Managing Mobile Work - Insights from European Practice

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Abstract: This article introduces the nature and practice of managing mobile work in Europe. On basis of empirical analysis of five selected case studies from a large European research project, a number of enablers and barriers for the successful introduction of mobile work initiatives are presented and discussed. So far, research in the area of mobile work is limited to a few, often singular, case studies and lacks a systematic assessment of current types, practices and applications. The authors aim to fill this gap by providing a structured assessment of cross-industry cases to distillate a number of critical success factors of mobile work in practice.

1. Introduction

The success of organizations depends to a large extent on the effort and performance of their workforce. Knowledgeable, productive, and flexible employees contribute significantly to firm competitiveness [1]. In order to achieve flexibility, many companies adopt ICTs that support mobility, context- and location-awareness, networking and ambient interfaces [2]. Mobile communication technology proves to be the most popular application with the most dynamic growth rates in the last decade. Better quality (e.g. mobile broadband connectivity and specialised mobile work solutions) and decreasing costs, paved the way for the emergence of the so called mobile (tele-)worker in the workforce of the European Union. The share of mobile (tele-)workers is already more than 6% in Finland and over 5,5% for Germany [3].

The introduction of new mobile work environments in practice, attracted the attention of scientific researchers from various research disciplines, such as information systems research (e.g. [4]), management research (e.g. [5]) as well as social theory (e.g. [6,7]) and architecture and design (e.g. [8]). So far, research on mobile work is in its early stages and definitions and concepts of mobility are still emerging. Early work has focused on the geographical or spatial mobility of workers [9,10], which is criticised for being a too narrow focus [11]. Andriessen and Vartiainen extended the concept of mobility to virtual mobility, which includes stationary actors moving "with the help of ICTs in a virtual working space" [12,13]. Kakihara and Sørensen postulate three interrelated aspects of worker mobility: location mobility concerned with the workers' extensive geographical movement, operational mobility in relation to flexible operation as an independent unit of business, and interaction mobility associated with their intense and fluid interaction with a wide range of people [4]. As such, aspects of collaboration can also widely change due to new qualities of ICT.

Our work focuses on the identification of enablers and barriers for successful implementation of mobile work in practice. We highlight aspects of location mobility and virtual collaboration. We define mobile work in case of work processes that are carried out independently from a fixed location and supported by ICT. Naturally, work processes

include collaborative as well as independent work activities. Furthermore, we distinctively analyse the changing work environment and the implications of change in terms of processes, organisation, human capital, technologies, implementation and performance.

Surprisingly little systematic assessments of the current practice of mobile work exists. With notable exceptions [e.g. 14], research of current practice reports primarily on singular cases [e.g. 15,16]. Our research addresses this gap and reports on the state of affairs in mobile work by analysing a set of case studies across different industries and application types. This article presents five selected cases from a large European project [17] and discusses the critical factors for the success of mobile work in practice.

2. Objectives

The objective is to provide a systematic and comparable overview of current mobile work practice. Enablers and barriers for the adoption of these new innovative work practices are discussed. The research takes on a user centric perspective, involving the organisational decision makers and users of mobile work applications.

3. Methodology

In-depth case studies were conducted. Whenever possible, we used triangulation to validate the interview outcomes by interviewing strategic level representatives, process owners and users. In order to compare the cases of researchers in the different countries an interview guideline was developed on basis of our work environment benchmarking framework .

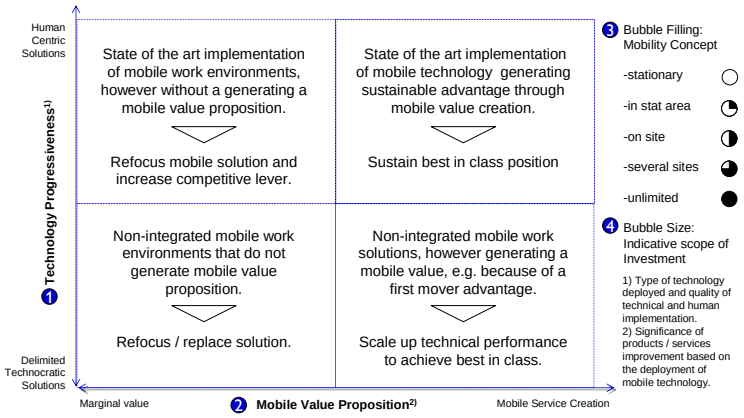


Figure 1: Technology Value Matrix

The benchmarking framework consists of eight dimensions: 1) technology progressiveness, 2) mobile value proposition, 3) mobility concept, 4) size, 5) social impacts, 6) change efforts in implementation process, 7) enablers / barriers, 8) near term developments. Each dimension was defined in detail and broken down to specific sets of questions for the personal interviews. Dimensions 1 to 4 were used for the comparative analysis of the cases. The dimensions were further defined in specified criteria sets and rated on a 5-point Likert scale. Dimensions 5 to 8 helped the authors to identify issues related to the success of mobile work environments. A "technology-value-matrix" was used to visualise dimension 1 to 4 of the comparative analysis. Four specific sectors of the matrix have been defined and a set of characteristic and implications per sector is used to categorise the cases (refer to Fig. 1).

