the ways in which they experience, articulate, and strategically take part in processes of sociotechnical change. The ways in which IWAs (or sub-elements of IWAs) are contested, negotiated, and perhaps differ in meaning, functionality, and shape in different sites of use and at different times will be analyzed through the employees and their practices.

4.3. Differentiating between IWA sub-elements

To clarify the "role of users", when and how users actually construct or design the application, the sub-elements of an IWA and features of these sub-elements will be differentiated in the analysis. An IWA is composed for example of a basic architecture (browsers, standard protocols, server software etc.), an application structure (such as database software, server structure, organizing principles for HTML pages and other facilities offered by the application), and lastly the actual content of HTML pages and application databases. Some of these elements are more negotiable than others and may be used - or re-constructed - in different ways to serve various purposes, interests or needs (perhaps not anticipated by designers). Some elements may also offer *resistance* to certain uses and constructions. These sub-elements, their resistance and differing degrees of *irreversibility* (Callon 1991), will therefore be investigated in order to scrutinize the aspects of the application that may or may not be

[4] Latour's early work has been coined as *actor-network theory* or *ANT*. Latour has, however, since criticized the three concepts of "actor", "network", and "theory" as inadequate and in many cases misunderstood as an attempt to develop a social theory (1999b). Drawing on Latour's more recent work (Latour 1999a), the project will therefore apply the concept of *collective* in conjunction with selected ANT vocabulary.

altered, the competencies necessary for such alteration, and how these elements enter into diverse relationships with existing work ensembles - and in different ways become transformed or transforming.

Particular attention will be paid to a recent initiative, a platform providing Web development tools and instructions, developed by the internal IT department to facilitate and encourage Web-site publishing. The system is currently being applied internally by several project groups, mainly to support communication between project participants and to systematically store and share documents relevant to project activities. These publishing and archive features will in the near future be supplemented by additional - more interactive - facilities for project coordination and cooperation. In conjunction with users, the internal IT department is developing tools for draft commentary and co-authoring of documents, chat facilities, notification services, as well as resolving issues of closed verses open spaces, safety, and confidentiality. The addition of new features to the IWA presents an interesting empirical starting point for answering the above research questions on integration, interactivity, and user-design – as well as for exploring the continual work it takes to build associations, align, and reconfigure both "technological elements " *and* "users" as a workable collective. A development group actively involved in the use (and development) of these new features will therefore be selected for the study.

5. Getting Involved

The study will apply a sociotechnical approach, as outlined above, in conjunction with ethnographical research methods (eg. Hammersley & Atkinson 1995). The overall methodological guideline will be one of *following actors* and *getting involved* in the local sites studied. Implied in the research approach is an assumption that research cannot be pre-determined, but more fruitfully be formulated in an open-ended and flexible manner that allows the actors' own categories as well as unanticipated events to be incorporated into the project. The research therefore applies a reflexive or cyclical approach, alternating between phases of data collection and analysis. The research questions and issues above will continually be re-formulated and developed as an integral part of the research process.

Furthermore, it is assumed that as a researcher I cannot subsume an objective, distanced or in any way privileged position in relation to the phenomena studied. On the contrary, the knowledge and findings of the study are constructed (or performed) through my involvement and interaction with the people (and things) in the setting studied. The quality and validity of this knowledge is thus generated through the relationships built – calling for me as a researcher to become involved, immersed, and engaged in the setting studied for a prolonged period of time. Methods such as "hanging around", participating when possible, and engaging in natural conversations with the people in focus are therefore the main methods to be applied.

Research "findings" will be analyzed, presented, and discussed in a series of field reports to be shared with other DIWA researchers. My research will hereby be linked to studies of similar settings conducted by DIWA participants (as well as existing literature), and subsequently, to broader discussions of information systems development and organizational management practices.

5.1. Multiple sites and perspectives

As described above, my research setting is quite complex, since IWA use takes place in many different geographically distributed sites. The IWA setting may extend beyond individual laboratories and organizations – and as described above these interconnections (eg. potential for interactivity) present a feature that render IWAs a particularly interesting technology to study. Whereas traditional ethnographical field work is single-sited, Marcus discusses the possibility for conducting physically mobile fieldwork – or multi-sited ethnography (Marcus 1995) - in order to explore the interconnections between two or more locales:

> "The other [multi-sited fieldwork] moves out from single sites and local situation of conventional ethnographic research designs to examine the circulation of cultural meanings, objects, and identities in diffuse time-space. This mode defines for itself an object of study that cannot be accounted for ethnographically be remaining focussed on a single site of intensive investigation." (Marcus 1995: 96)

In multi-sited fieldwork the boundaries of sites are continuously redefined according to observations and relevance to research problems.

When conducting multi-sited fieldwork one can follow people (Olwig 1996), artifacts (Appadurai et.al. 1986), or all relevant actors - these being humans *and* non-humans (Latour 1996). Each of these methods has differing methodological implications and provide the researcher with different types of data.[5] In this way, the study will combine methods of interviewing (broadly and in depth), participatory observation (to the extent possible), as well as analysis of texts and technologies. Drawing on various methods of data collection and analysis supports the aim of exploring the IWA from multiple perspectives - hereby unfolding the different interpretive configurations and negotiation processes that take place in a collective.

6. In Conclusion

As described above, the primary objective of my project is to carry out a detailed investigation of how IWA technologies and work practices co-evolve in empirical settings. Besides pursuing the research questions pertaining to IWA application integration, interactivity, and user-design, the study also includes a continual reflection upon the very concept of sociotechnical collectives. A secondary aim therefore consists of exploring the way in which the analyses produced can contribute to a broader understanding of systems development and implementation issues specific to IWAs. It is anticipated that the sociotechnical perspective outlined can serve not only to illuminate such issues, but also to point toward a re-orientation of the overall frame of reference for dealing with problems, solutions, and explanations concerning the design, use, and management of new technologies such as IWAs.

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[5] It is important to note that multi-sited fieldwork poses problems to the method of participatory observation itself, as the distinctive feature of doing long term fieldwork – closeness to the people and sites studied - is lost when one shifts settings. As the study proceeds, I therefore plan to combine multi-sited investigations with more long-term participant observations in a number of selected sites.

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