



HOW DO KNOWLEDGE WORKERS COPE WITH THEIR EVERYDAY JOB?

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ABSTRACT

Knowledge work, which forms a large part of modern economy, often involves collaboration. In order not to overemphasise either the transactional or the communicative aspect of collaboration, attitudes and technologies may have to change. Data from a survey show how knowledge workers manage their time and tasks using straightforward office technologies. Enhanced context awareness could help both the communication initiator and the communication target. This is a matter of behaviour and a chance for technology.

1 INTRODUCTION: THE ECONOMY OF KNOWLEDGE WORK

When considering knowledge work, many authors have proposed alternative methods to measure knowledge workers' productivity (see, e.g., Anderson, 2002; Kaplan & Norton, 1992; Upton, 2001). Some studies on return on intellectual capital investment point at short-term profits like best practices and quality management (Juran, 1951), while others emphasize long term profits such as newly developed products, and new solutions to long existing problems (e.g. McDermott, 2001). The latter category of productivity improvement is often associated with knowledge management and community building. The former category falls in the classical categories of scientific management (Taylor, 1911). These schools of thinking have yet to come together as there is value in both perspectives. The scientific management approach emphasises the competition in production methods, whereas the knowledge creating approach emphasises the competition of knowledge itself.

In recent years, the value of communities of practice has been acknowledged as a modern version of traditional workshops, where workers learn most and fastest through talking with one another (Wenger, 1998).

The balance between individual work and social interaction is clearly visible in the way offices have been organised over the years. Becker and Sims (2001) note that during the 20th century, office lay-outs generally changed according to Taylor's view that workers need to concentrate on tasks and that social interactions need to be limited. More recently, open office spaces have been reinvented to enable better visual awareness of one another and offer more room for social gathering. Office environments strongly influence the behaviour of knowledge workers and so do the media they use in their work.

In the shift toward more communication, communication and information sharing tools have gained popularity. For that reason companies like Shell, Unilever, and IBM (Lesser & Storck, 2001) gave these communities of practice a place in their organisations as breeding places for new knowledge and as hubs for rapid knowledge dissemination. No project team is complete these days without a kind of community support such as mail distribution lists, project workspaces, and discussion forums (Verwijis & De Poot, 2002).

It seems that the communication tide is still rising, with more hours spent on e-mails (Venolia et al., 2001) and mobile phone calls (Cellular Online, 2003). These relatively new media rapidly overtook slower and less flexible media. A similar growth is to be expected from instant messaging, which is taking the workplace by storm (Hu, 2003). The intensity of communication seems to become a goal in itself. Ideally, communication and rationalised work support and reinforce one another. Figure 1 illustrates this. In healthy work situations both activities are necessary. You need communication to understand and fine-tune activities, procedures, and work content. But the work tasks themselves, the actual production, is also important. Although quite evident, the relation between these themes is often overlooked.

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In this article we investigate whether work practices have gotten out of balance, and we propose some measures that could restore efficiency and effectiveness in off-balance situations.

This article is structured as follows.

In Section 2 we describe two perspectives on knowledge work. First, we briefly present a transaction-oriented approach to knowledge work. Put to the extreme, the knowledge worker should only be focussed on a single subject of expertise. We will discuss several reasons why an extreme focus on the business processes does not always work. Then we briefly present a communication-oriented view to knowledge work. Following this perspective community building and social capital play a central role. Put to the extreme, workers in a community work setting are in constant interaction with one another. The disadvantages of an extreme communication oriented approach are also discussed.

In Section 3 we present a study performed in a knowledge organisation into how workers actually deal with workplace collaboration and communication and how they keep a balance between the transaction and communication perspective.

In Section 4 we describe measures for keeping the personal and group objectives in balance. Primarily, measures are behavioural in nature: knowledge workers must learn to think in terms of mutual awareness. Additionally, there is room for technological support in and outside the office to help us communicate with care.

In the discussion, we look ahead and address the question of whether future technologies for awareness and productivity support will emphasise information sharing and translucence or whether “smarter” tools will gradually take over.

2 TWO PERSPECTIVES ON KNOWLEDGE WORK

Transaction perspective

In the transaction perspective proposed by e.g. Flores et al. (1988) knowledge work is about getting things done. Among economists, work specialisation was seen as an important factor to improve productivity. Division of labour leads to a higher efficiency, especially when the number of goods to be produced increases. Malone and Crowstone (1994) give an overview of the emerging field of study of coordination which is central in the transaction perspective. In their view, coordination is managing dependencies between activities. They predict that the information technology supporting coordination will change organisations and markets.

Ideally, rationalised labour organisation or scientific management (Taylor, 1911) leads to focussing uninterruptedly on a single part of work and finishing it before starting new tasks. Many office environments (e.g. CubeSmart, 2002) and workflow management systems are

based on that principle. The principle of division of labour, which enabled factories to produce efficiently, also applies to knowledge work to some extent demanding a clear focus.

Shortcomings of a pure transaction perspective

The course of history showed that a single-minded focus on transactions and business processes alone does not lead to productivity growth in the long run, as not all relevant work can be measured through simple productivity statistics (Brown, 1999). In the long run, industries will degrade to low wage enterprises if they only address focussed working. Focussing is important, but not sufficient. Industries must renew and improve their products or production methods to keep up profitability (Mytelka, 1998). Very often this involves multidisciplinary approaches which can only take off with less narrow focuses (Nonaka & Takeuchi, 1995).

Not every task can readily be rationalised

Examples of such mixed activities are in the jobs of small tradesmen, but also for knowledge workers, working for small companies or businesses not having specialised departments or specialists for many tasks. Doing-it-yourself is an essential part of all pioneering work and innovation work where there are no paved pathways yet (Diefenbruch *et al.*, 2000). Therefore, knowledge workers spend certain part of their time improvising and doing tasks that they have not been trained for.

Transaction Costs for Outsourcing are High

In affluent countries, the trend is that transaction costs increase steadily, e.g., as a result of overhead costs that will burden every labour hour. These overhead costs consist not only of labour costs for the incidentally/temporarily-employed worker but also

- the procedures to hire that person
- the costs in explaining the exact task
- controlling that the task has been completed as wanted

Only tasks that lie way beyond a knowledge worker's competence are more apt to outsourcing. As a result, many knowledge workers are professional multi-taskers (Cochrane & Lyons, 1996) lacking time to focus on core competencies.

