

Methods to Study Everyday Activities in a Mobile Work Context -- A Literature Overview

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Abstract. This article presents an overview of methods to study everyday activities in their contexts. We focused on contextual research methods used to study the daily life of workers, and a sub-group of mobile workers. The prevalence of the following methods was examined in literature: self-report recall surveys, time diaries, direct field observation, and experience sampling method (ESM). We identified only few articles where the methods were used to study working life. Adding the search term "mobile work" returned no hits. Based on this, we claim that there is a real need to apply the existing methods and to develop new methods to study mobile and multi-locational work in their contexts. The implication for future research is to point the need for filling the gaps between areas of daily research methods and studies of daily working life, and especially daily mobile work.

Keywords: mobile methods, mobile data collection, mobile and multi-locational work, daily life research, everyday activity research, bibliometric analysis, ecological momentary assessment, context-awareness.

1 Introduction

This article reviews the background of recently emerged research methods that enable contextual tracing of daily professional activities regarding mobile and multi-locational work. We will describe selected key methods, examine their current prevalence, and address their usual application areas. We have selected the following methods for examination: self-report recall surveys, time diaries, direct field observation, and experience sampling method (ESM). The research questions addressed are as follows:

1. To what extent are the targeted contextual research methods used to study the daily life of mobile workers?

2. How frequently and for what purposes are the methods used (assessed on the basis of paper count)?

We have come a long way from the situation we had only terms ‘telework’ and ‘remote work’ to describe all work arrangements done outside the main office [e.g., 1-2]. Even full nomadicity is possible due to modern technologies [3]. Knowledge workers operate often in many different locations, such as at home, main workplace, while travelling or commuting, in public places, and in customer’s or remote offices. However, the more varying the workplace and the more mobile the work are in nature, the more difficult and resource-intensive it is to study their work patterns and contexts. It has been said that the environment of a distributed workers provide a substantial support for pursuit of knowledge-intensive work [4], and that the workplace context is the key factor affecting performance and productivity of knowledge work [5]. Understanding the continuous change of workplace locations is important in the new work context of mobile and globally distributed work [6]. Vartiainen and Hyrkkänen [7] argue that more research is needed on the impact of multiple, often changing work locations on knowledge workers.

The advances in technology and mobile devices allow more automatic data collection and using contextually administered self-report questionnaires to trace professionals’ work and life. Manual questionnaires are still used, even with carried mobile devices, but it is increasingly common to rely on automatic collection of user data in its context. Methods of automatically collecting contextual data have been developed in the emerging field of context sensitive logging and mobile sensing. In this area, different kinds of tools have been used for data collection, such as carried cameras, mobile phones, tablets, diaries, and carried probe packages. Current developments in the social media applications have led to people sharing and logging their lives, and it has become quite normal for them to use mobile devices on the go for the task. Technologies like GPS and accelerometers, included in the development of the smart phones and their app stores have made life logging a more and more popular phenomenon. Many engineering conferences and journals have introduced and evaluated such devices. Two examples of these applications are the transportation method detection [8] and storing information about everything someone does or sees [9]. In spite of potential ethical problems concerning privacy, automatic data collection has many advantages. For example, the user activated collection of daily data causes considerable participant burdening. Although repeated collection of data regarding professional activities reduced retrospective biases of traditional questionnaires and interviews, self-reports are not as reliable as automatic tracing of activity in context. Users’ contributions may, in turn, be needed for interpreting meaning of automatically recorded data.

The most popular ways to study the activities of people in natural settings are self-report recall surveys, time diaries, direct field observation, and experience sampling [10]. These are the methods we study in this article. These methods can be used to capture features related to four types of work environments distinguished by Nonaka and his colleagues [11] namely physical, virtual, social, and mental spaces. Vartiainen and his colleagues have been investigating these spaces of professional activities in

the context of mobile and multi-locational work [12-13]. We will examine the prevalence and use purposes of these methods for studying knowledge-intensive professional activities in the next sections.

