

Empirically informed knowledge management systems in mobile domains

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ABSTRACT

This paper reports from an empirical study of how knowledge management takes place in the work of news journalist at a radio channel. Based on the field data, we have in cooperation with the work force studied derived implications for the design of knowledge management systems for mobile workers. The implications focus on *the evolving, dependent tasks of news journalists*. Having reported the implications from the fieldwork, we relate our findings to the so called “repository view” of knowledge management, which dominates the field.

Keywords

Ethnography, Mobile CSCW, Knowledge management, Organisational memory, News production

INTRODUCTION

Knowledge management has received much attention in research recently. So far, much research on the topic has been theoretical and rather abstract. Topics of concern involve the epistemology of organisational knowledge [14], the sharing of knowledge in communities of practice [39], the categorisation of organisational knowledge [10], comparative reviews of organisational learning and knowledge management concepts [34]. This research may be valuable in many situations, but it does not offer much guidance for designers and users of knowledge management systems. Another strand of research on knowledge management conducts empirical work on micro-level, analysing knowledge in organisations [19, 30, 5, 2]. Clearly, the level of detail in this research is more suitable for designers. However, the research in this category has not been so concerned with design of knowledge management systems. In most cases, the empirical results have been used to criticise current systems and theoretical frameworks. Yet a third strand of knowledge management research has been technologically oriented. The main focus has been on developing knowledge management systems. This research has rarely been based on empirical investigations of how knowledge management really takes place in practice. Accordingly, the assumptions on which the systems are

based on are not informed by empirical work.

Against this background we call for the need to conduct empirical studies of knowledge management with the explicit objective of informing the design of knowledge management systems. This call is answered by the research reported in this paper.

The fieldwork we report was conducted at Radio Sweden. Our study investigated the work of news reporters and the ways in which they use and manage knowledge during the working day. Previous PD and CSCW research on the news domain is represented by Kensing et al [22] and Bellotti and Rogers [9], but their focus has not been on *mobile* reporters. We focus on mobile personnel for several reasons. First, many jobs in western society seem to become increasingly mobile. Accordingly, the need to understand mobile work and design applications that really match the mobile setting is emergent. Second, mobility has been largely overlooked by designers of CSCW systems [26]. Most research has been concerned with stationary settings; thus there is a need to broadening the scope of the field. Third, in the case of knowledge management, the main focus has been on the PC and stationary settings. However, the work of key personnel in many organisations is highly mobile.

Knowledge management has been used to describe many different things, ranging from “organisational learning efforts to database management tools” [32]. Needless to say, there is no general agreement on a definition of the concept. However, there has been a tendency in the literature to treat knowledge management in a Tayloristic way, which may not only result in unsuitable IT systems but also deskilled workers. Furthermore, knowledge management and related concepts, like organisational memory and organisational learning, are sometimes used inter-changeably. We view knowledge management as a social, dynamic process that has to be considered carefully, and in cooperation with workers to be understood correctly.

Clearly, in a work environment the ability to manage knowledge, i.e., find, create, use, is important to accomplish work. The objective of the study we present in this paper is to investigate this in practice with the ambition to provide designers of mobile knowledge management systems with design implications.

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RESEARCH BACKGROUND

An introductory textbook on news journalism suggests, in a top-down fashion, that events which fall into the following categories qualifies as news items [29]:

- Events that are likely to affect many people, e.g., a hurricane.
- Events that are immediate, e.g., election results and traffic jams.
- Events involving well-known people or institutions.
- Events in the circulation or broadcast area.
- Events that reflect clashes between people or institutions.
- Events that deviate sharply from the expected and the experiences of daily life
- Events that are being talked about

In order to help designers of interactive systems, these types of lists need to be complemented with detailed studies of how people actually go about to do their work. This has been much recognised in CSCW [e.g., 12] and PD [e.g., 25, 22, 15].

The empirical study we conducted used observational techniques for data collection. All together we observed the work for approximately 300 hours. We made copies of many of the documents produced and discussed by the journalists.

Having transcribed the field notes, we started the coding of the empirical data. We went through the data, made notes, and labelled data of interest. The analysis of the empirical data was aimed to identify where and how knowledge management occurred in the day-to-day work of the journalists. In the analysis, we used HTML to tag the field data and make links. We involved the workforce studied in the analysis of the empirical data. We presented our preliminary results for the journalists and they had a chance to make suggestions to assure a correct and effective analysis. The suggestions we outline in this paper should be viewed as the result of a joint effort between the authors and journalists.

