Web-based Information Systems - Infrastructures and Co-operational Patterns in a Networked Organisation

Hoffmann, Lone; Rosander, Charlotte

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© Lone Hoffmann

Computer Science Department, Roskilde University
P.O. Box 260
DK-4000 ROSKILDE, Denmark
Phone: +45 4674 3847
Fax: +45 4674 3072
hoffmann@ruc.dk

© Charlotte Rosander

Department of Informatics, Lund University
Ole Romers vag 6
SE-223 63 LUND, Sweden
Phone: +46 46 222 80 29
Fax: +46 46 222 45 28
charlotte.rosander@ics.lu.se.

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Abstract. This paper contains a theoretically and empirically based analysis of infrastructures and co-operational patterns in a Scandinavian Internet consulting company. The purpose of the analysis originated from the hypothesis that Web-based Information Systems could especially facilitate work in distributed organisations, this as a platform for supporting collaboration, communication and co-ordination within and among internal offices, partners as well as customers. One major challenge drawn from the case study regarding this expected facilitation was that two quite different communities of practice were identified. The findings from the case study suggested three aspects worth drawing attention to: Firstly, in Internet consulting companies the main part of the costs is directed towards investments in human resources causing the employees to frequently set the agenda, being the force that represents the organisation's competitive capacity. Furthermore, since sharing of knowledge is based on human networks, it is quite volatile. Secondly, a dynamic and distributed work place, with highly qualified and creative employees, is not synonymous with having a work force with preference for fast and flexible attitudes towards internal changes. Thirdly, in an Internet consulting company the work practice is dependent on the co-workers ability to co-operate from various shifting locations. Utilising Web-based Information Systems could facilitate mobility for the individual employees. Together, these suggestions give convincingly ground to conclude that universal design solutions are losing their value and the need for context specific design methods, supporting design-in-action, is strongly emerging.

Keywords. Infrastructures, co-operation, communication & Web-based Information Systems.

1. Paper Context and Structure

This paper is the first in a trilogy of papers, derived from a case study in an Internet consulting company, by the authors. In this first paper, the focus is on portraying the different competencies and roles in a full-service web-consulting company. In the second paper, "*Enhanced Mobility - Augmented Possibility? - Developments in Co-operative Work*" (Rosander & Hoffmann 2001a), the focus will be on how distributed communication and co-ordination is carried out and the implications of enhanced mobility in co-operative work. The third paper, "*Towards Mobility - Implications of Communities of Practice*" (Rosander & Hoffmann 2001b), will elaborate on the discussion of how technology supporting mobility in collaboration influences the organisational culture, adding the element of implications of communities of practice entailing co-operation.

The structure of this paper is organised around the dynamics of theory and the empirical findings. Bearing on that, the introduction is followed by a presentation of the theoretical frame focusing on *infrastructures* and *co-operational patterns*. Subsequently, the ethnographic research method and the company's organisational and historical background are presented, succeeded by a case narrative focusing on operationalising the concepts of infrastructures and co-operation as a framework for

analysing the empirical findings. Finally, some normative recommendations derived from the theoretically and empirically based analysis are discussed.

2. Introduction

In recent years Web-technology has become a widespread platform for organisational information systems, in connection with notions such as electronic commerce, Intranet and Extranet (DIWA 2000). These Web-based Information Systems (WIS) could be crucial for companies' effectiveness and competitiveness in the new IT-era. Related to this is an ongoing change towards more dynamic and flexible organisational and co-operational forms.

This new medium for human communication supports co-operative work at any time and any place, thus making space for a flexible and mobile work context for knowledge workers. The WIS will have an increasingly significant impact in organisational contexts, particularly on how people communicate, collaborate and co-ordinate their work both internally and externally (Lyytinen et al 1998). Emerging new companies are using WIS for regional networking and the technologies bring new conditions and possibilities that pose both organisational and technical challenges (Lamb & Davidson 2000; Scheepers 1999).

3. Theoretical Frame

Current research has emphasised the need for establishing a deeper understanding of the actual work practice when designing new systems. Using different techniques in the design process compared to traditional software engineering approaches and conducting ethnographic studies enable getting a rich picture of the work practices for the purpose of informing design (Blomberg et al 1991; Greenbaum & Kyng 1991; Simonsen & Kensing 1998; Suchman et al 1999). Hence, the ethnographic approach is becoming widely used in connection with workplace studies with the objective of informing design.

