How Do Mobile Knowledge Workers Communicate?

Full Research Paper

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Abstract

In recent years, the relevance of mobile working has been steadily increasing. New mobile devices (e.g. smartphones) and their innovative functionalities (e.g. mobile applications) enable ubiquitous access to a large amount of data. As a result, the increasing diffusion of smartphones and mobile applications offers new potentials for enterprises. Current mobile devices and related mobile networks have reached a high level of maturity. Therefore, organizational aspects of mobile work become a focal point of interest for enterprises as well as for academics. This research focuses on the communication and information needs of knowledge workers while being "on the road". In order to evaluate the communication behavior of mobile knowledge workers, the authors collected data of communication and information processes, which were initiated by IT-consultants. The results indicate that communication contexts play a major role for the selection of appropriate media channels.

Keywords

Media Synchronicity Theory, Mobile, Knowledge Worker, Communication, Profiles.

1 Introduction

The ubiquitous availability of information through mobile devices has led to the increasing independence of so-called knowledge workers from their stationary workplace. As a result, the latter has begun to lose its importance and a growing proportion of work-related activities takes place outside the office (Venezia and Allee 2007). Therefore, enterprise management can increase the productivity of employees by supporting mobile work. However, any corporate strategy in this area needs to consider technical (e.g. choice of devices and functions) as well as organizational aspects (e.g. integration of mobile applications within business processes). Moreover, and essentially, it has to be adapted to the communication and information needs of the employees.

One major driver for this development is the rapid diffusion of smartphones, which can be observed both in the private sector and in business contexts. In 2014 the worldwide number of smartphones exceeded one billion and market researchers forecast two billion in the next few years (Strategy Analytics 2012). Base on new technologies and improved broadband networks (Lattemann et al. 2009), the smartphone audience in the EU5 increased by 44% to 104 million subscribers, representing 44% of all mobile users. The USA saw an even greater increase by 55% to 98 million smartphone subscribers, representing nearly 42% of all US mobile users (ComScore 2012). In December 2014 182 million people in the U.S. owned a smartphone (ComScore 2015).

Additionally the emergence of so-called mobile apps in particular has yielded novel possibilities in the use of mobile phones that are also adaptable by companies. A study, carried out from the German net society, shows that 55% of consumers used a smartphone in 2014. Compared with 2013, the number of users increased by 11.2 million, which suggests a further diffusion of mobile applications (BITKOM 2014). The Mobile-Web-Watch-2011 survey developed by Accenture and based on questioning 4,000 people shows that 62% of the mobile apps downloaded are used for private purposes (Accenture Reports 2011). In this analysis the authors concentrate on 'mobile systems', which are understood as an interaction of technical hard- and software components and organizational measures that support or enable individual persons as well as groups to work independently of location. At present, there is little research about the influence of mobile systems on knowledge work (Picoto et al. 2010). Knowledge work denotes activities that require specific knowledge or skills or generate new knowledge and thereby create an added value (Ware and Grantham 2007).

In order to generate more detailed information about the needs of employees, we aim to analyse the mobile communication and information behaviour of employees within companies. For that purpose, an empirical explorative study was conducted, which included the evaluation of 228 communications acts of consultants. Each consultant completed data sheets in order to provide information about communication and information attempts. Overall, 15 mobile workers from the project-related IT service and consulting industry participated in the analysis.

The research objective of this explorative qualitative study was to: "obtain a general understanding of the nature of mobile knowledge worker". Hence we formulated the following research streams. (1) What are the information needs and purposes?, (2) What are the preferred communication channels?, and (3) How could the environmental situation of a mobile knowledge worker be described?

First, we provided an overview of the current literature regarding mobile working (Section 2). Subsequently, the theoretical background is presented from a communication-oriented view in Section 3. In Section 4 the method and the results of the empirical study are presented. The results are interpreted in Section 5. The article ends with a summary as well as an outlook for further research.

2 Literature Overview

Through a study on mobile phone usage data, Wajcam et al. (2008) found that the emergence of mobile information and communication technology has also caused an expansion of working time in private life. According to them, an increased use of mobile phones, on the one hand, requires more flexible and better coordination of employees, but, on the other hand, leads to the increased productivity of the company. This trend offers novel potential for enterprises to create business advantages, e.g. by savings on IT expenditure or through the increased efficiency and satisfaction of employees (Stieglitz and Brockmann 2012). Although employees usually have a broad range of communication channels at their disposal, mobile phones have become widely-used tools in business contexts (Wajcam et al. 2008).