The empirical research was conducted at a public service radio station in Gothenburg, Sweden, during the period of the Swedish election in September 1998. The station employs about 100 people and broadcasts nationally and in the local region. The study mainly concerns the channel responsible for the local region. A recent survey shows that 64% of the population in the region (approx. 650,000 people) listen to the channel every week¹.

The study was focused on three radio programs:

- News update. The news broadcast every hour.
- Gothenburg Direct. A program that covers what happens in the region. It involves interviews, music, and discussions.
- Election Extra. A program dedicated to the upcoming election. It covers news, interviews with politicians, etc.

The three programs run separately, with dedicated staff, but the news collected is often shared. The idea to investigate and report a particular news item can originate from a telegram from a news agencies like Reuters, an article in a news paper, a tip-off from the public, press releases, information found on the Web, etc.

The station is an open plan office (see figure 1). In the middle is a large table where the journalists join together in daily meetings. The studios and the work desks have PCs that share disks and printers via local area network. All PCs have Internet access, and there is a stationary telephone on each desk. The field journalists (figure 1) have mobile phones, but also a microphone that is connected to a transceiver on a rucksack. This equipment broadcasts to a van where the signal is amplified and sent to the studio.

Figure 1. A discussion in the office landscape (left) and a field interview (right).



To keep track of upcoming events the journalists use "diaries." A diary is a paper-based shared calendar. An entry of a diary can be the date of a press conference, a court verdict, etc. This information can also be found in an old, but widely used document management system called MANUS. The MANUS system also contains other types of documents, e.g., telegrams, broadcast reports and program manuscripts.

EMPIRICAL RESULTS

In this section we report the main results of the empirical study. Let us first give a brief overview of the work process of the radio station.

The Work Process

Every morning at 8.30 there is a scheduled meeting that is lead by the editor of the News update. The meeting takes place at a large table in the middle of the office. Journalists from all local programs participate, usually about 10-15 people. Journalists join and leave as the meeting progresses. The editor has a prepared list of potential news items that is passed to the participants. The list, which has been assembled using dairies, MANUS, local newspapers, etc.,

¹ The source is RUAB (<http://www.ruab.se/Engltx.htm>) a company that continuously carries out radio audience measurements.

serves as a starting point for discussions about "what should be done today."

When the meeting ends at about nine o'clock everyone has an overview of the preliminary schedule of the day. At this point the three programs usually have short meetings, where the discussion from the morning meeting continues. The journalists also decide who should do what and how activities should be co-ordinated.

It is important to assure originality of news items. This is often initiated at the morning meeting, but needs often to be continued by the journalists individually throughout the day.

A program can contain all kinds of formats, even for a single news item. The formats are:

- Recorded interviews: Recordings from telephone or field interviews are either transmitted from the field to the studio or recorded on tape. The recordings, called "clips," are always edited before broadcast.
- Live interviews: A live interview can be done in the studio, on the telephone, or in the field.
- Talkers: Talkers can always be found as part of a program, e.g., introducing other material or just reading important messages. A talker is either recording or read live by a journalist.

During a live interview the possibilities to change the focus is limited and it is up to the individual journalist to frame the conversation and ask the appropriate questions. When the material is recorded, however, there are some possibilities to conform the material. The purpose of the editing is to make the report more understandable in the time frame of the programs. Some final touches are also done to adjust the report so that it fits in the overall agenda of the program.

The material is sometimes insufficient, i.e., the right questions were not asked. This is not good since the collection of material is very time-consuming and the editing are often done in the last minute. To have a gap in the program where a clip was supposed to be is very frustrating for the journalists, but they usually manage it by rearranging the parts of the program and use some backup material, e.g., play extra music.

Let us now describe how the journalists in general and the field reporters in particular manage knowledge to get the work done.

The Preparation of News Items

Our primary focus describing the management of knowledge, in the work of the journalists, is on the process of preparing news items. This process involves two main tasks, which we call *exploring* and *elaborating* on news items. Exploring is the process to investigate potential news items and initiate them. Elaborating is the process of researching and framing the initiated news items to produce reportable news items.