4. Case Analysis

The case studies range from small to medium enterprises to large corporations from different industries and include private as well as public organisations. The cases stem from

various countries in Europe and deal with a variety of mobile work applications. This article features selected cases, dealing with mobile sales force, mobile emergence response applications and mobile patient data. For extended documentation of cases please refer to [18]. Table 1 provides an overview of the cases.

Company Background	Revenue '04 / Employees	Mobile Application	Motivation Focus	Specific Benefits
Hero AG (CH) International company for packaged food, focusing on branded retail business and selected b2b markets.	Worldwide revenue: ca. 1 bn.€ 3971 employees	Mobile Sales Force	Improve process efficiency – replacing paper based sales and order process.	• Stabilised revenue • Central marketing planning and controlling • Advanced appearance in front of the client • Take over sales actions from other manufacture
Customs Agency (NL) National customs authority for control of goods import and export.	5500 employees	Mobile Field Force	Central planning to improve field force utilisation and decrease waiting & travelling times.	• Improved control of and more efficient work processes • More flexible assignment of controls to distributed teams. • Reduced disturbance for the client's logistics • Improved employee motivation.
Nuon (NL) Nuon is a national distributor of gas and electricity in NL.	Worldwide revenue: 4,9bn. € / 9638 employees	Mobile Emergency Response Team	Reduce response times to comply with regulation without reducing employee safety.	• Higher efficiency and quality of power grid maintenance, maximizing safety in solving power failures and increasing customer satisfaction • Centralization of failure-registration and solving time to build problem history • Improvement of response times to increase network quality
Emergency Medical Service (CH) Organisation for emergency medical and patient transport.	70 employees	Mobile Emergency Response Team	Comply with regulation regarding documentation and response time.	• Better compliance to regulatory requirements. • Positive image effects
Frimley Park Hospital (UK) National Health Service Trust hospital serving Surrey area in southeast of UK.	Revenue: ca. 140 Mio. € 2500 employees	Mobile Patient Data	Comply with regulation for electronic patient data and reduce patient care cost.	• Indirect collateral benefits better bed usage, patient release 5h • Process cost decrease and time savings • Comply with the stringent government requirements for reporting • Motivated workforce

Table 1: Case Study Overview

4.1 – Hero Food Vendor

Hero focuses on branded retail business and selected b2b markets for packaged food. Its major products include fruit-marmalade, fruit-juices, fruit-bars and baby food. The company generates revenues of ~1 bn. €. In Switzerland the company employs 270 people.

The mobile sales force (MSF) solution is based on SAP "mobile sales" and tablet PCs. It is a so called "offline MSF solution" – requiring wired synchronization via DSL. It has no permanent online connectivity. In total 27 sales representatives are supported in Switzerland. They serve restaurants, specialist retail sales points, totalling to 40.000 Switzerland. Each sales representative covers between 600 and 1.200 customers in a dedicated region. The employee works from home, in the car and at the client site. A presence in the company's office is not required.

The company makes use of standard technologies that are combined into a working solution. However, certain shortcomings can be recognised; e.g. a lack of integration with company wide software environment, a dynamic upgrade of the electronic product catalogue according to customer profile and new marketing campaigns. The software solution is also not easily scalable to an international level, since it has been adapted to the specific Swiss sales organisation. Both facts limit the generation of scale effects.

The benefits of the solution include a more advanced appearance of the sales people in front of the client. The improved customer records allow for central marketing planning and controlling compare to the former situation where most of the customer knowledge used to be stored in the heads of the sales men. As a result, sales representatives can be better controlled and rewarded. The company does not realize more customer contacts per person because daily updates of customer base data compensate time gains from faster customer information access. However, the customer contacts can be planned better with improved targeted product and cross selling offering.

The improved sales process allowed the company to acquire sales activities from other companies in the same market. An integration of the external sales data was only possible due to the use of the digital sales and marketing database.