Watson-Manheim (2007) and Liu (2010) discussed the employee's choice of communication media for specific working situations (Picoto et al. 2010). The first study shows that it is not sufficient only to consider the comprehensiveness of a certain type of media or the ambiguity of a task in the choice of the respective medium. Likewise, it is not enough merely to distinguish between electronic media and face-to-face communication. The results of the study imply that the choice of communication instruments by individuals depends on various factors, such as their experience of a certain instrument. Liu comes to the conclusion that laziness is the main reason for the use of mobile phones, followed by the economic, rational and shared knowledge added value. In this context, the design of functionalities of mobile phones is an essential factor (Cheikh-Ammar and Barki 2012).

This research concentrates on smartphones. In contrast to traditional mobile devices like laptop PCs, smartphones can be categorized as wearable computers (Cheikh-Ammar and Barki 2012). They differ in terms of frequency of usage, types of tasks and users' willingness to use their own device for work-related tasks (Amft and Lukowicz 2009). Venezia and Alee (2007) investigated the demographic, physiological, and activity-related properties of mobile workers. By means of a survey among 557 knowledge workers they showed that mobile workers do not present the common picture of a male, technophile and young employee but are mostly rather older, experienced and gender-neutral. As a further result they showed that a majority of the interviewees preferred location-independent work instead of regular office work.

Sixty per cent stated they were most productive at home. Only 25% said that the office is the best place for work-related activities. Others preferred places such as the customer's office, other offices and restaurants (Venezia and Alee 2007).

Also Yuan and Zheng (2009) analysed the activities of mobile workers. By surveying 179 workers, the authors found that the complexity of tasks of 'mobile knowledge workers' is high. Following them, the location has low impact on the core activity of 'mobile knowledge workers' (Yuan and Zheng 2009). Further, Perry et al. (2011) understand 'mobile knowledge workers' as workers who travel because of work and fulfil contextual tasks (Drucker 1999).

3 Theoretical Background

Our study refers to media choice theories as a theoretical background. One of the best-known media choice theories is the media richness theory (MRT). This theory claims that 'rich' information is appropriate for equivocal tasks, whereas 'less rich' information is suitable for uncertain tasks (Daft and Lengel 1986). Although MRT well defines media characteristics and has been experimentally validated by several studies (Daft et al. 1987), many scholars claim that recent developments in ICT merit a more deliberate redefinition to explain the efficacy of various media (Dennis et al., 2008). However, it has to be remarked that some studies have shown that MRT cannot fully explain media choices. Markus (1994), for example, argued that social pressures can influence media use much more strongly than richness, and in ways that are inconsistent with media richness theory's key tenets.

The media synchronicity theory (MST) considers the above-mentioned aspects (Daft and Lengel 1986), but proposes five characteristics of communication capabilities: (1) immediacy of feedback, (2) symbol variety, (3) parallelism, (4) rehearsability and (5) reprocessability.

In this context, 'immediacy of feedback' refers to the speed of transferring messages from the sender to the receiver. High transmission velocity enables continuous communication because it allows faster message transfer (Dennis and Valacich 1999). 'Parallelism' refers to the number of simultaneous communications available, and the 'width' of the medium. Parallelism could lower the shared focus and might have a negative impact on a medium's abilities to support synchronicity (Dennis and Valacich 1999). 'Symbol sets' means the number of ways in which information can be transferred or the multiplicity of cues and language variety (Dennis and Valacich 1999, Dennis et al., 2008). Symbols characterized by naturalness can be transmitted and processed efficiently and encode and decode faster than the other symbols (Kim and Zeelim-Hovav 1994; Kock 2004).

'Rehearsability' refers to the extent to which the media enable the sender to rehearse or fine-tune a message before transmitting it. 'Reprocessability' refers to the degree to which media enable a content to be re-examined or reprocessed during or after the communication event (Rice 1987). 'Rehearsability' and reprocessability may reduce synchronicity and damage the development of coordinated behaviour and shared focus (Dennis and Valacich 1999). However, both are important for transmitting new and complex information because they enable the sender and receiver to re-examine and carefully consider content and facilitate the improvement of understanding.

Finally, 'convenience' is a fundamental communication process regardless of the communication's objective. The outcome of this model represents communication performance and reinforces appropriate alignment of media capabilities and these two processes (Dennis and Valacich 1999; Kim and Zeelim-Hovav 1994).