2 The Method Categories Under Study

2.1 Self-report Recall Surveys

Self-report recall surveys are research instruments with a series of questions to gather information filled by respondents. Self-report recall survey method deals with past events, and the questions are answered as the respondents remember it. They are quite widely used in organizational research for various purposes. They can be divided into six categories based on their purposes [14]:

1. Obtaining demographic or otherwise factual data;
Assessing the effectiveness of experimental manipulations that is comparing pre-and post-test responses;
2. Gathering personality data (traits, characteristics, need for achievement, etc.);
3. Obtaining descriptions of a respondent's past or characteristic behavior, and/or seeking for intentions of future behavior, or how would they act under certain hypothetical conditions;
4. Scaling the psychological states of respondents, and
5. Soliciting respondents' perceptions of an external environmental variable (formalization of organizational processes, climate).

This paper focuses on the category number 4 obtaining descriptions of a respondent's past or characteristic behavior using a survey that is when a respondent answers retrospectively to questions related to his working life.

There are some problems related to using self-reports for analyzing professional activities. Most knowledge workers pursue rapidly emerging and disappearing projects in inter-organizational border zones that involve distributed collaboration with heterogeneous participants. However, retrospective recollections and generalizations are not likely to provide reliable and valid accounts of actually enacted activities, as in most cases the answers cannot be validated by cross-referring, for example, other people. Such cross-reference could be argued to be only useful in the most obvious questions, such as how many days the respondent was absent [12]. Additionally, it has been reported that even the most minor changes in question wording can change the results [15]. There are some indications that retrospective accounts and contextual tracing of activities give a completely different view of even rather simple activities [16]. Yet, the repeated administration of self-report recall instruments enables examining changes and developmental trajectories.

2.2 Time Diaries

The term "Daily diary methods" refers to subjects recording daily events, feelings, and thoughts into a diary. This is one of the oldest methods to study daily life. Two

related uses of diaries when thinking of studying daily working life are the retention of private daily life experiences and the logging of professional incidents [17].

Another approach to diaries is self-record studies. Already in 1892, Hugo Münsterberg kept a diary over 9 months recording his own cognitive and affective states multiple times a day. He also included results of around 20 experimental tasks. An example of such task is measuring distances with fingers using a pocket-sized instrument. He had an interesting idea of using this instrument to evaluate a witness's true emotional state somehow calibrating self-report responses. Self-record studies have been used since to get a view into the experiences of subjects. [17].

Later applications of diary studies include econometrics and time budget research, some including data collected across nations [18]. In spite of considerable participant burdening, diary method appears to provide useful tools for documenting various aspects of mobile and multi-locational work. By restructuring desired diary entries, it can both reduce participant burdening and focus data collection to targeted aspects of professional activities. Mobile and multi-locational work takes places in multiple environments, making it difficult or expensive to observe or capture using recording devices. Because of this doing observations in diary form is an efficient way to record the features of the working life.

A Special Diary Method - The Day Reconstruction Method. The day reconstruction method [19] is a systematic way to reconstruct a person's day for research purposes. In this method, a separate private diary is given to participants of the study. They fill the diary describing a series of episodes throughout the day. The format of the diary is designed to help retrieval of events from memory, and the episodic format can help to overcome the common retrospective biases [20]. The researcher does not see the diary entries. This way a subject can use all the details she wants to make the episodes as accurate as possible. The actual data collection phase comes after this. From each episode a series of questions are presented. These include questions like: the beginning and end time of the sequence, nature of the participants' activity, his or her location, who she or he was interacting with, and a multi-dimensional questionnaire on their feelings. For methodological reasons not to include selection bias, it is emphasized that the respondents should complete the diary before knowing the next questions. The day reconstruction method has also been considered a suitable method for cross-cultural studies [21] and a viable new method for positive psychology studies [22]. The method offers a good tool to get more in-depth information when interviewing the mobile workers. They have many different episodes through their day, and using this method a more complete picture of their daily work is received.

2.3 Direct Field Observation

Observation methods and shadowing are options to capture behavioral events in natural settings or inside a lab. For example, a manager, a peer, a subordinate, a friend, or a researcher can make the observations. In shadowing [e.g., 23], a researcher accompanies a person throughout his or her day. Technical equipment, like

videotaping or audio recording, manual questionnaires, and notepads for notes can be used as assistance. Observation studies are used, for example, in anthropology, work sciences, sociology, primatology, and to a limited extent in psychology [24]. The value of naturalistic behavioral observations depends on the purpose of the study. When observational data has been intensively collected in psychology, it does not as such provide access to participants' interpretations and mental states [25]. In addition, the awareness of being observed may bias the participants' activities. Observing local professional activities is much more feasible than shadowing mobile workers whose professional activities are distributed across many places. To fill this gap, there is a call for developing methods for collecting momentary observation data across multiple contexts.