Exploring and elaborating are knowledge intensive processes, where the journalists continuously access information resources and colleagues to identify, assess, validate, frame, research, news items on which they are working. Furthermore, the processes are interrelated in that you while exploring a news item also partly elaborate on it, and vice versa. The processes are also co-operative in many ways. Most work tasks are collective and you would not be able to do so much work on an individual basis. The explicit distinction between exploring and elaborating is, of course, a simplification. There are cases when it is not so easy to know when the journalists explore and elaborate on a news item.

The management of knowledge in the preparation of news items relies on both people and information systems. In reporting the ways in which this happens, we highlight some important questions that the journalists need to consider. By understanding these questions - how they are managed - and the knowledge involved, we may be well prepared to inform the design of knowledge management systems.

Exploring news items

Exploring is the highly collaborative process to identify, assess and validate news items. The morning meeting serves as an important forum for doing this. At the morning meeting, the journalists bring up, discuss, criticise, assess, validate, news items in a highly collaborative fashion. However, the exploration of news items continues throughout the day. The process of exploring can be understood as a combination of *what* news items to report and *how* to report it. These two issues are thought of in a dualistic way: the journalists do not think "what" without thinking of "how," and vice versa. Below let us describe important considerations in the process of exploring potential news items.

What have others done?

One important source for news items is what other media and competitors have done. In many cases, the journalists argue for a particular news item with reference to another other media or competitor. Consider the following excerpt from a morning meeting.

Pedro says: "I would like to make a case of VF ice hockey and build on what they said in Metro" [Metro is a free newspaper that is available on the tram]. Mary answers "Great ... to move further on I mean ... since probably a lot of people have read it."

In this case, the ice hockey news was brand new, but it had already been reported by Metro. This is not a problem, however, but an advantage. The reason is that many people have read about the story in the newspaper this morning. The topic is new and people are familiar with it, and for that reason they want additional information, another analysis, and so on. Accordingly, it is a very good topic to move further for the radio journalists.

What have we done?

It is important to follow up on stories that have been reported internally. Many stories are not one shot, e.g., a court trial can run over a long period and are reported as it progresses. There are also issues that are always important, e.g., health care quality and economic politics. Most journalists have the responsibility of being especially well-informed on one such area. The following example illustrates a follow up discussion at the morning meeting.

Erica says: "Anything new about that 'abused couple from last week' ... Alice?" Alice responds: "I don't know, the police did not want to comment on the accusations and that was it." "Tell us what happened," Thomas asks.

Alice answers: "Well, it was a father and a son who were walking home from the church and got physically abused by someone... it happened to be police officers in civilian clothing doing some narcotics raid. Perhaps they [the couple] were mistaken for drug dealers?"

Erica answers: "Can you ask them if they want to talk about it as guests in the studio?" "Well... sure, I need to check if there is going to be a trial... and I will talk to Roy about it," Alice responds.

In this case, Erica starts the discussion and gives the word to Alice who had been working on the topic. Thomas asks Alice to inform everyone about the case. This happens often and results in that most journalists know about what their colleagues are doing. Erica also suggests that Alice should talk to Roy, who knows a lot about police issues. Alice accepts Erica's suggestion on how to take the case further.

Is it unique in the repertoire?

It is important that the channel gives a fair proportion of attention for current issues. For example, some political parties are very focused on getting media attention, but it is preferable that all political parties are getting equally much attention. This is of course difficult to accomplish when the workload is high and some parties constantly keep in touch, while others are very difficult to reach. Consider the following example.

At a morning meeting Lena says: "I can interview that fellow from the left wing party?" Annie [producer] answers: "Perhaps the left wing party have had bit to much attention this week? Adam had one [left wing politician] in the studio yesterday and Thomas reported from their press conference." Annie continues "I know that they are 'pushy' but there are other parties as well." "Yeah, you are probably right," Lena agrees.

Since Annie is the producer she had a better overview of the repertoire of the channel. Lena becomes convinced that she should leave the issue to rest that day. The producers are responsible for the repertoire, but a part for the morning meeting it is practically accomplished through ongoing conversation among journalists.

Is it valid?

All ideas for news items are validated collectively. The following example is an illustration of this.