The artefacts are set in different social contexts and in making sense of the patterns it is necessary to include this context when studying technology-in-use. Relationships between technology and work practice have consequences for how organisations design and use information technologies to support their work. To understand technologies ethnographically it is required to locate artefacts within a site and their relations in everyday use (Suchman et al 1999).

The use of new communication media is changing work patterns, and thereby putting new demands on the work place. There has been research with focus on the

interaction between information technologies and organisational dimensions such as structure, culture, control mechanisms, work practice, and social cognition (Orlikowski 1992, 1995). Communication between individuals is affected by introducing new technologies and should therefore be in focus (Suchman 1987). Suchman's conclusion is that because an action or event always is dependent of a certain social and physical environment the understanding for and the attention on this environment is important when that action is to be interpreted and understood. There has been an increasingly need for communication between people in different locations. Use of new technologies enable new possibilities for long distance communication and co-ordination through creation of virtual places for co-operation and mutual activities.

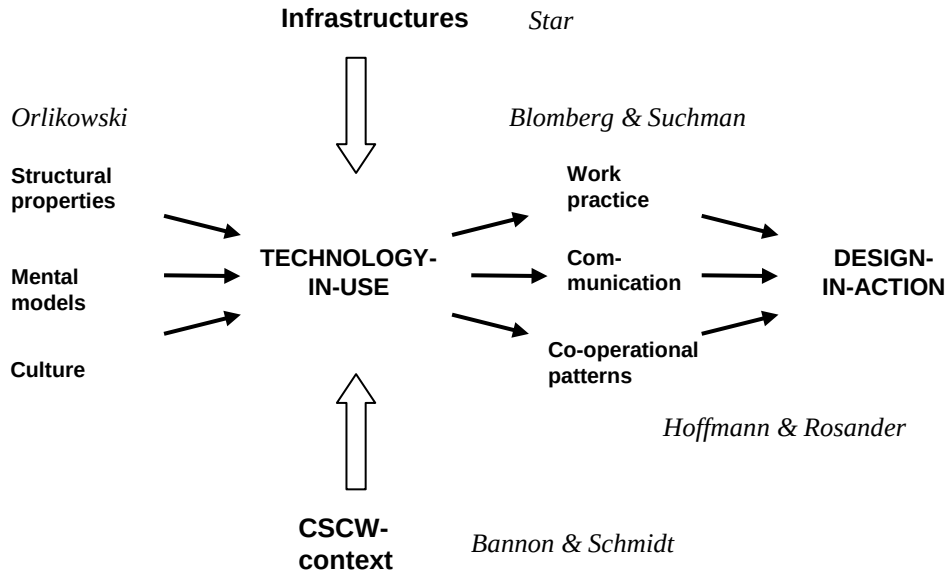
Orlikowski (1992) studied how the nature of work and patterns of social interaction change the use of collaborative tools. Her findings suggested that two organisational elements seemed especially significant in influencing the effective utilisation of groupware, both mental models about the technology and structural properties of the organisation, such as policies, norms and reward systems. She also found that where there are few incentives or norms for co-operating and sharing knowledge, groupware technology alone could not engender this.

The concept of infrastructure employed here is taken from the work of Star, who characterises infrastructure as simultaneously material and involved in socio-cultural contexts. Infrastructure is both relational and ecological, it is part of the balance of action, tools, and the built environment (Star 1999). Further, she suggests that the ecology of distributed high-tech workplaces is profoundly impacted by the so far relatively unstudied infrastructure that permeates all its function. Star and Bowker (2000) describe how the infrastructure is:

- Embedded in other structures.
- Transparent in the sense of invisible when taken into use.
- Stretching beyond single events or places.
- Learnt as part of membership in a community of practice.
- Linked to conventions of practice.
- Embodied in standards.
- Built on an installed platform.
- Becomes visible upon breakdown.
- Based upon local elements.