In the light of these insights, we discuss how smartphones fit the presented media theories. A smartphone refers to a mobile phone that offers more advanced computing capabilities and connectivity than an ordinary mobile phone. It has to be remembered, however, that smartphones usually allow users to choose between different media. The authors can imagine e.g. (1) to make telephone calls, (2) use mobile apps, (3) send and receive SMS/MMS, (4) leave notifications (text, audio, video), (5) browse through the Internet, and (6) email communication. Ones can summarize that, smartphones are highly accessible, convenient and synchronous and provide relatively high richness depending on the chosen media channel. Therefore, smartphones offer rich communication compared with traditional phones and they are especially able to support the communication needs of mobile knowledge workers. Finally in our study

we define the term communication as the interaction between human and human and the interaction with human and IT-systems using smartphones.

4   Empirical Study

4.1   Research Design

It is a challenging task to gather data about the information and communication behaviour of people. One approach is to evaluate log files and by this means gain insights into the number and duration of communication activities.

However, for this study, such an approach was not suitable as many different communication channels (e.g. phone, web and applications) needed to be analysed. Furthermore, the respective environmental situations as well as the contents of the communication had to be considered. Moreover, interviewing or surveying workers ex post, we would face the problem that individuals can usually barely remember information and communication activities from the past and statements concerning the activities are often distorted by subjective perception.

Consequently, a research approach was chosen in which relevant perceptions and activities of the target audience could be documented directly when and where they occurred. Thereby, data sheets were used that enabled a direct capture of communication and information incidents of mobile knowledge workers for a period of two to three days. Each participant used a prepared notebook (paper sheets) for the evaluation period to note each mobile information exchange incident. Gathering data by analysing the communication sheets presented a difficulty. On the one hand, the data collected about the communication behaviour of mobile workers are supposed to be as exact as possible. On the other hand, the effort needed by the participants should be as low as possible so that the barriers to filling out the sheets would remain minimal as well. A comprehensive and complex communication sheet may deliver more precise information, but it also involves the risk of wrong usage by the participants, which could lead to a distortion of the results. Therefore, a compact and easy-to-use form was developed which only required six crosses. Specifically we asked for the following aspects: (1) Type of information flow (provide information / request information), (2) priority (moderate / medium / high), (3) device (smartphone / feature phone / tablet / laptop), (4) place and context (car / train / plane / walking / meeting / waiting / hotel / home-office / other), (5) communication partner (colleague / supervisor / back-office / customer / other external), (6) content (scheduling / subject-specific / billing / status reports / customer information / other), and (7) communication channel (call / text-message / e-mail / app / website / enterprise system / waiver of communication).

Prior to the study, the communication sheet was briefly explained to each participant via the telephone. Furthermore, after the completion of the survey, additional interviews lasting 15 to 30 minutes, were conducted with all participants to gather more information for a deeper analysis.

4.2   Data Sample

Fifteen mobile knowledge workers employed at nine different companies participated in the study. Consulting firms such as Accenture, Info AG and CSC, but also smaller industry-specific consulting companies from the field of public administration and energy industry, participated in this survey. The participants predominantly worked as consultants (free riders, 75% outside the office) in project-based businesses. They were 89% male; 11% female and in average 33 years old. The employment duration ranged from six months to 36 years, the average travel (activities outside the stationary workplace) ranged from 50% to 90% of work time.

All 15 consultants were provided with a notebook with communication sheets (40 data sheets for each) via email and were requested to fill out their paper sheet during their next business trip over a period of two to three days. They should fill it out, right after the communication act occurred. Overall, 228 completed communication sheets were submitted and analysed.

4.3   Results

4.3.1 Descriptive Results

The most frequently used device in all 228 evaluated sheets was the smartphone (59%), followed by the laptop (34%). The evaluation shows that paper (4.7%) and tablets (1.9%) were practically never used. The analysis of the 'communication channels' indicates that emails (35.4%) and calls (26.9%) are the most frequently used channels. In only 14% of all cases did the consultants fall back on intranet systems. The use of mobile apps (7.1%), the access to websites (5.2%) and the use of SMS (4.7%) played a subordinate role. The cancellation of a process (waiver of communication) was stated in 7.1% of all cases.

Moreover, the evaluation shows that 43.4% of the participating consultants attempted to request some kind of information, whereas approximately one-third (35.8%) wanted to share information with others. In 20.8% of all cases, information was saved for individual purposes only (notes).

The majority of all examined information and communication incidents were of an organizational (26.9%) or subject-specific (24.5%) nature. Scheduling (17.9%) and the exchange of personal information (13.7%) played a minor role, too. Status reports (7.1%), customer information (5.2%) and billing (3.8%), however, were negligible.

The attribute priority could be classified as low, medium or high. The priority of an information and communication incident was in 33 of all cases denoted as low (15.6%), in 128 sheets as medium (56.6%), and in 63 cases as high (27.8%).