In summary this case shows a mobile work environment that enables the company to gain revenue by the acquisition of customers business. As such, it is one example for a

strategic benefit, compared to the other cases, that resemble mere operational efficiency gains. Accordingly, the case scores high on the mobile value axis (see Fig. 2). The technology progressiveness however, yields below average scores since it not based on current soft- and hardware versions and lacks full system integration.

4.2 – Customs Agency

This case study concerns the external control of trade goods. In 2004 an experiment was performed with a few custom controllers in each of the four geographical sectors of the Customs Agency in the area of Rotterdam, The Netherlands. The controller's task is to perform customs related controls at premises of clients, on roadside trucks, at Rotterdam harbour or Schiphol Airport.

At present, controllers come each day to the office where they get assignments on paper, which they execute that day. Completed forms are brought back to the office after the controls. In future, the allocation of assignments is delivered via GPRS to PDA's or labtops; during control digital forms are filled in and central databases may be consulted on-line, filled-in forms are returned electronically.

The purpose of the experiment was to develop a more automated and streamlined work processes and to test the use of certain devices (labtops, smartphones, tablet PCs) for the controllers. The work process implies that assignments are generated by planners and send to central control rooms. In the control rooms the assignments are allocated to the controllers. Their tasks are differentiated according to planned and ad hoc assignments, known and unknown clients. Controllers may be specialized in certain areas such as strategic goods, weapons, drugs or textiles. The customs agency relied on proven technology for the mobile work solution. Standard internet connectivity and access gateways where used in the case. The organisation tested different end-devices as personal equipment for the controllers to be used in different physical environments.

Relying on proven technology resulted in limited technical problems and moderate need for employee up-skilling. However, the experiment identified some technical issues in the area of data transfer speed, battery duration, and certain ergonomic conditions, e.g. use of the tools in rough environments like freeze-cabins. The mobile work solution allows for better control of and more efficiency in work processes by immediate remote data exchange. The solution also allows for higher flexibility of task assignment and execution, and a higher probability of discovering frauds. As a result, goods can be cleared much faster for the client with fewer disturbances of client logistics.

In summary, the new work solution increased employee motivation and is expected to improve the outside image of the agency. Profit and loss implications have not been part of the experiment. We rate the overall value impact fairly high, since the set up of a running solution, and the reduction of the administrative work generates a well-perceived motivation- and image-impulse for the agency. The technology progressiveness can be characterised as below average since it is based on proven applications and has improvement potential regarding personalisation or localisation and systems integration.

4.3 – Nuon

Nuon is a national distributor of gas and electricity in The Netherlands, generating 4.9 bn. € in 2004. The company employs 9,638 people. This case study involves the unit Disturbances and Maintenance (343 employees). This is a special case in the area of mobile working as the unit responds to (unplanned) emergencies to more than 65%.

Currently, the response team of maintenance employees start their work at the office. From the office they go out to their various assignments of their team of usually 14-20 people. Support is possible by means of telephone contact with a central helpdesk for

municipal information on power cables. The helpdesk is also consulted for arranging the responsibilities when solving e.g. a power failure and to make optimal use of individual expertises. The introduction of the new mobility work concept enables members of the response team to start their work from their own home. The distribution and allocation of the various assignments is done through a smart allocation system. The new system takes various aspects into account, such as the skill and clearance levels of the employee, location specific information, etc. Employees may choose to use either a PDA with less functionality or a more advanced Tablet-PC with GPS and GPRS (later on UMTS) for the more advanced and critical assignments. Through these devices the field service employees can check for power grid layouts or installation schemes themselves. On basis of GPS information the device enables field service engineer to locate the right power switch in public areas. When the switch is located the device enables a direct link to the right scheme for the switch in the database. This functionality reduces the risk of accidents due to possible failures of the field service employees.

Nuon uses a special custom made application since adjusting an of-the-shelve software package would take more effort to fit in the organizational back office applications, and would incur higher cost. A connection is planned to be made to the Web-GIS, providing actual location-based information on power lines and other underground infrastructure. Web-GIS has been set up as a portal application that encompasses all the other Nuon Information Databases (e.g. repair schemes).

For Nuon the mobility concept is vital for maintaining their service levels to their customers. As response times to power outages are regulated by European Law, mobile solutions are necessary to obtain these target response time. The following three reasons for the introduction of mobile work at Nuon were stated:

- Increasing safety of employees when solving power failures
- Centralization of failure-registration and solving time in order to build problem history
- Improvement of response times to increase network quality

The rating in terms of technology progressiveness and mobile value proposition in Fig. 2 is above average, resembling Nuon's substantial investment in custom-built but thoroughly integrated mobile field force solution.