Organisation sizes are often awkward

Many of the problems described occur in mid-sized organisations too large to hire specialists for every non-core task and yet too small to do these non-core tasks professionally. For example a large part of the work of project managers is spent controlling, thinking of workarounds and improvising, because production processes are not standardised and many tasks are being done for the first time (Leybourne, 2002). The same management of multiple details can be found among researchers or, for example, civil servants who try to realise innovations and have to work beyond the limits of normal practices.

Work is too much fragmented

Professionals with multiple tasks should pay special attention to tracking and tracing the progress of these separate tasks, for example by trying to finish them one after another or by keeping a minute administration so tasks can be suspended to be resumed at a later time. However studies of knowledge workers showed that they create rather chaotic biotopes with much work-in-progress lying around (Kidd, 1994) and use the mailbox as a workflow reminder (Venolia et al., 2001). A busy knowledge worker once expressed a desire for technological support to make appointments with oneself, a personal workflow management system. Current personal technologies usually enable knowledge workers to carry around entire calendars and email archives instead of really vital priority management.

Communication perspective

Another trend is to focus not on transactions and business but rather on communication. Following the logic of the communication perspective, many knowledge workplaces have recently been shaped as office gardens, open environments with glass or open doors supporting in their design that people meet one another on a frequent basis and increase the number of chance encounters (Becker & Sims, 2001). The underlying idea is that working is a group activity for the most part, with very few tasks being performed alone. Especially in innovative multidisciplinary teams, workers often have to perform fundamentally new tasks of which the procedures are unknown or incomplete in advance. Brown (1991) states that procedures in such organisations are seldom known by heart and are often overlooked. Yet they have a function, but as a framework to describe the demands to which the end product should conform rather than prescribing the work to accomplish this goal.

A characteristic of the communication perspective is to see modern knowledge workers as net-workers who need their fellow workers to realise parts of the work to be done. One owes to one colleague while building social capital with another. All in all, the work atmosphere in knowledge organisations will be pleasant when colleagues can remind each other of commitments and promises made, while understanding the overall task load of fellow workers and together forming a community of work (Helms Jorgensen & Warring, 2000).

Shortcomings of a pure communication perspective

It seems that knowledge workers are communicators a lot of the time. Even when communicative acts are reduced to simple e-mails, they consume a considerable part of an average workday (Venolia et al. 2001). Most knowledge workers appreciate electronic communication as being less time-consuming, allowing easy administration, and forcing no instant reaction. The mobile telephone is another example of a tool that has changed knowledge work. Both tools have been so widely adopted, that we may wonder whether current thresholds for communication have become too low. Communication about every bit of work introduces costly interruptions (Jackson *et al.*, 2001).

Low transaction costs leading to task and attention fragmentation.

As transaction cost theory predicts (initiated by Ronald Coase), easier communication tools enables more frequent and more fragmented communication. One effect of this may be that firms may disintegrate into smaller units (Malone & Crowstone, 1994), but for the individual knowledge worker, this may be alienating: communication becoming a hasty matter permeating through all processes. The moment an idea comes to one's mind it can be conveyed to whoever (s)he wants. From the initiator's perspective, it is useful to act instantaneously on any impulse and free the mind of wandering ideas and put them to action instead. But the receiver may have to pay the price of having to decode and understand (Grudin, 1988). More importantly, all this may be at the cost of deeper concentration on a single task (van Solingen *et al.*, 1998). Less may be more for many of these communicative acts.

Too many interruptions

In synchronous dyadic communication, both the sender and the receiver risk being distracted from their current tasks and thus lose concentration and focus. There is much evidence for this effect in the literature (see, e.g., CubeSmart, 2002; Cutrell *et al.*, 2000; Czerwinski *et al.*, 2000; Jackson *et al.*, 2001). Of course, an a-synchronous communication form can be used instead, allowing some time to pass before the receiver gives his reaction. However, knowledge workers "spoiled" by the instant gratification (Mischel, 1983; popularised by Daniel Goleman) of fast communication may not accept slow media in the long run. With the advent of email, snail mail has completely lost knowledge workers' favour and instant messaging may do the same to email.

For many users, the only way to avoid this media terror is to abstain from these media completely: to have their telephone off the hook or work at home.

Information neurosis: always in a hurry

It seems that knowledge workers are not just busy, but are in a constant hurry in many cases. From the sender's perspective, acting instantly on impulses may just be an easy recipe not to forget an idea or lose the motivation. E.g., Venolia *et al.* (2001) report that workers send e-mails as to-do reminders to themselves and others.

But haste and urgency is in the nature of the knowledge worker rather than in the nature of the job at hand. This was also confirmed responses to our questionnaires (next section) that some tasks must be performed under time pressure but most need not. It may lead to mistakes and impose risks by turning all links in a process chain into critical issues.

Loss of one's individuality: too little time for reflection

The main disadvantage of a constant rush in the workplace is that organisations lose their flexibility to take up new work. Of course full time-schedules force workers to use their time more economically than empty ones (Parkinson's principle). So although a deadline-driven work organisation may seem very efficient and productive superficially, in reality it is not. Too

much work refrains knowledge workers from critical reflection and being responsibly lazy now and then. The late Dutch economist, banker, and statesman Jelle Zijlstra talked about the necessity of “lazy reflection” in this respect¹. This seems a world apart from the yuppie-like fuss visible in knowledge work places, where workers are distracted by email, mobile phone and an overkill of project meetings.

3 EMPIRICAL STUDY: WORKPLACE MEDIA ATTITUDES

In order to understand how knowledge workers actually deal with work and communication, we had a group of knowledge workers from a midsized organisation (104 employees) fill in a questionnaire on media use and management of interruptions. Next, we performed some control measurements using activity logs and conducted a number of interviews to focus on specific details undetectable with logs and questionnaires. Our main questions were how knowledge workers would reach their colleagues, how they manage their interruptions and how intensively they used the respective communication media at hand.