The questionnaire shows that the most frequent information context is 'meeting' (29.2%). Some 18.9% of all information and communication incidents happened in trains and 12.3% in cars. More rarely mentioned were 'walking' (9%), 'waiting' (6.6%) and 'hotel' (5.7%). 'Others' was stated in 18.4% of cases. Notes made by the participants indicated that 'others' usually describes so-called third places like cafeterias, restaurants, coffee kitchens and office corridors.

4.3.2 Communication Profiles

According to media choice theories, the selection of different communication channels depends on the personal characteristics and preferences of media usage and the media repertoires of each consultant (Pitt et al. 2011; Carlson and Zmud 1999; Fulk et al. 1990). To structure the different observed communication patterns and to distinguish communication profiles, an explorative cluster analysis was realized. The data basis for the cluster analysis was the used communication channel of a certain communication act.

In a first step, the usages of each communication channel were measured for each consultant. These metric variables were divided into clusters by means of the agglomerative hierarchical cluster method, which, in each iteration, uses the average of all distances between the new clusters and the considered cluster. The clusters with minimal distance to each other were linked to a new cluster. The average linkage method was used as a compromise between the single linkage method, which is often used for chain clusters, and the complete linkage method, which is mostly used for small-sized clusters. The euclidic distance metric was used to calculate the distances between the clusters.

Using the cluster algorithm as described above, we identified four clusters of mobile knowledge workers which seems to have a similar communication behavior. We interpret for the first cluster, which consists of seven objects, that in this cluster the consultants use a wide variety of communication media. We name the cluster as the 'broad media repertoire users'. The second cluster consists of three knowledge worker. They often preferred to use the access to intranet systems as well as emails. As mentioned in Section 4.3.1, notebooks are mainly (12.7 %) used for access to intranet systems and, obviously, to write emails. We named the second identified cluster 'notebook users'. It can be assumed that people who belong to this cluster are more introverted; they prefer a non-verbal way to get access to the information they need. The third cluster, which also consists of three objects, has a strong focus on the use of the telephone. We suggests that the individuals in the cluster prefer to use the telephone for calls and, therefore, this cluster is called 'telephone users'. The last cluster comprises individuals who mostly like to communicate via email. This cluster is named 'email users'. The identified clusters and their characteristics are summarized in Table 1.

Cluster	Characteristics
Broad Media Repertoire Users	Balanced communication behaviour, high media competence, generally fewer communication acts, selective media choice.
Notebook Users	Often in meetings and office, prefer email and access to intranet systems, introvert characters.
Telephone Users	High movement, often in cars, low priority information, always on the move, extrovert characters.
Email Users	Less movement, higher use of smartphones than 'Notebook-Users', often in meetings and trains, prefer emails, high and moderate priority information.

Table 1. Characteristics of communication profiles

5 Discussion

The objects of the clusters were matched to the situation in which the communication act occurred. This allowed an inference to be made between the communication profile and the context. The number of communication acts of each participant within one cluster was presented. Afterwards, the comparative numbers of communication acts of each cluster in a specific context were calculated, and are shown in Table 2.

Cluster	Number of individuals	Car	Train	Walking	Meeting	Waiting	Hotel	Others
Broad Media Repertoire User	7.00	0.71	1.00	1.00	1.86	1.14	0.57	1.29
Notebook Users	3.00	1.67	1.67	1.00	9.33	0.33	0.00	6.67
Telephone User	3.00	5.67	0.00	0.67	3.67	0.33	1.33	2.33
Email User	2.00	2.50	5.00	4.00	8.50	2.00	2.00	2.50

Table 2. Identified clusters related to locations

The comparative numbers show how often an individual with a specific communication profile will communicate in a certain situation. Depending on the cluster, it is striking that the 'email user' and the 'notebook user' mainly communicate in meetings. It is intuitively understandable that 'notebook users' need fixed locations and more time at a certain place to use the notebook, such as, for instance, in meetings. In our interviews, we asked the consultants about other contexts in which they communicated. The respondents said that they often did so at a customer's office or at home. This validates the thesis that they need a fixed place to use a notebook and that they require long set-up times to start there devices. Therefore, they avoid communicating while walking or waiting. This is also observable in the cluster of the 'email users' because most of the emails are written on notebooks. However, the 'email users' communicate 33% of the time while walking and on trains. This indicates that this group uses smartphones for email communication more often than the other groups. The 'telephone users' mostly communicate in the car. Beyond that, the gathered data suggest that 'telephone users' generally prefer telephone calls in other situations as well. The cluster 'broad media repertoire users' is the largest one and relates to seven objects/individuals. In this cluster, we could not identify a distinct trend towards the use of a certain communication channel. In fact, this group, which consists of nearly half of the participants of the survey, uses all communication channels in a very balanced fashion (variance $s^2=1.00$). There are two reasons which explain this communication behaviour. The first reason is that the individuals have a high level of media competence. This means that they know which medium is the appropriate one in a given task in a specific context. Thus, they have a broad media repertoire, because they choose – from their

