

# I Learn You Learn: Is There a Relationship between our Approach to Learning and Our Interpersonal Style?

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## Abstract

This article features a number of enablers and barriers for the successful introduction of mobile work initiatives. ICT enabled mobile work environments are an emerging phenomenon in many industries and sectors. On basis of current theory and the empirical analysis of five selected case studies from a large European research project both facilitating factors and possible obstructions are illustrated and discussed. So far, mobile work research is scarce and limited to singular and distinctive case studies. A systematic assessment of current types, practices and applications is missing. The authors aim to fill this gap by providing a structured assessment of cross-industry cases in order to distillate a number of critical success factors of mobile work in practice.

## 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 (Kleinknecht and Mohnen, 2002, Pfeffer, 1998). In order to achieve flexibility, many companies adopt information and communication technologies (ICTs) that support mobility, context- and location-awareness, networking and ambient interfaces (Malone, 2004). 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.

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. Kakihara and Sørensen, 2004), management science (e.g. Reichwald et al., 2000) as well as social theory (e.g. Cooper, 2002, Luff and Heath, 1998) and architecture and design (e.g. Penn, 2004). 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 and flexibility of workers (Lilischkis, 2003, Perry, 2001), which is criticised for being too narrow in its focus (Sherry and Salvador, 2002). The flexibilisation of work time, i.e. the change of temporal patterns of work became a second integral research focus (Hardill and Green, 2003). Spatial and temporal flexibility and the implications on job performance, private life satisfaction and the changes in the work-life balance then became key topics in the scientific and public debates on the future of work (Hogarth et al., 2000).

Working closer with the mobility of work per se, Kakihara and Sørensen (2004) 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 (Kakihara and Sørensen, 2004). As such, aspects of collaboration can also widely change due to new qualities of ICT. Andriessen and Vartiainen (2005) extended the concept of mobility to virtual mobility, which includes stationary actors moving "with the help of ICTs in a virtual working space". Virtual working spaces envision a substantial reduction of physical presence and meetings and with that a decreasing need for commuting. However, complete abandonment of face to face interaction is seen impossible due to fact that personal interaction is driving teamwork and creativity (Connaughton and Daly, 2004).

Despite a growing range of publications on future scenarios of mobile work, surprisingly little systematic assessments of the current practice of mobile work exists. With notable exceptions (e.g. Barnes, 2004), research of current practice documents primarily singular cases (e.g. Pica et al., 2004, Fui-Hoon Nah et al., 2005). In order to challenge the productivity paradox (Schrage, 1997, Solow, 1987) proofs for positive links between the general adoption of ICT and industrial productivity are now available (Papaconstantinou, 2004, OECD, 2003). However, little systematic evidence exists for significant shifts in work force mobilisation and performance. Branch-specific insights on work force efficiency and implications for human and social capital are scattered (see e.g. Ortiz and Clancy, 2003). Comparability and validity of these emerging data are further limited by varying definitions of indicators (Felstead and Jewson, 2000, Pyöriä, 2003), cause and effect delays as well as overall complexity of measurement (Brynjolfsson and Hitt, 2003).

Hence, a need exists for the analysis of the actual state of mobile work in industry practice to better understand if and to what extend mobile work is emerging phenomenon, and what are the new risks and opportunities that companies face today. Our research addresses this issue and reports on the state of affairs in mobile work by analysing a set of case studies across different industries and application types. This paper presents five selected cases from a large European project (Schaffers, 2005) and discusses the critical factors for the success of mobile work in practice.

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. 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 involves both the organisational decision makers and the actual users of mobile work applications.

## **Method**

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. 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 the 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 figure 1). The cases are then positioned into one of the four quarters of the matrix. Based on the systematic assessment of the cases and their relative positioning our research derives the enablers and barriers that need to be addressed in order to improve the relative position along the technology and the value axis.

## **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. The selected cases deal with a mobile sales force, mobile emergence response applications and mobile patient data. Table 1 provides an overview of the selected cases.