Although global, infrastructure in Star's sense is acknowledging local artefacts and actions. The everyday communication is not comprehensive in terms of utilising one single medium, a separate infrastructure, but involves complexes of infrastructures. The emphasis is upon the local contexts where users act, co-operate and interact with infrastructures. It is only in the local context, in concrete places, that users have access to global networks and structures. There is need for an extensive perspective in order to

capture how values are inscribed into technical systems. In information infrastructure, every conceivable form of variation in practice, culture, and norms is inscribed at the deepest levels of design (Star 1999). A theoretical frame, illustrated in model 1, is mapping the different perspectives and focus taken as starting-point in our analysis.



Model 1: A theoretical frame of perspectives, themes and focus in this paper (Hoffman & Rosander 2001).

4. Method

The purpose of the study was to analyse and present how people currently are working with WIS, further the implications of this in terms of co-operational forms and infrastructures in a networked organisation. Distributed work is a term that here is used to describe work life that is less dependent of concrete workplaces. Through the use of a selection of qualitative research techniques and sources of data-collection the study took an ethnographic approach to develop an understanding of everyday activities of particular communities of people (Blomberg et al 1991). The research method used was case study-based, as it enables a collection from a variety of sources in order to get a rich empirical base (Yin 1994). The techniques employed were observation, qualitative interviews, descriptive field notes and document analysis (Flyvbjerg 1988).

The case study investigated how a specific so-called ‘Fast company’ uses Web-technology as a platform for collaborative and distributed work inside and between

their offices. The definition here of a ‘Fast company’ is a distributed, fast-growing and highly IT-driven organisation. The empirical study was carried out in a global web-consulting company, due to a number of emergent criteria. There are some immediate cultural differences compared to traditional organisations, which makes these companies especially relevant for our research purpose. Besides being categorised as a ‘Fast company’, its employees are organised in small, distributed units in several countries. The analysis focused on the units in Sweden and Denmark.

5. Organisational Background

The web-consulting company is one of the world’s leading Internet consulting companies. It is a full-service Internet bureau with employees globally organised in 53 offices around several countries. It was founded in Sweden, and now also has offices in Bulgaria, Denmark, France, Holland, Italy, Norway, Switzerland, Spain, Great Britain, Germany, USA and Austria. Their mission is to discover and develop the ideas that will drive the digital economy, i.e. to create new business opportunities for the global network economy with help of strategic counselling and digital services. They furthermore want to build an environment that encourages creativity and gives the, at the time, almost 3000 employees sufficient support to develop their ideas (according to the web-consulting company). The company has had an aim to organise itself in small units of fifty employees each in so-called cells. The idea behind this was that it would promote close internal relations and create a flat organisation with short distance between employees and division leaders. The limited number of employees in each cell could facilitate communication and make the decision-making process short, turning the cells into small, dynamic and innovative workplaces. The vision is that between cells there should be an ongoing exchange of knowledge and ideas, for example through their common Intranet. Often several cells need to co-operate in a networked manner when having a shared customer project.

The statement is that to keep the creativity and neighbourhood-feel of a small business they *must operate globally, but act locally*. With the cell structure they balance the advantage of working in a small, coherent office with the benefits of a large organisation. This is necessary in order to preserve the speed and flexibility of a small enterprise. They are building one large, powerful business out of many small offices. This gives a local organisation with evolved independence, and still encourages the thriving entrepreneurial spirit. The decentralised organisation also offers them the stability they need, in order to enable a rapid growth. In consequence, there can be several cells within the same city or region.

6. Case Narrative

The case study took place in Copenhagen, Denmark during the fall of 2000. Having had beneficial experiences earlier, at a prior joined field study, making observations of the place before focusing on the people, projects and products, led the authors to take descriptive field notes based on environmental observations. Following introductory description is the outcome from that approach.

6.1 Infrastructures

Focusing on the place; the inspiration from the concept of a factory has been taken further than just mimicking the organisation around small cells. It bears much resemblance to the organisational workgroups in many production factories during the industrial age and which also can be found in the military world. This specific web-consulting company has like so many new advertising agencies and Web-firms a preference for moving into old factories and storage buildings, both in New York and around Europe's capital cities. In the remainder the reader is invited to picture the following scenario, in order to get a feeling of the place, activities and atmosphere at one of the first Danish offices.