Erik says: "An upset emigrant called me and said that there has been too little information about the election in foreign languages... perhaps we should do something with it?" Adam [Election Extra] answers that "It's not true ... there has been a lot..." Some other people agree and Harry says "all political parties have had gatherings for different groups... with interpreters... but only like three people showed up."

Here, Erik has been misinformed, but it is taken care of because of the others' knowledge about the issue. This minimises the risk that valuable resources are put on news items that are not accurate. It also minimises the journalists' ability to misuse their position, e.g., to help friends that would benefit from media coverage.

In this case a discussion was started on why emigrants does not seem to care about the local election. Some notes were than taken and stored in MANUS system under the category "issues-to-watch." Under the right circumstances it may become a news item at some other point.

Is it possible to do?

How to conduct a report is often a matter of what is possible to. An event can be considered too difficult to report in relation to its news value. In other cases the possibilities for a report must to be assessed in a little timeframe. This is illustrated in following example.

Mary [the producer of the News update] gets a tip-off on the telephone that there are very long waiting time in the switchboard system at Sahlgrenska [The largest hospital in the region]. Mark and Carrie [News update journalists] say that they have the same experiences.

Karin is on her way to Sahlgrenska right now to do another report, but Mary stops her. Mary asks Karin: "Could you please go to the switchboard as well and try to get an explanation and an interview?" Mary and Karin start a discussion. Mary recalls that she heard something about the switchboard system. Mary queries the MANUS-system and finds a telegram from couple of months earlier about it. The telegram contains the text: "progress without any disturbance" and the name of the responsible manager. Karin takes a note and leaves.

In this case, Mary considered the tip extra carefully since she knew that the problem would affect a lot of people. That the two colleagues, Mark and Carrie, had similar experiences imply that it is true. Furthermore, it is easy to report because Karin is going there anyway.

Mary's suspicion that she heard something about the switchboard system was confirmed by the telegram and the promise to "progress without any disturbance" could be used in an interview. The name of the manager may be useful for Karin. The story was also, predicted to fit the genre of the News update.

Elaborating on news items

This category of observations concerns the ways in which initiated news items are researched and framed. As more information about a news item gets known it may drift in focus, relevance and validity. Nevertheless, when a new item enters the elaboration phase it almost always results in a report, even though the initial plan and expectations may differ from the final result. Below let us describe important considerations in the process of elaborating on news items.

What have others done?

It is important to have an overview of what has been done previously by others when framing a news item. In the following example Adam is going to report about an airport, Sävö, which has been threatened to be closed down.

Peter says to Adam while pointing in a newspaper: "It says here that Sävö is expanding... more helicopters traffic." Peter goes to Adam's desk and they start to search in the external archives for "Sävö" and a name that was mentioned in the newspaper article. Adam and Peter browse the results and Adam says: "Oh yeah, I remember... I guess it's best to just call them." "I agree, a live interview at 14.35 would be great," Peter says and hurries away. Adam makes some notes before he calls.

Peter knew about Adam's task, thus he recommended the newspaper article. Adam's search gave him an overview about the topic that was enough to continue. Adam could rediscover the details without having to go through complete and exhaustive records. The information came from several sources, i.e., the newspaper and external archive system, which would be difficult to include in a single system.

What have we done?

It is also important to know what has been done internally on topic to facilitate the research and framing. In the following example Emma wants to elaborate on a new framing.

Emma walks in a hurry to Annie and says: "... about the angle on the Nazi issue. How come the extreme right wing has grown stronger in Europe?" Karl overhears and says: "... extreme right wing has always been strong in Europe." "Yea right, but have we done anything on it," Emma continues facing Annie. "I don't know," Annie says and queries the MANUS-system. Annie browses the results and says: "No, seems as if we haven't done anything about that... Peter has been on to the Nazis..., Steve as well." "Ok, great I will go and talk to Peter then," Emma says and walks to Peter's desk where she saw him recently.

In this case Emma was in a hurry with little time for preparations. The new angle was collaboratively validated with Annie and Karl who seemed to approve. The search in the internal archives revealed that Peter had been working on the topic earlier. It was likely that he knew more about the topic than Emma did. Thus, talking to Peter could increase quality of the report. Steve was also mentioned, but

since Emma had seen Peter recently, he was the obvious choice.

Are there any new issues that should be considered?