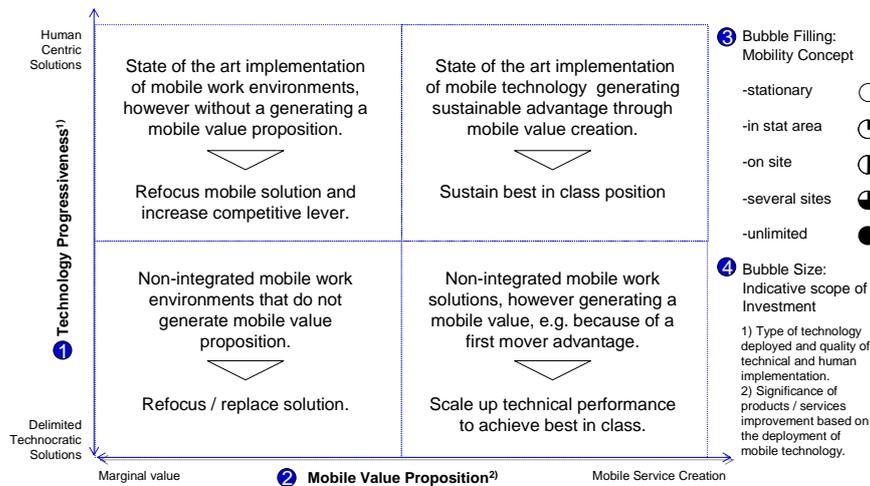


Figure 1: Technology Value Matrix

*Case 1: Hero AG - Mobile Sales Force at a 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.

Table 1: Case Study Overview

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.	<ul style="list-style-type: none"> <li>• Stabilised revenue</li> <li>• Central marketing planning and controlling</li> <li>• Advanced appearance in front of the client</li> <li>• Take over sales actions from other manufacture</li> </ul>
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.	<ul style="list-style-type: none"> <li>• Improved control of and more efficient work processes</li> <li>• More flexible assignment of controls to distributed teams.</li> <li>• Reduced disturbance for the client's logistics</li> <li>• Improved employee motivation.</li> </ul>
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.	<ul style="list-style-type: none"> <li>• Higher efficiency and quality of power grid maintenance, maximizing safety in solving power failures and increasing customer satisfaction</li> <li>• Centralization of failure-registration and solving time to build problem history</li> <li>• Improvement of response times to increase network quality</li> </ul>
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.	<ul style="list-style-type: none"> <li>• Better compliance to regulatory requirements.</li> <li>• Positive image effects</li> </ul>
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.	<ul style="list-style-type: none"> <li>• Indirect collateral benefits better bed usage, patient release 5h</li> <li>• Process cost decrease and time savings</li> <li>• Comply with the stringent government requirements for reporting</li> <li>• Motivated workforce</li> </ul>

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. This is a distinct improvement from the former situation

when 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, customer contacts can be planned much easier 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. During the integration phase, the management experienced a number of operational difficulties. As the project manager put it: "Being an early adopter is a two edged sword - it brings the opportunity to differentiate in the market but bears the risk of complex technology implementation". Being one of the first adopters of the solution resulted in malfunctioning of software, deviations from the mobile process specifications, a need to replace the integration consultant during the integration process and evident project delays. From the beginning of the project, the company involved the sales personnel with the implementation process in order to capture the user requirements and keep the new work environment transparent for the future user. The involvement of users supported the user acceptance, however, when complications and delays became obvious, the close integration of the users started to become counter-intuitive. The sales representative started to lose faith in the solution. On top of that the users feared increasing control and administration effort, namely the recording of additional customer information in the field besides their normal work. To sustain this phase of extra workload, the company relied on the strong support from top-management and invested even more effort into the integration process to keep the spirit up. Passing this peak of additional work repeatedly proved the critical point in time for the adoption of new technology at work (Leonard, 2004). 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 a rate example for a strategic benefit, compared to other cases that resemble mere operational efficiency gains. Accordingly, the case scores high on the mobile value axis (see figure 2). The technology progressiveness however, yields below average scores since it not based on current soft- and hardware versions and lacks full system integration.