Increasingly, knowledge workers are on the move, either because they wander between different work places around the office or because they spent large parts of their working time outside the office. Therefore we specifically addressed the issue of reaching colleagues when they are mobile and reaching colleagues when respondents were mobile themselves. Different locations may be different in quality as far as working and communication are concerned. Some places are ideal to retreat for concentrated activities, while other places are too crowded and too open to discuss work over the telephone.

Another trend that may influence work is the management of private activities and work related activities. For example, when working at home, a knowledge worker can be a parent at one moment and an author at another. Similarly, aspects of private life sometimes must be taken care of during office hours. These matters were specifically addressed in the interviews.

Methods

47 employees of the organisation investigated completed the questionnaire. This was a response rate of 44%. Given the length of the questionnaire (20 minutes) the response rate is reasonable. Additionally, responses were equally balanced over function categories. 8 employees participated in the interviews and 30 employees gave permission to have their email and telephone activities logged. The activities of a trial group of 15 Instant Messaging users were also logged.

Results

The workplace is the focus of most interaction. 90% of the respondents report a stable workweek with most time spent at the office. Thus, most work is done around the office and

¹“Real governing happens in rest and silence. Not when you have five heavy bags filled with files around you. (..) Ruling a country is a long-term matter, of reconciling group interests with the public interest. That requires lazy reflection. During holidays. Or in your bathtub. Or another visit to a concert.” Volkskrant (Dutch newspaper), February 1992

very frequently this involves communication and coordination with others. Only 19% of the respondents indicate that interruptions at work trouble them. For the other 81% interruptions are a natural part of work. Generally respondents are open to communication and interruptions. It is important to note that most respondents think interruptions are generally for non-important non-urgent matters. Only 22% report that they are interrupted for important reasons. In Figure 2. we see some of the strategies used to work without being disturbed.

----insert figure 2 about here

Although they are usually in the office, 70% of the respondents carry a mobile telephone, but 68% of them only use the mobile phone 0 to 5 times a week. While users may seldom use the mobile phone, they know how to operate its special functions and services. 50% of the reported mobile phone users use voice mail and SMS. Figures 3. through 5. show that calls are not always welcome, especially when the telephone is used most.

These statistics are quite different for the use of the desk phone. All respondents have a desk phone, but most special functions are hardly used. The phone-number shortcut buttons (used by 29%) and the “call back later” when encountering a busy line (20%) are used most. The telephone is typically used as an alternative for walking to fellow workers’ offices. Obviously there is little urge to learn more about the special function and possibilities of the desk telephone yet. We’ll come back to the role of telephony when discussing how our knowledge workers reach their colleagues.

----Insert figures 3, 4, 5 about here

All respondents use email as a communication medium. A majority receive 15-50 emails a day (47%) and send 6-15 emails a day (60%). Figure 6. gives an overview of the e-mail frequencies. In the logs we found quite a few email communication patterns that resembled “instant messaging”, with a rapid sequence of consecutive responses. Email is also used as a tactic to urgently reach fellow workers, when telephone or agenda information give no clue as to their availability. When asked about a working day without email, most respondents report that the flow of activities rapidly comes to a standstill. So email is really integrated in almost all activities, lightweight as well as serious activities. Many of our interviewees also indicate that e-mail is often a formal medium, allowing, e.g., archiving facilities for future reference.

----Insert figure 6 about here

Instant messaging (IM) had not been introduced as an organisation wide communication medium yet. Nevertheless, 15 respondents used instant messaging at work, 3 other respondents only used IM at home, and the majority of the respondents know what IM does and expect to use it some time in future. Current users mainly used IM for brief communication, Figure 7. Although the group under investigation was too small to expect network effects like the ones for email (“everyone has email, so email is always a valid medium to use”), the

patterns found are already remarkable. In Figure 8. the patterns of knowledge sharing communities and the hubs and spokes roles for individuals acting in multiple communities is already obvious. The question is not whether instant messaging will grow with more users, but how it will grow: governed by Metcalfe's Law (as a square of the number of users) or Brown's Law of Communities (exponential in the number of users).

---insert figure 7 & 8 about here

In the workplace investigated, the electronic agenda currently plays a central role in the coordination of tasks, especially in reachability management.

Almost all respondents reported that they place their meetings, project appointments, colloquia etc. in the electronic agenda. As a result this agenda is trustworthy as a source of information. It can be observed that the categories reported by the respondents were actually used in a sample measurement period of four weeks as is shown in Figure 9. In other words the presence-information provided by the electronic agenda is remarkably complete.

---insert figure 9 about here

The value of the electronic agenda is confirmed in another overview about the tactics used to reach colleagues. Figure 10 gives an overview of the relative popularity of methods to reach colleagues. We asked respondents to rank these different tactics. These individual results have been summarised here by assigning values 9, 8, 7 down to 1 for respectively the first, second etc. in rank. The scores in Figure 10 are totals of these associated values. The figure clearly shows that the fixed telephone is used most often to reach a colleague fast. 40% of the respondents put the telephone first in rank. Moreover many respondents chose to check the fellow worker's electronic agenda. 30% of the respondents first check the electronic agenda before trying to establish a contact. As a result, the agenda is the second most popular tool. The electronic agenda plays an important coordinating role in "availability management".

---insert figure 10 about here

The respondents' preference for using the fixed telephone indicates that knowledge workers need fast and easy solutions. On the other hand, the use of the electronic agenda rather indicates a need for accurate presence-information. These aspects of speed, simplicity and accuracy are all-important in presence technology and will be further discussed in the following section. Figure 10 also shows that presence-information from instant messaging-tools was not being used heavily yet among our respondents. This could be because 69% of the respondents did not use instant messaging-tools at the office, limiting the relevance of the medium as a uniform presence tool. After we introduced instant messaging into this organisation it was more broadly recognised as a presence awareness cue indeed rated 4th in rank (De Poot et al. 2003). Also, the accuracy of the electronic agenda information can be higher than presence tools with only limited categories, such as "busy", "online" and "offline". A combined use of calendar information in presence tools and presence information in calendar tools could therefore be very promising. See, e.g., De Poot, Kort & Langley (2004) for an assessment of these combined media.