A Special Case of Field Observation - Ambulatory Assessment. Ambulatory assessment involves using behavioral and biosensors in mobile electronic or mechanical devices together with self-reports to measure experiences, physiological reactions, and behavior in people's daily life settings [26]. Such methods and instruments can be used to collect data and measure behavior and associated physiological processes in the everyday contexts of professional and other activities. This methodology has long roots; the origins of ambulatory assessment are in the portable electrocardiography (ECG) -monitoring device in the 1950s by Holter. The method was created for increasing ecological validity of investigations in terms of getting results that can be generalized to the actual or real life of people [27]. The ecological validity can be reached through ambulatory assessments by measuring repeatedly in natural situations that are randomly selected from across all possible or relevant situations. Wearable biosensors enhance ambulatory monitoring of the participants' physiological processes and unfolding patterns of their everyday motor activity. Toward that end, various biosensors are used, i.e., instruments that record cardiovascular activity (e.g., heart rate, blood pressure), physical activity, and the cortisol level across the participants' natural environment of activities [28]. Hodges's [29] study using pedometers to measure distances walked at workplace can be seen as the beginning of ambulatory assessments. There is a possibility of having technology instruments to signal the respondent to take blood pressure or other physiological measures to cross-validate self-reports and physiological measures. Such multi-method approach and triangulation allow investigators to cross-validate measures used by capitalizing on several independent streams of data. Beyond research data, such instruments make physiological processes visible to the participants themselves, and therefore motivate them to take part in corresponding investigations [26].

2.4 Experience Sampling

Psychological phenomena related to professional activities, such as work engagement [30] and "flow", are hard to study retrospectively. This is because concurrent socio-emotional states tend to color past experiences. Investigators interested in studying contextual variation regarding motivation, engagement, and stress have developed methods for repeatedly sampling experiences [31-32]. Experience sampling methods

involve repeated assessments of people's current experiences and behaviors in their natural environments without or only with minimal latency [18]. Conner and colleagues [33] define the shared characteristics as participants providing reports in their everyday lives right after being asked or following a particular event. There are three ways of sampling experiences:

1. Signal-contingent sampling, i.e., activation at fixed or random intervals by using signaling device;
2. Interval-contingent sampling, i.e., pre-scheduled sampling times;
3. Event-contingent sampling, i.e., participants activate sampling when encountering predefined event [34].

The duration of such studies may vary from days to months. These studies have recently been made of people's momentary positive and negative experiences.

Experience sampling studies have revealed that participants experience flow when they encounter highly challenging and interesting tasks in conjunction with feeling that they are competent enough to overcome obstacles and complete the tasks in question. Flow experiences are associated with the complexity of an activity and are, therefore, more often experienced at work than in any other life sphere.

Ecological momentary assessment (EMA) broadened the scope of contextual study of activities to recording various external events and actions, such as occurrence of targeted phenomenon, e.g., a phone call. There was a need for an instrument and methods that would enable valid sampling of experiences throughout the day instead of mere retrospective reporting. The original instrument of EMA consisted of an electronic pager (beeper) that sounded an alarm signal for the participant to fill in a paper form concerning the experiences at random intervals [31]. Since then also computerized methods of responding have emerged in terms of using personal digital assistants (PDAs) for collecting data on users' daily activities [see for reviews 16, 35-36]. Such instruments allowed transforming queries to digital formats, thereby improving participants' compliance as well as enabling digital data management. Currently, many investigators are using smart phones as an instrument of experience sampling [37-38]. Smart phones do not only have more functionality than PDAs but also support multi-modal sampling of experiences across text, picture, audio, and video. Moreover, many smart phones have a number of sensors, e.g., GPS for collecting location information, Bluetooth for tracing proximity of team members, and on-the body biosensors for documenting heart rate intervals, that can be used to collect information complementing self-reports. Kahneman et al. [19] considered experience sampling studies to represent the "golden standard" of contextual tracing of human activity.

3 Data and Methods

The present study uses citation index data as the basis for doing literature searches. The citation databases chosen for the purpose is the Web of Science Databases: Web of Science Core Collection that includes the Social Sciences Citation Index (SSCI).