*Case 2: Customs Agency - Mobile Control Force.* 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 to the office every day and receive their assignments for the day. Completed forms are brought back to the office after the controls. In future, the allocation of assignments will be delivered via GPRS to PDA's or laptops; 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 (laptops, smartphones, tablet PCs) for the controllers. The work process implies that assignments are generated by planners and send to centralized 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 deployed proven technology for the mobile work solution. Standard internet connectivity and access gateways were used here. The organisation tested different end-devices as personal equipment for the controllers to be used in different physical environments. As the customs agency decided to rely on proven technology, limited technical problems and a moderate need for additional employee training were reported. 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.

The mobile solution was very well received by the custom controllers. An important enabler proved to be the overall user-friendliness of the tool. Controllers liked the fact that they could ask for relevant information during their trip. Data entry turned out to be very easy as the data had to be entered only once instead of numerous times. Barriers for the mobile solution were hardly noticeable as the tool clearly and instantly improved the current control process. A possible barrier for future use may be the relative limited bandwidth. Controllers may want to exchange more information in the future than during the test phase. The only complaint

from the controllers was that they did not like the fact that they had to log on to the system multiple times. However, they understood that such a security protocol was needed in order to limit unauthorized wireless access to the intranet of the customs organization. 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.

*Case 3: Nuon - Mobile Maintenance Team.* 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 crowded public areas. When the switch is located the device enables a direct link to the blue print and other relevant information concerning the switch in the database. This functionality reduces the risk of accidents due to possible failures of the field service employees that may rely on the wrong information when fixing a particular power switch.

Nuon uses a special custom made application since adjusting an of-the-shelf 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 databases (e.g. repair schemes). So far, the users are pleased with the mobile solution in terms of the improvement access to relevant information. Failure registrations are much easier to accomplish. As one of the users mentioned in the interview: 'It takes much less time than before to do the actual registration of a problem but it is even better that there is an immediate update of the problem history of the installation'. According to Nuon the response times can easily be reduced through using the tool and safety levels will be improved when solving power failures. Possible barriers for the implementation are the difficulty of building the devices into all the different cars of Nuon. Due to the large scale of Nuon's activities there is a great diversity in company vehicles and it would have been easier if there would have been just one standard car. Another possible barrier is the fact that GPRS is relatively slow and provides only the absolute minimum for connection speed. As soon as UMTS coverage is sufficient and viable for a large companies such as Nuon this problem can be solved. The company is aware of the fact that users may miss the informal meetings with colleagues after the implementation. A workgroup is currently involved with this issue.

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 the safety of employees when solving power failures with improved information supply
- Centralization of failure-registration and solving time in order to build problem history per installation
- Improvement of response times to increase network quality.

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

*Case 4: Emergency Medical Service - Mobile Dispatch Solution.* 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<sup>2</sup> 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 organisation experienced being the first adopter of the solution as a barrier for rapid and cost efficient implementation. The project responsible said: "It took over a year until the system worked properly - considerably longer than expected. We just wanted to implement too much at one time. Today, the team is proud of the solution but would not risk being an early adopter again". As such the organisation is hesitant to swiftly upgrade to UMTS connectivity, since they experienced bottlenecks in GPRS connectivity in the early stages. Furthermore, they would not implement two solutions (the central dispatching and the GPRS data transfer to vehicles) simultaneously again but chose a sequential approach.