Things that are planned in the morning may turn out to be irrelevant later during the day as more things arise. The following example illustrates when new facts arise, which affects the task.

Mark's phone rings. It is a police officer who comments on traffic accident report that was just in the broadcast. Mark exchanges a few words and hangs up. Mark queries the archives. Then, he says to Adam and Jessica: "It was a police officer who said that the traffic report was wrong. They have sent a new telegram about it. I can fix it before next broadcast." "Great, I missed that telegram... peculiar title," Adam replies and continues "Erica is at lunch now, but is going to continue on that track. Send her an email."

Here, some facts were broadcasted that was not correct. This happens quite often for accident reports, where the uncertainties are usually high. Mark informed Adam and Jessica about the change. Adam told Mark to inform Erica as well, but since she was at lunch, Mark sent her an email. The event rapidly changed Erica's possibilities of doing her task.

How does it relate to the repertoire of the channel?

To care about the repertoire of the channel is especially important throughout the day when the programs run concurrently. Two programs should not cross-report news items without different foci. The following example illustrates when it has broken down, but is repaired:

Alice who works on the program "Election extra" arranges so that a political scientist could be interviewed about the possible outcomes of the election. A bit later on, Alice becomes aware that "Gothenburg direct" is going to interview a political scientist too. This makes her concerned that there may be "too much" political scientists. A bit later Alice approaches, Erica, the producer of Gothenburg direct asking about the political scientist in a gentle way. Erica says that they have dropped that part of the program. This makes Alice happy...

The journalists at a program needs to know what is being done in other programs, and visa versa, so that the overall picture can be cared for. This is normally done at the morning meeting, but in this case it had broken down. The reason for this was that Alice had not mentioned that there was going to be a political scientist in the program, since it was not settled at that point. It was not settled at the morning meeting for the other program either.

What is possible to do?

It is especially difficult to research and frame news items for journalists in the field. It is also more difficult to plan what may happen in the field. If the plan for a news item is distorted the journalist must reframe it and to be able to create a quality report. If there were to be no report it would be very expensive, since the resource could be used for

another news item instead. The following example illustrates this.

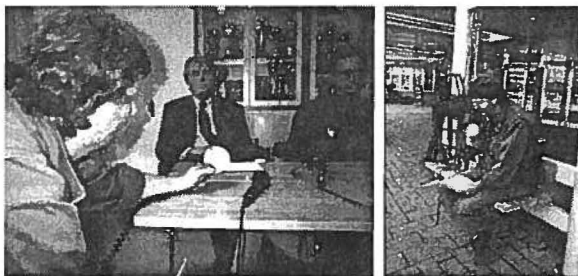
John is in the field and has just finished a task when Pedro calls on his mobile phone. Pedro tells him that the board of an ice hockey club, Frölunda Indians, has just announced that they are going to give a press conference. John remembers an article from a morning newspaper "The Metro," where the club was accused of tax avoidance when paying salaries. Pedro asks John to go there and do a report for the 12:30 news.

At the site John waits outside. He chats with some people from newspapers, television, etc. When the board of the club arrives, John asks the chair of the club, "Could we do an interview for the 12.30 news?" The chair replies immediately: "No, I won't give any interviews today."

The press conference starts and John puts a microphone on the table in front of the board of the club (see figure 2). He also makes a quick call on the mobile phone to the studio, informing them about the chair seems unwilling to give interviews.

The press conference starts. John asks the first question and a cascade of questions from other journalist's follow. The microphone records the conversation and transmits it to the studio.

Figure 2: John at the ice hockey clubs press conference (left) and reporting after it from the field (right).



John calls the studio (again) and says, "I do not think Hasse is will give an interview... Perhaps we should use a recording ... I will try again to get Hasse" This happens ones again during the press conference.

The press conference ends. John waits for the chair outside the room. He tries to persuade him, but it doesn't work. He calls the studio and suggests that Peter Anderson, who knows everything about ice hockey, should be contacted. He could assist the editing, he knows how to frame the story, etc. During the last call John assists the editing by suggesting where important things seemed to have happened.

John sits on a bench outside the arena (see figure 2) and composes how to report the event. After a while, the studio records John reading the report. This is finished at 12.20. The report is broadcasted 12.30.