After these questionnaires, 8 respondents were interviewed about details of their interruptability management. The strategies to get in touch with a colleague (i.e. to interrupt him/her) actually differ depending on the colleague, the time, and the initiator's location. Someone who is often on the move can expect a telephone call, that is, a less subtle treatment. On the other hand, email is used to involve superiors. Many interviewees expressed a remarkable sense for hierarchy given that the organisation was actually quite flat.

This sensitivity also became evident when considering the interruption management. Interruptions at meetings or in public transport are seen as inappropriate. Similarly, interviewees will not easily interrupt their colleagues during a meeting. As a result, they expect that meetings will only be interrupted for really important matters.

Many interviewees reserve moments in the agenda, e.g. for concentrated writing. These notes are an appointment with oneself and signal to others. An assertive attitude helps one to follow the agenda. For those who are less assertive, or who have a more fragile concentration, measures can be more drastic, such as hiding away from all interruptors, leaving out media. The interviews also shed new light on the nature of interruptions. People differ in nature. One interviewee needs to close the office door to concentrate, while another only feels interrupted when time management is in danger. Not simply the interrupting event, e.g. a ringing telephone or a new e-mail, determines the energy and attention required, but also the content. Receiving an unexpected and unwanted task is therefore far worse than just getting information or being asked questions that can be readily answered. Ideally, ad hoc communication is frequent but not disruptive to the point that one is distracted from the original work. In our interviews, we discovered a difference between nice and annoying work. Work that is not liked is most endangered by interruptions but the same goes for creative work. Working at home marks a very clear prioritisation. At home things can be given priority one at a time. Therefore being disturbed at work for private matters is seen as more annoying than being disturbed by work matters and the other way around. Their work life and private life have different value systems. At home and during private time, one is apt to react on private matters. At work one is at work. These rules of the game are important. Thus even though someone stays one and the same person, we must think very carefully about the roles and modes that someone is in. One is not always in the mood to be disturbed for certain matters.

If we compare this information with the literature on interruptions, we see an important distinction between activities that people like and do with ease. They can be easily rescheduled and are robust to many disturbances. Next these there are matters that are difficult, boring, or even annoying and for that reason an easy prey for disturbance and distraction.

Therefore it is too easy to assume that knowledge work is a constant top achievement in every respect. Many things are easily gathered and many things are easily decided when discussing matters with one another. But it is clear though that collective working or collective acting is only meaningful if both persons or parties are concentrated on the subject. It seems

not very productive to be less than 100% committed to a team meeting as is consistent with the responses of our interviewees.

Much communication and knowledge sharing is a matter of bits of knowledge and, ideally, a little effort put into helping a colleague usually leads to a positive effect. Similarly a question can be challenging and in that respect positive for the initiator and for the receiver. In these cases, communication can be very productive. On the other hand, for annoying matters a request for help can be like passing the buck to the other. In these cases communication is just a vehicle to alter responsibilities; one that demands the instant attention of the potential victim and may be time consuming. Closing oneself off from communication is therefore also a valid strategy for those who are easy victims for new tasks and new requests. The interviews taught us that knowledge workers do not necessarily think in terms of group work versus individual work, but rather in terms of nice tasks, boring tasks, annoying tasks, urgent tasks, common meetings, and around all that a whole lot of knowledge and experience exchange is seen as functional, non distractive. For creative work (such as writing or composing a lecture or document) the desire for noise-free environments was largest and we saw almost no blurring of the borders between work matters and private matters as they are different modes of behaviour by nature.

4 IDYLL: A GOOD MIX OF PRODUCTIVITY AND MUTUAL UNDERSTANDING AND COORDINATION

In some cases, knowledge workers need a new behavioural repertory supporting one another to work productively and delegate effectively, while keeping a balance between one's personal ambitions and the interests of fellow workers. Now this balance is often disturbed (Grudin, 1988). To achieve this balance, knowledge workers need to improve their perception, send out clear signals to one another and maybe have technological tools to help them.

Better perception: what will I be disturbing when involving someone else now?

How are we to understand each other's productivity? Any demand for help or advice should be reasonable given the workload involved and the moment of asking (timing). An improved mentality should guarantee that the productivity of fellow workers is not subordinated to one's own productivity and communication demands. Much could be improved if labour organisations are made aware of lost hours (CubeSmart, 2002). If a fellow worker's lost hours would directly influence one's own project budget the cost of a disturbing interruption would be quite evident (van Solingen et al., 1998). However productivity loss is difficult to measure: What would a person have realised if (s)he had not been interrupted during his/her work? Moreover not all activities fall in a budget category. Of course helping co-workers creates social capital, but the same social capital could be built when help would be demanded at a better timed moment.

Sending out the right signals: how many interruptions can you take now?

A remarkable finding is that knowledge workers often hide in places where they will not be interrupted, for example working at home. For some reason or another, explicitly refusing to help a fellow worker is less acceptable. The rule of conduct in many organisations is often to always help fellow workers when they ask you so. To prevent misuse by others, knowledge workers must be assertive enough. The best strategy is to be as clear and explicit as possible. One can put a red lamp at the door, leave the office door firmly closed, leave a telephone unanswered or even switch it off. These are just a few examples of clear signals to be given: At this moment interruptions are inappropriate and disturbing. E.g., CubeSmart (2002) propose solutions for cubicle users. Another possibility is to allow fellow workers access to one's electronic agenda so they can see the nature and importance of the activities one is being involved in. A category like time for lazy reflection is yet to be accepted among knowledge workers, although it could be very productive if they plan enough time free for reflection.

Sending signals to distant colleagues

A study of walking distances (Allen, 1977) made clear that office workers treat their colleagues at walking distances >30 m or 20 s much like they would treat workers at offices kilometres away. Walking past their office is generally not seen as an option, so media like telephone and email are used instead.