"Amongst the medical staff there exists a notion that every cent that is not spent on medical equipment can be saved, and ICT is not perceived as medical equipment" said the IT-responsible in the organisation. In combination with the delays in technical integration, the adoption of the new technology within the mobile workforce was below expectations, although there has been no significant change of the work-process. During the integration phase, management realised that an early involvement of the rescue team in the decision and implementation process would have helped to increase acceptance for the system. Both the limited acceptance and the early malfunctions of the technology caused self-enforcing negative effects onto the pace of implementation necessitating extensive ex-post training and controlling. The careful balance of automation and information is seen as an important trigger in the new work environment of the EMS. On the long run it is important for the EMS to avoid a too high technology dependency. The organisation intends to keep ambulance men "thinking" and acting consciously when performing their tasks. Team members are afraid to let the IT-system take over the decision making from the ambulance men (e.g. routing information). The dispatch and fleet management solution has improved the operation of the EMS at reasonable operational expenses. The dispatching cost are 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 is able to comply better to the regulatory requirements (e.g. incident documentation, response times, etc.). For ex-post case analysis, the system makes detailed statistics available in central office. 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.

Case 5: Frimley Park Hospital: Mobile Patient Data Access. 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 and employs a staff of around 2,500. 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 care 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 patients. 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.

This case identified key enablers in the area of technology management as well as in organisational and stakeholder management. As in other ICT-implementation projects in the health care industry (Mueller-

Albrecht, 2000), the Frimley Park team found it critical to provide the project with a mixed implementation team of in-house and external personnel. The in-house team had access to the formal and informal process structure, whereas the external team provided specialised ICT and change management know how. In terms of organisational enablers, this case identified stakeholder management as a crucial aspect. An active stakeholder management should not be limited to single user-groups. The integration of different hierarchy levels (e.g. nurses and doctors) and different departments has repeatedly proven helpful. This does not only allow for capturing the various functional user requirements but sheds also light on the systems of power which might shift with the introduction of mobile working processes (Lapointe and Rivard, 2004). The early involvement of the mobile workers and the use of a pilot study were valuable to communicate changes and iron out problems. The hospital team described this as a "non-bureaucratic approach with an open and participative culture". The mobile data access solution was well adopted by medical 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 upgrade 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 figure 2.

### **Results - Status Quo of Mobile Work**

Figure 2 depicts the consolidated assessment of the cases along their technology progressiveness and their mobile value proposition. The individual ratings have been discussed in the previous section. 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 physicians are restricted to in-house- or "on-site" areas, that are covered with WLAN. 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, i.e. their mobility spans "several sites". 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. This is indicated by the bubble size in the diagram. With regard to technology progressiveness, Nuon ranges higher than the other cases, since the soft- and hardware solutions 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. Therefore, it ranges lowest on the technology axis in the diagram.

In terms of mobile 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 the company acquired additional sales activities from another company in the market. The latter resulted in a top-line growth and stronger competitiveness in the market. In contrast, the rating of the mobile response solution at the emergency medical service is lowest in our assessment since the investment of the EMS came out as a zero-sum game. The following sub-chapters will elaborate on the two main dimensions of the assessment.

*Technology.* Mobile technology turns out to be generally used to further improve the automation of work processes and the information of the mobile worker. Developments in mobile work are part of an evolutionary process, however technology is far from being well implemented. Most of the illustrated mobile work environments provide potential for integration with adjacent systems, which would help to further accelerate workflows and improve resource efficiency. 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 stronger 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 an important restraint for mobile sales force applications (Bush et al., 2005)