What happens here is that the chair refuses to be interviewed and puts John in a difficult position. He must complement the Metro article with some additional analysis or information. Almost everything that was said at the press conference was in the article and John did not know very much about sports politics. However, by noting what the chair said and by giving an introduction, John manages to produce material that - after some editing - is of reasonable quality. John said after the press conference, that a talker would have been "too passive" adding little value compared to the newspaper article. He also said that he knew that Peter Anderson who knows everything about ice hockey and could assist in the framing of the news item. Unfortunately, Peter was not accessible, because he was not on duty.

Later that day the topic was debated in the program Gothenburg direct. At that point, Thomas, a journalist with special knowledge on the issue, was present which resulted in a good discussion.

IMPLICATIONS FOR DESIGN

In this section we discuss what the empirical results imply for the design of knowledge management systems. We seek to summarise the results from the study that we think are most important for designers of interactive knowledge management systems, discuss what implications these observations may have for design, and relate them to the literature.

- **Observation #1:** The main purpose of making searches in archives is to get an overview of information, not to find "the right answer."

In the process of exploring and elaborating on news items, the journalists frequently used archives of different types, e.g., the MANUS system. However, most often the use of archives aimed at getting an *overview* of the issues of concern, not finding specific information about something. To illustrate this, let us return to the airport case described previously. The journalist starts to work with the news item, and makes therefore a search in the archive (MANUS), he would be more interested in the list of headings returned from the system than the individual instances as such. In a sense, the list of headings is the answer. This is often enough for the journalist to continue to explore and elaborate the news item. The overview helps the journalists to put the news item into context. The implication of this observation is as follows:

- **Implication #1:** Provide easy access to surveys of archives based on the work item in focus.

So, how does the implication match the literature? In fact, we can trace similar thoughts in a wide range of research contributions. For example, according to the empirical results reported by Bowker [11], the ways in which nurses use medical records sits well with our implication. The main use of the record is overview and classification to facilitate remembering. March [27] provides a similar line of

reasoning in an essay on the problems of rational choice. However, the focus of his essay is not exactly knowledge management.

In literature under the label of knowledge management, the implication above has rarely been considered. In most cases, the focus has been on providing detailed information exclusively [e.g., 16]. In well-known knowledge management systems, such as Answer Garden [1, 3], Project memory [38], and Designer assistant [36], there are search features. However, the ways in which users can survey search results are very limited. Clearly, these systems are much more oriented towards finding "the matching record" (which sometimes is very important) than providing the user with an overview. There are some exceptions, however, as represented by gIBIS [13] and RepTool [20]. These systems offer features for overview information. However, the information to overview is very different from our case: design rationale in long-term projects. Accordingly, the possibilities to overview the types of information that the news journalists are interested in have not been provided by any system up to now.

- **Observation #2:** Information in archives is often used to locate expertise.

The journalists often have difficulties to remember who knows something about a special issue. Therefore, in order to locate expertise, they often use the internal archives to investigate who have published on a particular topic, i.e., who can assist them in exploring and elaborating on a news item. Quite often the names of the author found in the system reminds the journalist of whom to ask. Usually, the colleague to ask is someone known, but for one reason or another he or she could not be remembered before seeing the name in the archive. This implies the following implication:

- **Implication #2:** Attach authors to all information. This would help users to find the expert.

A similar finding was reported by McDonald and Ackerman [28]. They found that programmers often used the change histories of source code files to identify expertise. The importance of "knowing who knows" has been highlighted by, e.g., Randall et al [30]. In our case, the main reason why the journalists want to discuss the news items with others does not seem to be a matter of incompetence. Rather, it is often a question of getting a "second opinion" and another context of the work.

In Answer Garden 2, there are features that route users to expertise if the system does not contain solutions to their problem [3]. Such features are also provided in the system described by Streeter and Lochbaum [34]. The user queries the system with a keyword, and receives a list of people who can assist. Similar features are provided by the Referral Web system, described by Kautz et al [21]. The importance of expertise location has also been acknowledged by the designers of the Designer assistant [36] and the Project

memory [38], but no explicit support is included in the systems.