4.4 – Emergency Medical Service

The Emergency Medical Service (EMS) is an organisation of 70 employees focusing on emergency and patient transports. The service area comprises the city and agglomeration of Basel - a 40 km^2 service area with 250.000 inhabitants in the north of Switzerland. The organisation operates 11 rescue cars and handles about. 20.000 incidents per year, of which 50% are emergency cases.

The mobile work solution includes a digital dispatch station in the control centre (3 seats) and a mobile fleet management application. The control centre records incidents and assigns jobs to the rescue teams in the vans. The mobile data transport is done via GPRS to the vans. A mobile order confirmation back-reports the status of the rescue process.

The entire solution consists of four main parts: the on board unit, the network and server infrastructure and the dispatch centre work station. The on board unit in the car consists of a touch screen, an easy login and user identification with a personal batch of the team leader, a printer, the GPS system and the GPRS radio. The GPRS network covers the entire service area. In the control room, the organisation operates three fully equipped dispatch terminals.

The dispatch and fleet management solution has improved the operation of the EMS at reasonable operational expenses. The OPEX is less than 10 € cents per incident. At the same time the information availability in the car improved (incident description, location and routing information). This goes together with higher speed and accuracy, the data

exchange between mobile ambulance man and dispatcher happens almost in real time. The system-response-time is below two seconds.

Further, the organisation better complies with regulatory requirements (e.g. incident documentation, response times, etc.). For ex-post case analysis, the system makes detailed statistics available in central office (e.g. performance controlling).

Bottom line, however, accounting for the investment in hardware and technology the new process resulted in a zero sum game. Furthermore, as an early technology adopter the implementation process became longer than planned. The EMS case rates below average on both axis in Figure 2.

4.5 – Frimley Park Hospital

This case study was conducted at the National Health Service Trust hospital serving the Surrey area in southeast of the UK. The hospital treats 75,000 patients per year, manages 700-beds, employs a staff of around 2,500 and generates an annual turnover of almost 150 million €.

The Frimley Park Hospital introduced a mobile online access to patient data for medical staff whilst working in the hospital premises. The solution is available for both doctors and nursing staff. In total some 60 devices located at nurses station are used as required by approximately 200 doctors and nurses. WLAN technology is used as access bearer. The system has been tested in a series of pilot trials carried out in August 2004. At present, the system is up and running and widely used in 12 wards.

The hospital is characterised as an early adopter of the mobile work solution in the health industry. The main motivators lay in a need to increase quality and cost of the X-ray procedures and the need to comply with government regulations. Because the resolution of the digital image is now high enough to ensure quality of the X-ray diagnosis and cost effective it was decided to upgrade the X-ray procedure. Changing the process provided an opportunity to look at new technology to deliver a better IT service to both the medical staff and to the patient. The second driver for change was the upcoming requirement for web based NHS Care Records Service to be harmonised across the UK and accessible from anywhere.

The mobile data access solution was well adopted by medicals staff, resulting in a number of benefits:

- Indirect collateral benefits - better bed usage, patient release five hours earlier
- Time saved in accessing data and information per treatment
- Comply with the stringent government requirements for reporting
- Motivated workforce – seen that they are provided with top quality IT and that it works
- The mobile technology costs were offset by update to Digital X-ray process.

Due to the technological advance and the cost benefit generated by the case, we rank it clearly above average on both dimensions in Fig. 2.

5. Results - Status Quo of Mobile Work

Figure 2 depicts the assessment of the cases along their technology progressiveness and their mobile value proposition. The individual ratings have been discussed in the section 4. For further illustration, we highlight and explain the extreme-ratings along each dimension.

All but the hospital and the Hero case allow for global mobility of the work force, since they are based on GPRS connectivity. The medicines in hospital are restricted to in-house areas, that are covered with WLAN and Hero sales men need to synchronise their data by use of a fix-net broadband access, which is in most cases done in their home offices. The investments in the mobile work environment range from below 50.000 € in the pilot at the customs agency to over 500.000 € at Nuon and Hero.

Regarding technology progressiveness, Nuon ranges higher then the other cases, since the soft- and hardware solution have been selected and customised to Nuon's specific requirements, determined mainly by the existing software line-up. The customs agency copied a proven mobile field force system from another company and set it up as an island solution, i.e. without integration with existing back-office applications or database.