An old production factory, situated in a back yard in the inner city of Copenhagen, has been turn into a hype glass and steel office. When opening the heavy red factory doors at the second floor, loud music, laughter and conviviality greet you. The reception is a big steel bar, with sweets and apples in big bowls. Moving further into the all-in-one high-roofed office, there is a wardrobe behind a sculptured moveable wall. On the wall is a collage of articles from different written media, showing the firm's development. Some of the laughter comes from two young employees, who are in the midst of a table football match, just in front of the reception. Behind them a meeting is taking place in a small livingroom-like arrangement, with a television, two sofas and a big armchair. When asked about the atmosphere of playfulness the creative director stated: "*In the beginning there was space enough to play and use the basket-ball basket, now there are too many tables with computers*". This is a workplace and workspace highly suitable for verbal communication, which encourages a socially oriented and flexible work culture. The atmosphere and activities were surprisingly similar to a university during lunch break. However, the scenario is primarily based on our first meeting, which actually took place during lunch hour.

Focusing on the people raises the question; what characterises the age, values, education and competencies of the employees at this web-consulting company? The average age of the employees is quite low, about 27 years, but those holding leading positions are a couple of years older. This, and also the different backgrounds and education, create some difficulties. "*...then we have a very large internal problem with*

getting a process around development, and that is because of all the interested parties, it is on a value level." Further, "...o*ur youngest man is 17 years old, his mother has just signed the contracts. He will sit and co-operate with some guy, who has been for 15 years at IBM and is certified in head and foot. And then there is one with a business degree...*". The different skills and perspectives give the employees quite diverse points of view, which makes it hard to establish a common ground. They acknowledge having "*general problems around the world view internally*".

The background for the diversity in skills is that one of the cells was originally an Internet bureau and therefore some of the co-workers there have a background in the advertising business, with prominent creative skills. This was the first cell and it is internally referred to as the "*mother ship*". Later it was divided into two cells due to lack of space when they started to grow. Following to that, the next cell was acquired through the purchase of a smaller advertising agency that today foremost work with the customer segment telecommunication and media. By the fusion with a consultant company another cell was formed that is characterised as a system development house. Finally, the last two cells have specialised tasks around economy and management. The cell structure has lately been object for reconsideration, and thus thoroughly scrutinised. This is mostly due to the character of the recent assignments, which makes it difficult for a single cell to manage the increasingly complex tasks. Furthermore, the number of employees and the complexity of the co-ordination between the cells also make it desirable to gather the cells physically more closely as well.

Is there in this case a link between standards and conventions of practice - learnt as part of membership in the community of practice - as Star (1999) puts forward, and the employees' technological conditions? There exists several Intranets; one local Intranet is used for information, reports, handbooks, role descriptions, telephone list, attendance, and reservation of premises. A process-based project method offers standard documents on the Intranet, to be filled in during the work process. It is a chronological phase model including requirement specifications, check lists and use-cases. The creative director stated that making generic documents on how to create design is impossible, due to the difficulties in documenting a work process he refers to as *black box*, where the content grows out from brainstorm meetings. People are valued with regard to earlier experiences and tool skills. On the Intranets are possibilities to search for someone with specific competence. The general opinion is that knowledge is hard to spread in the organisation, but one effort is having so-called *white papers* in an article database. This database along with time registration and discussion forum is to be found on the worldwide Intranet.

6.2 Co-operational patterns

Two organisational elements seemed especially significant in influencing the effective utilisation of groupware, both mental models about the technology and structural properties of the organisation (Orlikowski 1992). The examinations of utilisation of different facilities supplied through the Web-based Information System in the web-consulting company were surprisingly similar to Orlikowki's conclusions on the influence of people's mental models. The organisational structure and culture significantly influenced on how groupware was implemented and used. In regard to mental models and cultural analysis, some initial visits earlier took place in Lund, Sweden, where it was put forward that communication over electronic media was considered "*the heart of the organisation*". The use patterns of technology were similar in Denmark. The use of e-mail seemed to be compatible with the self-image as being a 'Fast company' based on decentralisation and a great portion of entrepreneurial spirit. The facilities of a company-wide electronic calendar were implemented, but were however not particularly used. This could be connected with the employee's strive towards a feeling of autonomy. Still, much co-operation and communication are of external character, which should suggest an underlying need. This study suggests elaborating Orlikowski's factors to include the objects of business, in forms of customers, solutions and products. Following description of the work practice takes this into account.