----insert figure 11 about here

The drawback of this mediated communication is that one does not perceive a fellow worker's activities or interruptability. Instead the chance is taken to try e.g. a telephone call. For fellow workers within walking distance one's bodily attitude and body language often clearly convey when an interruption is unwelcome. In Figure 11 we show the average walking distances for an institute we investigated. Note that average distances differ remarkably for different workers. Some are privileged while others are not in terms of physical reachability. These workers are harder to meet face-to-face and miss a great deal of the subtle interaction among fellow workers and will be treated more like external persons. Here technological improvements might be of help.

What technology can do: offer translucence and smartness

As mentioned before computers/technology can be an important help for knowledge workers to better coordinate their activities (Boyer *et al.*, 1998). Erickson & Kellogg (2000) propose to restore "social translucence" this way. This so called presence awareness has multiple connotations, ranging from the sense of being there, (IJsselsteijn & Riva, 2003) to one's ability and willingness to communicate (Montgomery & Copeland, 2001).

Technically, presence information is not more than a user state in the mediating system (Day *et al.*, 2000). The possibilities for technology are not just restricted to information sharing like agenda sharing, but they can also include forms of activity sharing: When a knowledge worker is typing, or in a telephone conversation, or reading his email, any of these activities

may be signalled to his fellow workers as a sign that he is at his office but currently busy. The interesting question is how to give meaning to a knowledge worker currently *not* interacting with any electronic medium. In both cases interpretations can be false of course, but the belief is that many such indications of activities help you form a picture of one another and give some idea of presence and availability. Another source of electronically conveyable information is the location of knowledge workers. In a meeting room one has different matters on one's mind than behind one's desk or when one is outside the organisation.

A very interesting approach has been followed in the NESSIE project (Prinz, 1999) where office workers could place their avatar at a virtual coffee corner to signal that they were in the mood for a chat and open for interruptions. The possibility to signal one's activities and interruptability are becoming more compelling now that computers are turning into personal media allowing one to have access to a fellow worker's presence information all the time. The underlying thought is that these personal media would allow knowledge workers to perceive and think in terms of one another's accessibility and availability as a second nature and likewise update one's own accessibility information whenever appropriate. Next to the existing desktop systems, two new developments are currently under way to convey personal availability information (Schmidt, 2002):

- Ambient telepresence (e.g. Gellersen & Beigl, 1999, Aarts & Marzano 2003) where changes in fellow worker's availability status are subtly translated in changing patterns, colours or sounds in a surrounding soundscape.
- Wearable (Currently at least two companies, viz. Wapag.com and Splendo.com offer websites to Dutch users to relay web-based chat to c-html for telephones, whereas other companies offer solutions for Pocket PCs and PDAs) where such status information is available in an always on, always at hand mode.

For the sake of developing new prototype systems for the latter category of wearable devices, we conducted this research to understand how knowledge workers communicate with one another and how they deal with interruptions, how they balance issues of work and private life and what they know, what they are used to and what they expect from new technologies.

Usability of such systems is currently under investigation. New research prototypes are being proposed that combine electronic agenda information and instant messaging capabilities. A better view of each other's availability is our primary main goal. We hope to gain a better understanding of one another's time management. The idea of these prototypes is to provide mobile workers with information which normally unavailable. In doing so, we may encounter the problem of what being online means when you carry an always on device with you. Therefore, location information and agenda information are considered essential ingredients for mobile presence applications.

5 CONCLUSION AND DISCUSSION

It is an interesting question whether new technology will enable knowledge workers to deal with the many new media in a “post neurotic” manner. Communication is of essential importance to realise knowledge work (Brown, 1991) but it needs to be balanced with the nature of the work itself, the nature of the communication act proposed and the interests of the communication initiator and the communication target. These are context data that have to find their way into new generations of computer supported cooperative work systems and new generations of communication systems.

- e-work systems have to become more communication enabled and communication systems must be more work-enabled.
- sufficient translucence and smartness must enable users to make subtle use of the ever increasing set of media.

The progress toward “instant communication” in MS Live Communication Server and services like MSN, Skype, and Nextel’s Push To Talk teaches us that “buddies” are willing to share all kinds of activity information to enhance presence awareness, from updates in blogs, Wikis, or intranets to photos, videos and the music that buddies are listening to. A lot can be learned from a number of pilots conducted in the Dutch Freeband research programme (www.freeband.nl) which also encompasses projects focussing on knowledge work, such as B4U. In these pilots, users test prototypes of new mobile computing applications. Next to white-collar worker pilots other domains are addressed such as health care, emergency services, and services for consumers and business users. These contexts differ in commitment and desired dependability. In health care, interruptions can be very pressing and interruption handling must be very professional. For consumer services, on the other hand, comparable interruptions will not work. There more subtle methods of customer approach must be tried. We do expect, however, that these different work contexts, white collar, health care, emergency services, and business and consumer services will also show common characteristics: all cases deal with people using more or less comparable (wearable) devices and switching between several roles during the day. As a next step in our investigation, we will try to extend our Instant messaging pilot toward larger user groups and to mobile users. In these cases issues of availability are of growing importance.