The SSCI is a multidisciplinary index to the journal literature of the social sciences. It indexes over 1,950 journals from 50 social science disciplines and relevant items from over 3,300 of the world's leading scientific and technical journals¹.

The version of the database used also includes some conference proceedings. Many recently emerged journals related to computer-mediated and mobile aspects of human activity are not, however, acknowledged by ISI. Nevertheless, the ISI Web of Science provides a good tool to recognize the prevalence of the methods under research in this article, and if they are used in the studies of mobile work. The keywords were chosen to represent the targeted research methods reviewed above. We included articles that matched the keywords: "Ecological momentary assessment", "Experience sampling", "Ambulatory assessment", "Diary method", "Day reconstruction", "Diary studies", "Self-report recall", "Recall survey OR Recall questionnaire", "Field observation", and "Shadowing". To find the working life -related articles, an additional keyword "work" was used to limit down the number of articles. For mobile work we added to the basic search term a keyword "Mobile work". Then the title and abstract of each search result was read to make sure that the word "work" indeed was related to working life. Only a very minor part of the matching articles ended up dealing with work.

4 Findings

4.1 Self-report Recall Surveys

The search terms used to capture articles using self-report recall surveys were: "Self-report recall", "Recall survey OR Recall questionnaire". The search term "self-report recall" returned only seven hits in the database with none related to working life. The topics of the articles were physical activity, fitness, dietary questionnaire, and health. The study subjects were mainly school children. The low number of articles raises questions as more hits were expected to exist related to working life. Maybe the search term did not capture all the relevant articles? Another search was then conducted with the search term "Recall survey OR recall questionnaire". This search returned a higher number of 297 hits. But again, after reading the abstracts, only two articles were related to working life. Both of them were again related to dietary investigations. First of them studied the nutrient demands and energy expenditure of forest workers. The second one focused on the workload and work-time of women in developing countries, and their impact on health and nutritional status. The plain search terms "survey" and "questionnaire" return an enormous number of results, 1 097 678 hits and 756 898 hits, but they include many other type of studies than the self-recall method we are focused on. It is impossible to read all them through, so we have selected to do the search with the chosen search terms and focus on those results.

¹ http://images.webofknowledge.com/WOK48B5/help/WOK/h_database.html#sci

4.2 Time Diaries

To find time diary articles, two search terms were used: “Diary method” and “Diary studies”. Diary method returned 185 hits, and after reading abstracts 15 of them were related to working life. Diary studies returned 115 hits, and also 15 of them were related to working life. One of the work-related articles was shared between the two searches. The journals and the fields of science were quite variable from their fields. They included, for example, *Journal of Personnel Psychology*, *Human Relations*, *Journal of Personality*, *Information and Software Technology*, *American Journal of Industrial Medicine*, *Vocations and Learning*, and *Work and Stress*. The common theme in these articles is that they try to drill down to the daily activities of the people. Some of them use the method to get a better view what persons feel and think. Another reason to use methods is to reach the daily life in situations and places where observations of the subjects would be difficult, expensive or impossible. The research topics include ethical considerations of psychiatric staff members, work stress feelings and effects, time usage of academic staff, motivation of workers, fatigue feelings of seafarers, work engagement, and contact diary to analyze the spreading of diseases.

Day Reconstruction Method. The day reconstruction method is a special case of diary research. The search found 68 articles with search term “Day reconstruction”. 16 of them were confirmed to deal with working life. One of the articles was common with “diary method” search term. The journals were variable including *Journal of Happiness Studies*, *Economic Journal*, and *Journal of Organisational Behaviour*. The topics included work happiness, workaholism and recovery, sleep problems and heart rate variability, and social comparison processes in organizations. The research contents shared the themes with what was mentioned with the general time diary section.

4.3 Direct Field Observation

The search term “Field observation” returned 214 articles. Four of them are relevant for observing humans, but they were quite old (from the years 1961-1979), and they didn’t have abstract available. Two of them could be confirmed by title to deal with working life observing the work of teachers and nurses. The keyword “Shadowing” returned 155 results, with three relevant to working life studies. One of these described the method and experiences of using it from a Muslim hospital chaplain. Another did a study about urban principals. Third one analyzed working life activities for ergonomics study by observation. The journals were *Qualitative Ergonomics*, and *Urban education*.