Focusing on the projects and products; the web-consulting company's typical customers are private enterprises. They differentiate between two dissimilar types of projects, concept development and business-oriented projects. The former is more of a short-term range project and the latter often develops over an extended period of time with much more complex tasks involved. In the beginning they foremost managed the concept development-types of projects, but recently there has been a trend towards an increasing part of larger business-types projects. Today it is an equal division between the two types. In a concept development project there is focus on idea or concept development with emphasis on design, communication and evaluation among typical users from the target group. It can be campaign sites, on-line communities as well as portals. The business-oriented projects normally involve development of an integrated system solution, where a Web-based front-end system is integrated with the customers' existent IT-systems. The general view among the employees seems to be a relaxed attitude towards projects; "*If it is done earlier is it not really fun. We preferably want to go where it hurts a bit*."

There are mainly four competence areas represented in the cells. In *strategy and business development* the employees typically work as key account managers with responsibility for different projects and customer relations. Their competence area is basically to understand customers' business processes and thereby produce suggestions

for projects or products. Within *design and communication* they foremost work with shorter assignments. Their task is to understand the customers' need and their target groups' profile. Further, on that background develop concepts and marketing new products. *System development & hosting solutions* has deeper IT-competence within implementation of the technical aspects in the projects. Finally, the employees in *user experience* define themselves in a role as "*the users' advocate*" in the process of development. They work with design and analyses of both quantitative and qualitative user investigations, with focus on usability, relevance and aesthetic.

The company is not hierarchically organised but works in a project organisation. A project consists generally of several employees including a project leader, a technical project leader, a graphical designer, an interface developer, systems developers, and furthermore, the centre for user experience. The employees believe Web-technology to be suitable for co-operating across competencies. It is platform independent, and there appear synergy effects when they work in this project fashion. Still, they do not feel the sensitiveness from the management to be sufficient to reinforce the communication and co-ordination, but claim to a widespread willingness towards this among the employees.

7. Discussion

In this paragraph the three following aspects will be discussed: (1) Employees are frequently setting the agenda as well as controlling knowledge sharing. (2) A general reluctance to follow standardised procedures and methods, in favour of a brainstorm approach commonly used in the branch of advertising agencies, reflecting diversity among the employees. (3) Support for mobility in the work practice is essential for the co-workers ability to co-operate from various shifting locations.

Firstly, in Internet consulting companies the main part of the costs is directed towards investments in human resources causing the employees to frequently setting the agenda, being the force that represents the organisation's competitive capacity. The web-consulting company helps customers with strategy creation and development of Web-based systems for co-operation and knowledge sharing; still the employees have not had time or prioritised this internally. Even if there is the means for it in form of the Intranet, there are no routines for making use of earlier experiences in any systematic way. There are often just informal channels for sharing knowledge; "*...by hearsay that someone was out there*". A fruitful utilisation of the WIS is dependent on reflection and evaluation. So even though the Intranet is supposed to support knowledge sharing, and contains all documents, reports of best practices and vital information, it seldom works well for this purpose. The management does not know why there is this tardiness, but think an active use demands reflection and "*taking a step backwards*" which takes time

they do not have during the project processes. There exists awareness that it requires incentive structures to activate the use, but so far they have not succeeded in creating these.

When someone need specific information within a project they simply try to contact another employee who is thought to be able to help, "*then you call someone who has that knowledge*". Hence, much of the knowledge sharing is dependent on human networks and further also linked to individual employees. This creates vulnerability in terms of the strong link between the individual employee and specific knowledge. The phenomenon evidently creates a risk of loosing certain knowledge, should for instance project leaders decide to leave the company.

Secondly, a dynamic and distributed work place, with highly qualified and creative employees, is not synonymous with having a work force with preference for fast and flexible attitudes towards internal changes. Other problematic considerations involve dealing with rapid growth and having partly young inexperienced employees. All these concurrent factors coalesce into an unwieldy and almost incalculable calculation for the management. In striving towards creating a culture of verbal communication, with a socially oriented and flexible work culture, an acknowledged need for a centralised strategy for knowledge sharing is absent.