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REFERENCES

- Aarts, E.H. L. & Marzano, S. 2003, *The New everyday: views on ambient intelligence*. Rotterdam 010 Publishers
- Allen, T. J. (1977). *Managing the flow of technology*. Cambridge, MA, USA: MIT Press.
- Anderson, M. (2002). Measuring intangible value: The roi of knowledge management. from http://www1.astd.org/news_letter/November/Links/anderson.html
- Becker, F., & Sims, W. (2001). *Offices that work, balancing communication, flexibility and cost, international workplace studies program*: Cornell University.
- Boyer, D. G., Handel, M. J., & Herbsleb, J. (1998). Community presence awareness. *SIGGROUP Bulletin*, 19(3), 11-14.
- Brown, J. S. (1991). Research that reinvents the corporation. *Harvard Business Review*, January 01.
- Brown, J. S. (1999). Sustaining the ecology of knowledge leader to leader. 12.
- Cellular Online. (2003). Global, handset, base station, & regional cellular statistics. Retrieved 2003-05-05, from <http://www.cellular.co.za/stats/stats-main.htm>
- Cochrane, P., & Lyons, M. (1996). 21st century companies. In Foster & Jolly (Eds.), *Cbi corporate communications handbook*. London: Kogan Page.
- CubeSmart. (2002). Social interruption and the loss of productivity, cube smart inc (white paper). Retrieved 2003-02, from <http://www.cubedoor.com>
- Cutrell, E. B., Czerwinski, M., & Horvitz, E. (2000). *Effects of instant messaging interruptions on computing tasks*. Paper presented at the CHI 2000 conference on Human factors in computing systems, New York.
- Czerwinski, M., Cutrell, E., & Horvitz, E. (2000). *Instant messaging and interruption: Influence of task type on performance*. Paper presented at the OZCHI 2000, Dec. 4-8, Sydney, Australia.
- Day, M., Rosenberg, J., & Sugano, H. (2000). *A model for presence and instant messaging*: IETF Network Working Group Rfc 2778.
- De Poot, H.J.G., ter Hofte, J.H., Kijl, B. (2003) [Connecting knowledge workers on the move](#) In: R.M. Verburg and J.A. De Ridder (Eds.), Proceedings of the [C&T 2003](#) conference workshop [Knowledge Sharing Under Distributed Circumstances](#), ISBN 90-9017372-2, pp. 67-71, September 19-21, 2003, Amsterdam, The Netherlands.
- De Poot, H., Kort, J. & Langley, D.J. Enhancing presence and context awareness in collaborative settings. In: Cunningham, P. and M. (Eds) *eAdoption and the Knowledge Economy: Issues, Applications, Case Studies*, 2004 IOS Press Amsterdam, ISBN: 1-58603-470-7
- Diefenbruch, M., Hoffmann, M., Misch, A., & Schneider, H. (2000). Situated knowledge management – km on the borderline between chaos and rigidity. In Reimer (Ed.), *Proc. Of pakm 2000*. Basel, CH.
- Erickson, T. & Kellogg, W. (2000) Social Translucence: An Approach to Designing Systems that Mesh with Social Processes. TOCCHI Vol. 7 No. 1 March 2000, pp. 59-83.
- Flores, F., Graves, M., Hartfield, B., & Winograd, T. (1988). Computer systems and the design of organisational interaction. *ACM Transactions on Office Information Systems*, 6(2), 153-172.
- Gellersen, H.-W., . Beigl, M. (2000) Ambient Telepresence: Colleague Awareness in Smart Environments in: Nixon, P. Lacey, G., & Dobson S. (ed.), *Managing Interactions in Smart Environments*, Springer. Berlin. pp 80-88.
- Grudin, J. (1988). *Why cscw applications fail: Problems in the design and evaluation organisational interfaces*. Paper presented at the ACM Conf. on Computer-Supported Cooperative Work.

- Helms Jorgensen, C., & Warring, N. (2000). Workplace learning and learning environments, working paper 77, *Working Knowledge: Productive learning at work, 10-13 December 2000*. Sydney.
- Hu, J. (2003). Instant messaging, corporate software view for workplace. Cnet news.Com. Retrieved 2003-03-13
- IJsselsteijn, W., & Riva, G. (2003). Being there: The experience of presence in mediated environments. In G. Riva, F. Davide & W. A. IJsselsteijn (Eds.), *Being there: Concepts, effects and measurement of user presence in synthetic environments*. Amsterdam: Ios Press.
- Jackson, T., Dawson, R., & Wilson. (2001). The cost of email interruption. *Journal of Systems and Information Technology*, 5(1).
- Juran, J. M. (1951). *Quality control handbook*. New York: McGraw-Hill.
- Kaplan, R. S., & Norton, D. P. (1992). The balanced scorecard - measures that drive performance. *Harvard Business Review*, 70, 71-79.
- Kidd, A. (1994). *The marks are on the knowledge worker*. Paper presented at the ACM CHI'94, Boston.
- Lesser, E. L., & Storck, J. (2001). Communities of practice and organizational performance. *IBM Systems Journal*, 40(4).
- Leybourne, S. (2002). *The project management of change within uk financial services: What about improvisation?* Paper presented at the PMI Research Conference, Seattle.
- Malone, T. W., & Crowstone, K. (1994). The interdisciplinary study of coordination. *ACM Computing Surveys*, 26(1).
- McDermott, R. (2001). Measuring community value; presentation for the workshop on communities of practice. Retrieved 2001-12-06, from www.knowledgeboard.com
- Mischel, W. (1983). Delay of gratification as process and as person variable in development. In D. Magnusson & V. P. Allen (Eds.), *Human development: An interactional perspective*. New York: Academic Press.
- Montgomery, W. A., & Copeland, R. (2001). Internet network intelligence and presence enhanced communication ietf spirits working group memo november 2001. from www.watersprings.org/pub/id/draft-montgomery-copeland-presence-spirits-00.txt
- Mytelka, L. K. (1998). *Competition, innovation, and competitiveness, learning to innovate under conditions of dynamic industrial change*. Paper presented at the International Conference, The Economics of Industrial Structure and Innovation Dynamics, 16-17 October, Lisbon.
- Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company*. Oxford University Press.
- Prinz, W. NESSIE (1999): An Awareness Environment for Cooperative Settings. In: Proc. ECSCW '99, Copenhagen, Denmark. 391-410.
- Schmidt, K. (2002). Problem with 'awareness', introductory remarks on 'awareness in cscw'. *Computer Supported Cooperative Work*, 11, 285-298.
- Taylor, F. W. (1911). The principles of scientific management. from <http://www.socsci.mcmaster.ca/~econ/ugcm/3ll3/taylor/sciman>
- Upton, M. (2001). Knowledge capital: The 21st century leverage. from http://www.kmadvantage.com/km_overview_knowledge_capital.htm
- van Solingen, R., Berghout, E., & van Latum, F. (1998). Interrupts: Just a minute never is. *IEEE Software*(September/October).
- Venolia, G., Dabbish, L., Cadiz, J.J., & Gupta, A. (2001). Supporting Email Workflow. Technical Report MSR-TR-2001-88 Microsoft Research.
- Verwijs, C., & De Poot, H. J. G. (2002). *Communities, de kracht van het kennisdelen*: GigaPort Highlights, Telematica Instituut.
- Wenger, E. (1998). Communities of practice: Learning as a social system. System thinker. from http://news.com.com/2009-1033-992348.html?tag=fd_lede2_hed