The keyword was found most often related to medical students training, where they shadow senior doctors in their work. Other articles were about other type of work-related learning and facilitating understanding between groups at a workplace.

4.4 Ambulatory Assessment

With the search term “Ambulatory assessment” 217 articles were found. Reading the abstracts confirmed that 12 were related to studying working life. The journals were such as *Journal of Occupational Health Psychology*, *Stress and Health*, *European Psychologist*, *International Journal of Industrial Ergonomics*, and *Zeitschrift für Arbeits- und Organisationspsychologie*. The topics included spinal shrinkage during a day, sleep quality, stress levels, effects of physical activity on affective states during everyday life, work strain, and work and rest schedules.

4.5 Experience Sampling Method (aka. Ecological Momentary Assessment)

Experience sampling method has many names, so we used a couple of search terms to find relevant articles. The main search term “Experience sampling” returned 901 hits, with 113 relevant to working life studies. The term “Ecological momentary assessment” returned 728 articles, from which 16 were related to working life. The search term “Ecological momentary intervention” returned five articles, but none were directly linked with working life research. The term describes more a form of a therapy, such as a substance abuse.

In total, 62 journals had published work-related articles with a matching keyword “experience sampling”. The list of journals is too numerous to be completely published here. It includes many journals mentioned in the other methods as well, but in addition also *Academy of Management Journal*, *Human Relations*, *Journal of Management*, *Dance Research*, and *Journal of Organizational Behavior*. The contents included research on workload, energy and emotional reactions, burnout symptoms, work and family life, flow experience and the paradox of work, job satisfaction, stress, problem solving and well-being, and workday practices of school principals.

The publication forums of “ecological momentary assessment” show some variance in the list of journals, but the same themes can be found. The list includes journals such as *Journal of Advanced Nursing*, *Psychology and Health*, *Work and Stress*, *Organizational Research methods*, *Academic Medicine*, *Psychoneuroendocrinology*, and *Journal of Applied Psychology*. Topics included nurse tasks and work stress, worker tasks and emotions, emotional self-awareness, emotional labor processes, and work appraisal.

5 Discussion and Conclusions

We studied the prevalence of basic methods that are used in contextual studies of daily life. After describing each of them, we used database searches to find out their availability in literature. The data collected provide more information of previous than the current use of the contextual methods. Another angle of our study was to evaluate and discuss briefly how each of these methods is used to study working life, and especially mobile work. We did this by limiting the keyword search with additional keywords: work and mobile work. The articles found after these additional keywords were verified to be relevant by reading through the title and abstract of each search

result. After studying the found articles we can state that the additional keyword "work" narrowed down the number of the search results, and the additional keyword "mobile work" returned no hits. It was also necessary to read the abstracts to find articles related to work.

The findings indicate that there are only few workplace studies that capitalize on the emerging contextual research methods in spite of the fact that mobile and multi-locational work is becoming more and more common. There is an urgent need for mobile research methods and instruments in studying professional activities as the traditional methods have shortcomings and their results covers only narrow fields related to work. The traditional fields include work stress, work-family balance, studies of nurses, flow experience, and nutrient demands of health care workers. The reviewed studies did not include studies regarding highly mobile knowledge workers' well-being, social connections, or studies of varying physical locations. In the future, there is the need to fill gaps in these fields, and apply better the results from one field to other fields and apply them in mobile devices. Currently, technologies are improving so rapidly that researchers have hard times to keep up studying issues inside their own field, and not putting efforts into combining the fields. There is an increasing amount of literature on the technical capabilities of the smart devices concerning, for example, sensors. However, it is essential to develop instruments that allow more flexible tracing of contextual experiences, documenting them multi-modally, integrating self-report with automatic behavioral, physiological and contextual information for intelligently triggering self-report queries [37].

The implication of this study for future research is to point the need for filling the gaps between areas of daily research methods and studies of daily working life, and especially daily mobile work. The contextual research methods reviewed have to some extent been used to study daily work, but not mobile multi-locational work. However, socio-digital technologies have been rapidly transforming practices of knowledge-intensive professional activities making mobile and multi-locational work more and more feasible. The same technologies provide possibilities to develop methods and instruments to contextually trace professional activities wherever they happen. There are many possibilities that have not yet been adequately utilized. It appears to us that applying these digitalized methods for studying mobile work will provide new insights of various emerging aspects of distributed and mobile knowledge work.

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