- **Observation #3:** *Expertise location is determined by who is accessible.*

Expertise location is dependent on who is available. Accordingly, knowing the author of certain information is not enough. One also needs to know if they are available for interaction. In the field, in particular, the journalists have problems to know that (if they even know whom to contact!). They often used the telephone to find out, which is probably not the most efficient way. Furthermore, when the journalist is in the field, it is not always easy to articulate the local conditions when talking to the expert. These observations imply:

- **Implication #3:** Provide easy access to available authors of information, especially for field reporters.

The problem of locating people in a distributed and mobile work context was found in a field study by Bellotti and Bly [8]. McDonald and Ackerman [28] also found the importance of geographical distance in expert location. The importance of distance in collaboration has also been reported by, among others, Kraut et al [23] and Randall et al [30]. The political problems of expertise location, e.g., status, have been discussed by, among others, Allan [4] and Randall et al [30]. We did not observe such problems in our study.

There are PC based applications like ICQ (www.icq.com) that help people to find out if colleagues are available (or busy, etc.). However, these systems are not very sophisticated when it comes to expert location. Furthermore, their support for mobile workers is very limited. The Babble system [18] can help people to get an overview of ongoing conversations between people, which could be used to know who is available. However, using Babble in our case would not be straightforward in this context. For example, there would be very many conversations going on simultaneously. Furthermore, the mobile work context would be difficult to deal with (e.g., how to represent and change the setting of a journalist?). As far as we are concerned, there is no system that provide sophisticated mobile support for expertise location.

- **Observation #4:** It is important to handle overlapping news items.

The work at the radio station is parallel, but also distributed and mobile. As a consequence, there is sometimes a risk of cross reporting news items, i.e., that two programs reports the same issue. Cross reporting matters for the repertoire of the radio channel. For example, a political party should not receive too much attention, there should not be too many interviews with ice hockey players, and so on. Therefore, it is very important for the journalists to know the work of the colleagues. Due to the mobile and distributed organisation of work, but also because the work items evolve (and new

are initiated) through out the day this is not always easy to handle. This implies:

- **Implication #4:** Help the journalists to keep each other informed about the (evolving and new) work tasks.

This implication relates to issues of co-ordination [33], notification [31], and session management [17], which have received much attention in CSCW. Co-ordination is about coping with interrelated work tasks. Notification deals with acknowledging events in collaborative systems. Session management is the ways sessions are set up and handled in collaborative systems.

Despite the research on these issues in CSCW, the work on how to handle this in a mobile context has received little attention. Nevertheless, in a knowledge intensive work environment with mobile staff such support seems vital.

- **Observation #5:** New information on the task of concern may be very important.

In time dependent work, such as news journalism it is very important to be aware of new information of the topic of concern. For example, if a journalist starts to work on a news item that is planned to be reported three hours later, it may be very important to know what the news agencies, television, other radio channels, etc., report on the topic meanwhile. In other words, new information on the topic needs to be considered in order to prepare a good news item.

It is important to notice that the news items often evolve during the working day, and that the journalist quite often work on the field. From this it follows that:

- **Implication #5:** Provide staff with new information based on the (evolving) items on which they work. Continuous support is important, and it needs to be mobile.

Modern editorial software, e.g., ENPS (www.enps.com), allows people to define filters that redirect news telegram to their desktop PC. These filter support the long-term interest of users, assuming that the defined profile actually match the interest of users. In our case, the interest in new information is not mainly long-term, even though the journalists obviously have long-term interest [cf., 7] The interest is not short-term either, but rather "task-based." The interest the journalists have in new information is based on the task (news item) on which they work, which is temporary (until the item is reported) and evolving. This type of interest is not supported by current systems. The only system that is a bit related to this is Darwin [24], of which, the design was informed by a study of a dispersed and mobile IT-support group.

DISCUSSION

Systems aiming to support the management of knowledge in organisations increasingly called "knowledge management systems" have traditionally assumed a "repository view" of knowledge [6]. From such a perspective a knowledge

management system is basically a collection of solutions to problems. The central idea is that the system provides solutions to problems experienced by the users. In cases where the system cannot assist, the user would typically search for the solution elsewhere and update the system with the new piece of knowledge. Some systems also provide features for expertise location. The idea is to assist users to find people who could help solve their problems in cases where the solution cannot be found in the system.

Many researchers have criticised this perspective of knowledge, stressing the importance of context, and the emergent collective nature of knowledge. In many cases, the critique against the assumptions of which current knowledge management systems builds has been rough. Few of these contributions come up with suggestions for how to improve current systems. They do not make the life much easier for designers and users of knowledge management systems.