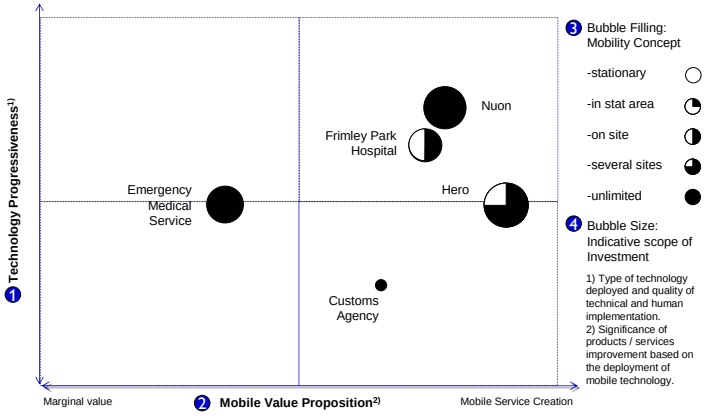


Figure 2: Case Assessment in the Technology Value Matrix

In terms of value generation, the Hero case ranges highest since the mobile sales application enabled the company not only to introduce a sophisticated central marketing and sales planning, which helped them to stabilise revenues in a decreasing market but also acquire additional sales activities from another company in the market. In contrast, the rating of the mobile response solution at the emergency service is lowest in our assessment. The following sub-chapters will elaborate on the two main dimensions of the assessment.

5.1 – Technology

Mobile technology turns out to be generally used to further improve the automation of work processes. Developments in mobile work are part of a steady move towards further automation – however, technology is far from being well implemented.

Most of the illustrated mobile work environments provide further potential for integration with adjacent systems. This is caused by a lack of holistic planning for business processes or by a lack of technical functionalities. The lack of technical functionalities appears in early adopter cases, where the compatibility to adjacent software systems could not be achieved as planned. This notion is confirmed by market research, where "integration complexity with linked ERP, email, legacy applications, [and challenges of] business process re-engineering" are ranked as second most important restraint for mobile sales force applications [19].

In terms of human interface design none of cases utilised advanced hard- or software for mobile working. Regarding connectivity, companies do use GPRS and to a certain extend UMTS connectivity. However, some of the organisations prefer to connect via faster and more cost efficient solutions, such as WLAN or fixed broadband connectivity. Finally, contextualisation, which is one of the long discussed features and advantages of mobile technology [20] is rarely used in current practice of mobile work.

5.2 – Mobile Value

Today's mobile work environments do create value. However, most value is created within selected functions or divisions – value chain integration is seldom found. Most of the mobile work environments support employees that have worked mobile in one or the other way before. Thus, the way of working was not subject to a radical change.

The investment in mobile work environments of the reported cases vary and show different approaches of implementation management. Most of the interviewees, independent from that fact if they were early or late adopters, found it challenging to quickly make a mobile work solution beneficial to the organisation. However, as soon as a mobile work solution is up and running, the organisations report clearly positive effects on the motivation of employees and image of the company. An early user involvement and a strong top management support has repeatedly been stated an important factor for success. Profound performance controlling could not be identified in any case.

6. Business Benefits - Near term value driver

The analysis of cases shows that adequate skills, sufficient commitment and a systematic preparation are key enablers to the success of mobile work environments. This applies to the planning and implementation of the mobile work solution and also to the operation, which includes the usage as well as support activities. Based on the current practice assessment, we postulate distinct areas for improvement to increase sustainability of mobile work designs. To achieve a stronger mobile value propositions, adopters should address:

- Integration along value chains, including the development of mechanisms supporting cross company integration of m- and e-work to avoid silo solutions. Objectives should be improved system and organisation interfaces and a balanced collaboration incentive structure.
- Faster organisational adaptation: Management should increase flexibility of processes, organisations and regulation and address the determinants of ICT competencies among employees [21] to adapt faster to technological opportunities.
- Maintain workforce motivation: It is imperative to maintain social cohesion and the "thinking" employee for critical tasks. Automation should be pursued when appropriate (e.g. repetitive and low involvement tasks) and alternative tasks should be promoted for compensation.

To increase technology progressiveness, technical solutions should allow more flexible integration with adjacent systems (e.g. the seamless use of GPS information in mobile work processes) and a less complicated deployment across divisions, functions, and countries.

7. Conclusions

On basis of our detailed case analysis we have identified key enablers and possible barriers for the success of mobile work environments. Providing adequate skills to the mobile workforce and having sufficient commitment are important factors. Another source for success is to allocate sufficient time for a systematic planning. Potential barriers are the threat of organisational fragmentation, a possible increase of administrative activities due to the nature of digital devices, limitations of decision capabilities and self management due to the "automation of humans", and a lack of employee autonomy, which in turn will reduce employee motivation. Further research is needed in order to identify the different enactments of the various mobile practices within different cultures and industries. Through such analyses companies will be able to adapt their mobile work practices more carefully and designers of mobile solutions may benefit from the detailed lists of requirements which comes forward from the growing research into mobile work in practice.

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