Figures and tables

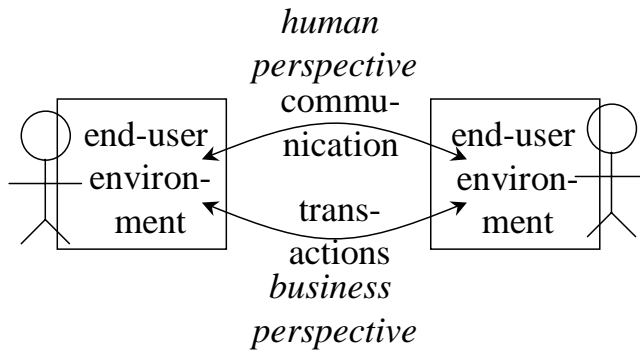


Figure 1. Business processes and communication reinforce one another

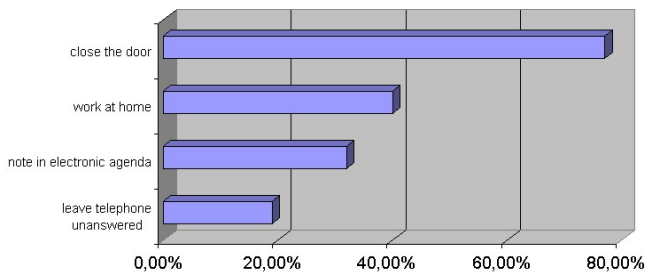
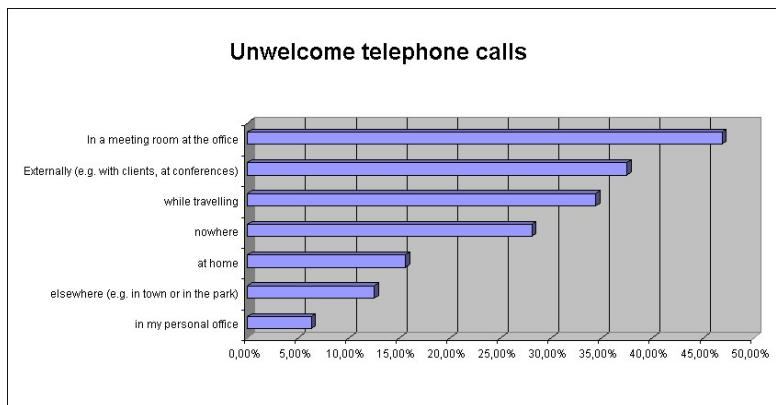
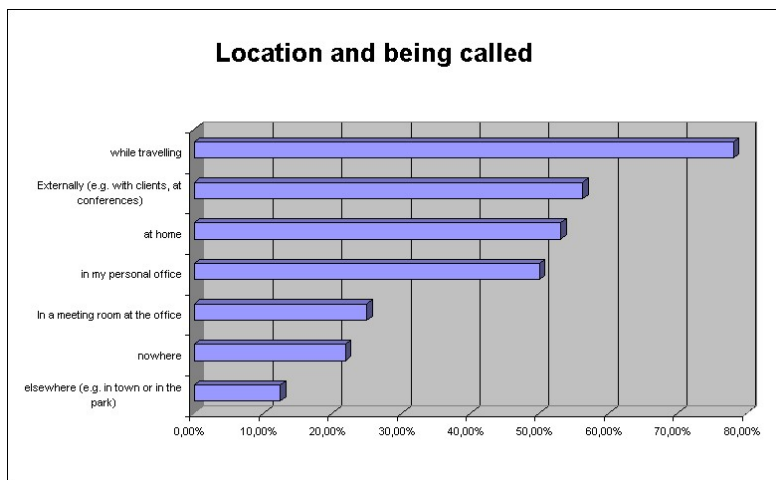
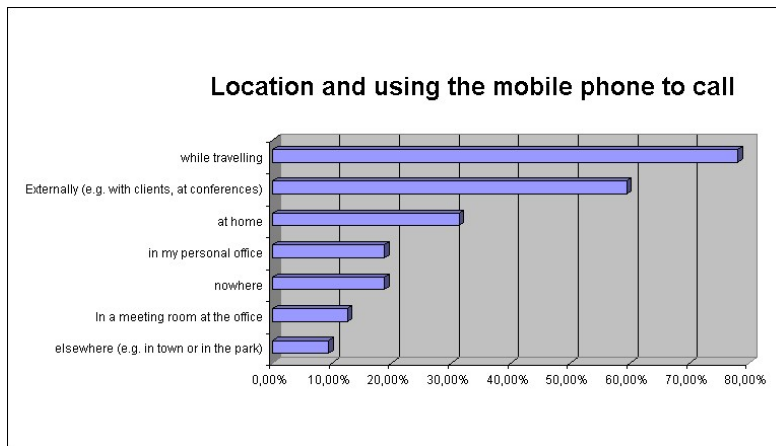


Figure 2. Strategies to work without being disturbed

How do knowledge workers cope with their everyday job?



Figures 3, 4 & 5. Locations where the mobile phone is used to call (3) and to be reached (4), and locations where the phone calls are unwelcome (5)