The objective of the research presented in this paper is to be a little more specific about how to improve the design of knowledge management systems. We believe that it is difficult not to consider repositories in this setting. Even though no repository is perfect, they do provide valuable help in some situations, and are definitively worth developing further. As Weick and Westley [37, p. 444] note in a discussion of the relation between organisations and repositories:

"If organisations are repositories, they are flawed sources of guidance, both because storage is imperfect and because retrieval is an act of reconstruction. Memory is imperfect twice over, which is bad enough. Even worse, organisations face chronically 'novel present'. To rely on repository of built-up knowledge is to rely on approximations rather than certainties. To underscore the approximate character of prior learning, self-designing systems apply lessons of the past while simultaneously questioning their relevance."

So, how could we complement the repository model to provide a better platform for knowledge management?

- From problem to evolving task

The point of departure for how the journalists managed knowledge in their work was not a problem, which often is assumed in knowledge management, but the news item, or *task*, of which they were concerned. Furthermore, the task evolves over time; it is not a fixed entity.

- From independent to dependent input

The repository model of knowledge management does not assume any dependencies between "inputs" to the system. Our study implies the opposite: users are very interested in the input of others, simply because they need to make sure that different types of double work does not happen. Therefore, the repository model needs to be put in a co-ordination context, where the management of dependent tasks and inputs is taken seriously.

- From information as such to information linked to authors and their accessibility

We could interpret the repository model as promoting a perspective where “the information speaks for itself,” the user has a problem, the system contains the solution. Why then would the author of the information be important? As we have seen in our study, it is often very important to know who are the authors. It is also important to know whether or not they are accessible. Therefore, we should add author and accessibility to all information in the repository.

- From short and long-term interest to task-based interest
Tasks typically evolve through out the day, and the journalist would be interested in new information related to a particular task as long as the journalist works on it. We can call this *task-based interest* in information. Task-based interest is different from both short term and long term interests, which most often are the only types of profiles discussed.

- From “hits” to hits *and* overview

The main focus of the repository model is the “hits” that a user receives from a query. As we have seen, the overview of hits could be equally important in many cases. Therefore, we need to expand the model from focusing on hits (more or less exclusively), to also consider the overview.

- From stationary access to flexible access

The work environment in many organisations of today (including the radio station) is flexible in that people work both at the desktop and while on the move. This requires flexible access to the knowledge management system, i.e., both mobile and stationary clients.

Based on these ways of extending the repository model of knowledge management, we are currently developing a flexible knowledge management platform that:

- starts out from evolving, dependent tasks
- with all information linked to authors and their accessibility.
- with filters that are task-based
- that shows hits and overview, and
- which provides flexible access (stationary and mobile)

SUMMING UP

The objective of the study we present in this paper was to investigate knowledge intensive work in practice in order to provide designers of knowledge management systems with suggestions for design. Using qualitative methods, we found that the preparation of news items involved the process of exploring and elaborating. Knowledge management in these processes involved information in archives and colleagues. Based on these observations we elicited five design implications, which is related to the literature. We also used the data to suggest how to enhance the repository model of knowledge management. This model has been criticised in

the literature. However, it is our claim that it has important aspects that are worth keeping, and therefore, we ask how the model could be enhanced and improved. Based on the empirical analyses we made the following suggestions: First, the starting point should be *evolving tasks*, not static problems only. Second, the inputs to the system should be treated as *dependent* of each other, not independent. Third, the information in the repositories need to be *linked to authors* and their *accessibility* (the information as such is not enough). Fourth, the user interest in the repository is *task-based* (interesting as long as they work on the task), and not only short term or long term. Fifth, the overview of “hits” in the repository is important, not the individual hits only. Sixth, users need flexible access to the system, not from desktop only.

Our future work involves two main tasks. First, we will complete the development of the knowledge management platform we are developing based on suggestions above. The system, which is called the NewsMate, will be evaluated and tested in practise. Initial user feedback is positive. Second, we will develop a general architecture for flexible knowledge management. The objective is to set up an architecture that makes it easy to develop knowledge management systems for new domains.

We also suggest more empirically oriented design projects on knowledge management, which develop novel systems based on observations of work and participatory design principles.

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