Earlier hard-learnt lessons around the taken for granted belief in the abilities and opportunities of technology, that did not turned out as expected, have led to a certain moderation in general. Yet, there is still an over-confidence in technologies like Intranets to automatically solve all communication problems within an organisation. As Orlikowski (1992) concluded, where there are few incentives or norms for co-operating and sharing knowledge, groupware technology alone could not engender this. As stated by one of the employees; "*It is a Intranet solution. We have some basic things that work fine, but we have very poor control over knowledge sharing*." In the organisation there could also be found at least two different communities of practice (Lave & Wenger 1991), both the improvisational and creative community represented by the art directors and graphical designers, and the logical and structured one represented by the technicians and financial responsible employees. This added to the complexity, when communicating and co-operating across these communities.

Thirdly, in an Internet consulting company the work practice is dependent on the co-workers ability to co-operate from various shifting locations. Utilising Web-based Information Systems could facilitate mobility for the individual employees (Rosander & Hoffmann 2001a). This new computing platform will, among other things, result in a ubiquity of services, i.e. services will be available at any time and at any place (Lyytinen et al 1998). In this way it could provide a foundation for more flexible and mobile co-operational patterns. The ubiquitous and emergent nature of Internet-based technologies (Lyytinen et al 1998) could inspire new innovative use possibilities. Though, just due to the fact that there is an Intranet does not necessary induce an

efficient utilisation, there is still need for incentives and motivation. An Intranet should preferably be developed in relation to the work practice and the employees' daily routines, and also beneficially support the co-operational forms used in the organisation. Especially, when an organisation is comprised of a large number of semi-autonomous entities in various locations, Intranet integration becomes problematic according to Lamb & Davidson (2000). They found that enterprise-wide directories could help people find experts within their organisation and hereby provide a way to navigate between the islands of practice.

Because of the vast potential of the technology, Intranets may have a major impact on organisational aspects like power, communication and norms (Scheepers 1999). An Intranet could be seen as foremost a communication technology rather than just an information system. It is an interactive medium that can facilitate multi-directional information exchanges (Scheepers 1999). Hence, the use of Intranets may facilitate a range of possible interactions and hereby enable new co-operational forms and work practices to be developed. In the case of complex and networked technologies, Scheepers (1999) argues that these evolve over time and the meaning ascribed to such technologies by actors is highly context-specific, they are affected by the local organisational culture and supporting infrastructure. Thus, these new technological infrastructures mean an increased openness and exchange between actors in different locations and communities, hereby creating an even more complex interaction.

The social context in which a technology is developed and used has a significant influence. The WIS are embedded in, and shaped by, this context. When implemented in the organisation it should fit with, rather than challenges the established social structures (Scheepers 1999). Hence, the material infrastructure should support existent social systems. By enlightening that growing co-operational patterns are firmly linked to the social infrastructures, a shift in focus could lead to enhanced possibilities for efficient implementation and utilisation of WIS in networked organisations.

The normative recommendations derived from the theoretically and empirically based analysis of infrastructures and co-operational patterns in a Scandinavian Internet consulting company could be summarised as following:

(1) Employees working from self-fulfilling and short-time sharing-of-knowledge perspectives are a potentially liability well worth considering.
(2) Designers should consider the diversity in competencies, communities of practice, and co-operational patterns, thus making Web-based Information Systems that give the employees room for customisation through design-in-action, securing utilisation and trust.
(3) Management directing a work culture primarily based on verbal communication and camaraderie would benefit from selecting Web-based Information Systems supporting video, audio and text equally sufficiently, thus enhancing an individual flexibility as well as mobility.

8. Conclusions

Infrastructures for supporting collaborative and distributed work call in addition for deeper insights in the social infrastructures. This paper suggests that considering the Web-based Information Systems as foremost social media help designers understanding the complexity when designing and implementing Web-based Information Systems in this kind of organisation. In strive for change towards more dynamic and flexible organisational forms, the infrastructures must also support the intertwined social systems. The conclusions are that universal design solutions are losing their value and the need for context specific design methods, supporting design-in-action, is emerging.

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