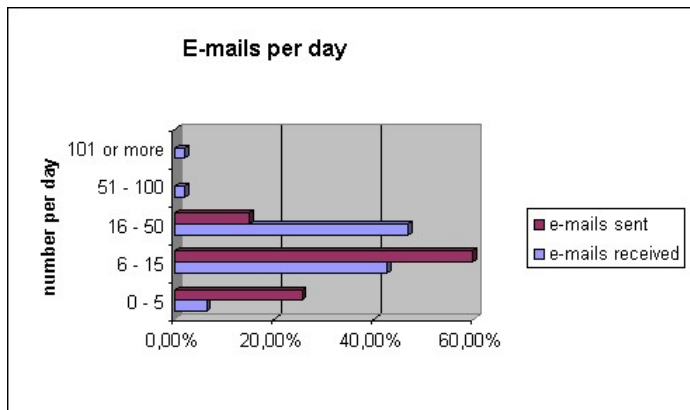


Figure 6. Emails sent and received per day

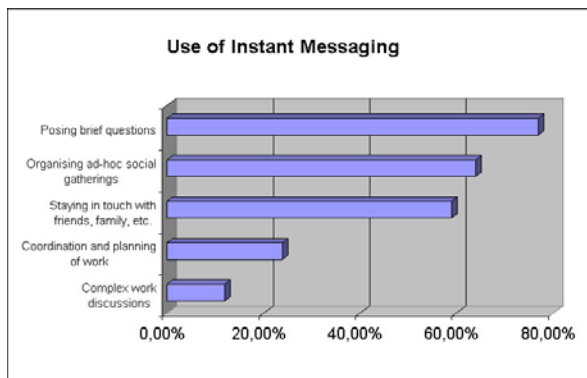


Figure 7. Activities performed using instant messaging

Social Network Analysis: view from IM conversations

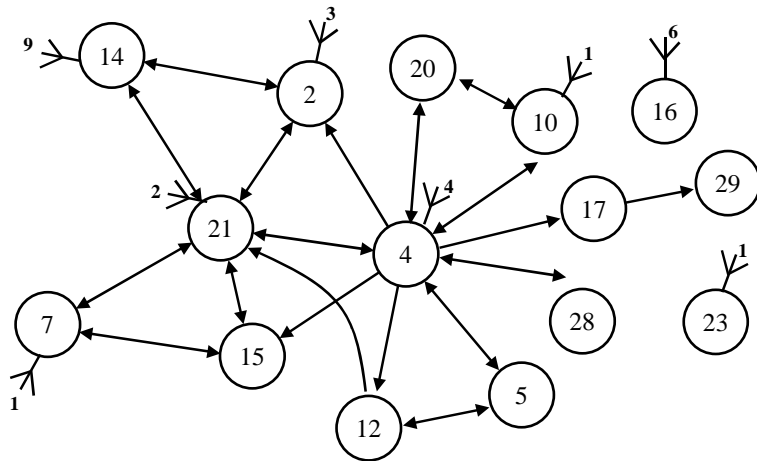


Figure 8. instant messaging creates communication networks

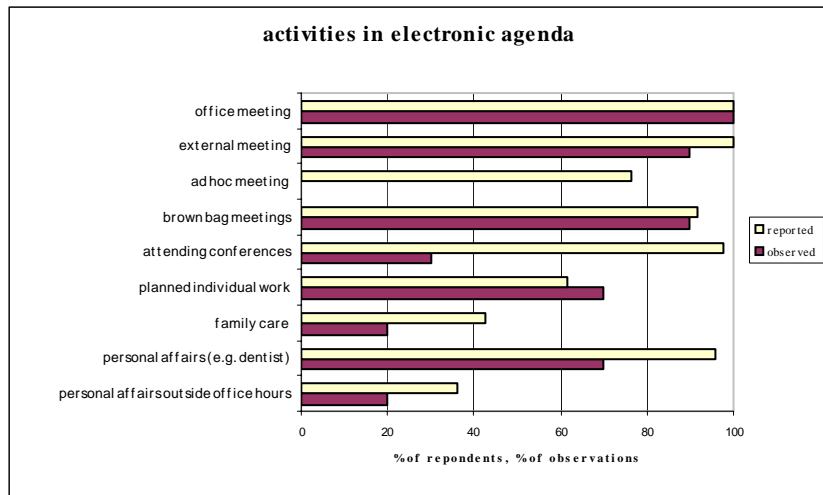


Figure 9. activities placed in the electronic agenda

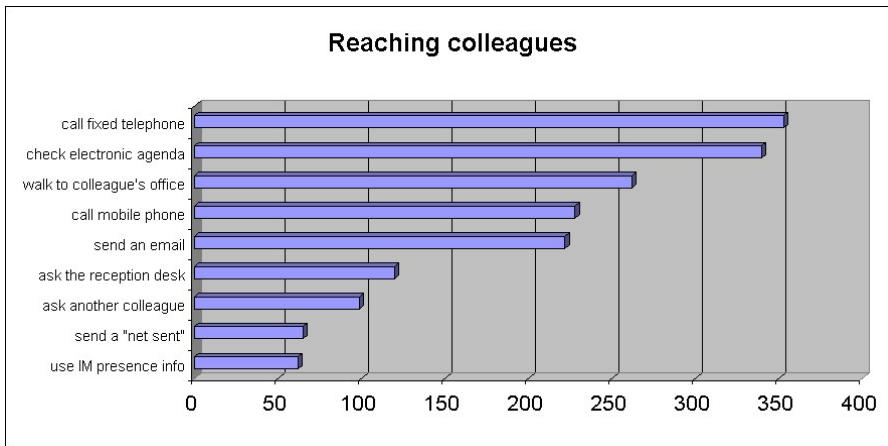


Figure 10. Strategies to reach a colleague

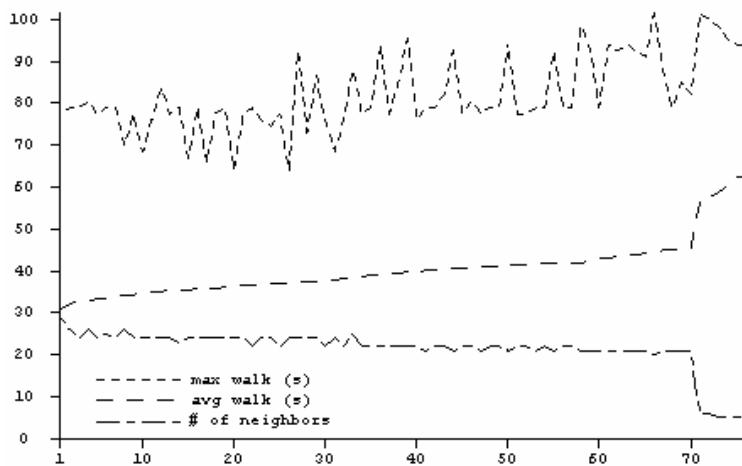


Figure 11. Offices in the investigated workplace ordered according to average walking distances and the number of nearby “neighbors” in the 20 s zone