point of view – the most appropriate communication channel instead of their most preferred communication channel. The converse thesis is that the individuals in the other clusters have a low media competence. As far as the data set is concerned, this cannot be confirmed and is a subject for further research activities.

The second reason concerns the context. Comparing the data of the 'broad media repertoire users' with the context, it is striking that their communication frequency in a situation is balanced and ranges from $s^2=0.71$ (car) to $s^2=1.86$ (meeting) communication acts. This suggests that the consultants have a balanced travel profile and explains why the communication channel choice has fewer peaks. Another characteristic of this group is that that they communicate less in comparison with the whole sample. The seven individuals (46% of all individuals) of this group combine 53 communication acts. This makes up 23% of the overall communication and suggests a less intensive communication behaviour. The other variables that were part of the data set, like information flow, priority, duration and content, were deferred for further research. This was because the described cluster analysis in this paper follows an explorative approach, and because of the limitations of the data set, as mentioned in section 6.

The 'broad media users' have a high level of media competence and they choose their communication channel according to the context and the task they want to perform. This means, for example, that they choose a smartphone function with an immediacy of feedback for a high-priority urgent task, or if they are on the move, they will choose a smartphone function with high convenience.

	Immediacy of feedback	*Parallelism*	*Symbol Sets*	*Rehears-ability*	*Reprocess-ability*	*Synchronicity*	*Convenience*
Broad Media Repertoire Users	Depends on task and context (high, low, medium)	Depends on task and context (high, low, medium)	Depends on task and context (high, low, medium)	Depends on task and context (high, low, medium)	Depends on task and context (high, low, medium)	Depends on task and context (high, low, medium)	Ambition High
Notebook Users	Low	High	Low	High	High	Low	Medium
Telephone Users	High	Low	Medium	Low	Low	High	High
Email Users	Low	Low	Low	High	High	Low	Medium

Table 3. Communication profiles and discussion towards media synchronicity theory

The second group, the 'notebook users', seems to focus their communication to a high level of rehearsability, reprocessability and parallelism. Less important is the immediacy of feedback and synchronicity. In contrast to the 'notebook users', the 'telephone users' defiantly favour a high value of immediacy of feedback, synchronicity and convenience. Less important are, for example, rehearsability and reprocessability. The 'email users' prefer a high degree of rehearsability and reprocessability, and feedback, parallelism and symbol set are of less immediacy (see table 3). The authors are aware that the s^2 values might be confusing for qualitative research. The calculations are used to structure the results of the paper sheet based inquiry. However they were not validated or the reliability is not even tested. We merely used the results of the clustering as a foundation for our discussion to investigate further research directions.

6   Conclusion

Our study shows that mobile communication and information behaviour in the enterprise context are strongly affected by the increasing dissemination of smartphones and mobile applications. As a major contribution, the paper structures the communication behaviour of consultants. Our data provide a rich source of information on what is needed for a better support of the mobile workforce. Based on a cluster analysis and the characteristics of the MST, we identified four different types of 'communication profiles'. We are aware that this study is not without limitations: (1) our analysis is based on 228 incidents generated by 15 consultants in two or three days and can therefore not be generalized, (2) despite the

preliminary introduction of the survey to the participants via the telephone, the communication sheets could have been ambiguously interpreted by the consultants, and (3) the fields of activities of the participants are heterogeneous, so it is uncertain what influence this has on the results.

Even though some of these limitations have to be resolved in the next research steps, our current analysis has a theoretical impact by identifying and discussing communication profiles and by being one of the first approaches to refer to MST in the context of mobile working. We also contribute to the business context by discussing how the efficiency of mobile work can be improved by better support of knowledge workers in different situations.

Further research needs to conduct additional analysis: e.g. on the occurrence of information defects. Additionally, it is planned to enlarge the control sample with a more homogeneous group, for example, one company, and to gather more data like travel profiles or available technical equipment in a pre-questionnaire (Carlson and Zmud 1999). Our results are also a good starting-point for developing a requirement catalogue for the design of enterprise apps for mobile knowledge workers.

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