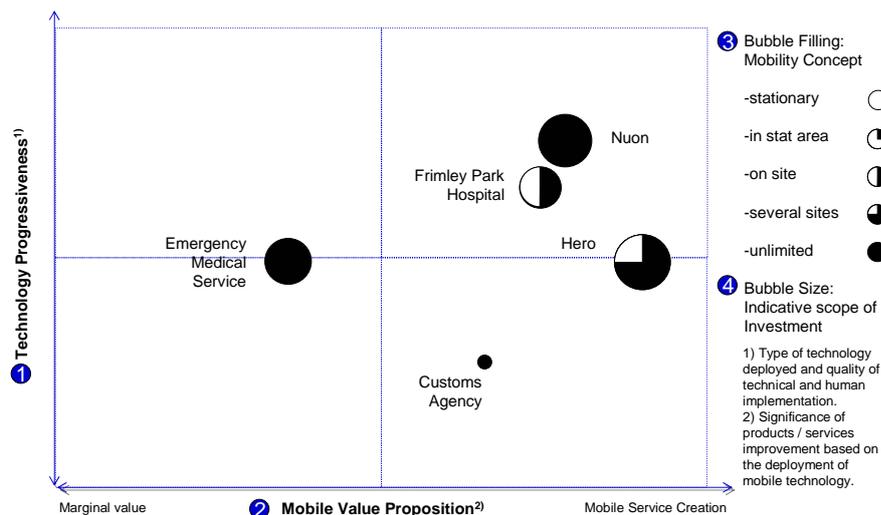


Figure 2: Case Assessment in the Technology Value Matrix

In terms of human interface design none of cases utilised advanced hard- or software for mobile working. Features like voice recognition, simplified user identification and personalisation of applications as well as wearable computing equipment are areas for improvement. For example, Frimley Park Hospital is investigating ways to further limit the disturbance of the patient treatment process by improving the user interface and moving the technology into the background. Therefore they seek for ways to reduce the heavy weight of the portable tablet PC's. Similarly, the customs agency is investigating how to improve data recording in rough environments, like freeze cabins, where gloves limit the handling of PDA's and tablet PCs.

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 (Dix et al., 2000) is rarely used in current practice of mobile work. To increase technology progressiveness, technical solutions should also allow for more flexible integration with adjacent systems (e.g. seamless integration of front end and back office systems) and a less complicated deployment across divisions, functions, and countries. The integration and sensible use of context information is a second area for improvement, which companies in the field currently tackle. For example, the EMS started to integrate specifically configured high resolution location information into its mobile field application. However, the two systems still run in parallel and require double data entry in the dispatch centre.

*Mobile Value.* On basis of our field studies we conclude that today's mobile work environments do create value. However, most value is created within selected functions or divisions and value chain integration and corporate mobilisation strategies are 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 respondents, 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. Early user involvement and a strong top management support has repeatedly been mentioned as important factors for success. Profound performance controlling could not be identified in any case.

### Discussion: Enablers and Barriers of Mobile Work

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. Throughout the planning and implementation process, it is seen as critical to transparently communicate the cost and benefits of a new working environment to the users and to the stakeholders. This can either be done through user involvement with the specification process in order to capture user needs or through pre- and post-integration training of users. Stakeholders should be managed carefully especially if a new work environment causes shifts of power of different stakeholders. One way is to include key stakeholders into the integration

team. Furthermore, small scale trials have been mentioned as an important instrument to involve users, test the functionality of different hard- and software elements. From our case analysis it became clear that early adoption of new ICT for mobile work environments should be assessed with high scrutiny. Only if early adoption is required to achieve superior value creation and if appropriate ICT-integration skills can be made available a company should favour early adoption.

In general our case companies show a number of positive experiences with a mixed integration team, including know how of the formal and informal work flows and relevant ICT-skills. Strong top-management support is also vital for the success of mobile work environments, especially in periods of disappointments and delays. Potential barriers for mobile work environments arise mainly from the changes of work processes and work styles of mobile workers. These include organisational fragmentation stemming from a reduction of face-to-face interactions in a shared physical work location. In other words, changes in the informal information exchanges. Furthermore, digital solutions can possibly increase administrative activities due to possibility to record and analyse more information electronically. Respondents also mentioned potential limitations of decision making capabilities and self management of employees due to the “automation of humans”, and a lack of employee autonomy, which in turn can impede employee motivation.

Based on the current assessment of practices, 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 (Tijdens and Steijn, 2005) 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.

## Conclusions

These are exciting times for many members of the workforce as a growing number of companies are changing their traditional work environments. So far, communication possibilities have improved and enable high quality collaboration between people across traditional boundaries. Businesses are no longer tied to a single time zone. The Internet as the almost universal medium for interaction across boundaries has created an infrastructure that enables many organizations to work across borders. Individuals may even work fully mobile as their link to their back offices, clients and partners is supported by high tech collaboration solutions, such as email, videoconferencing, electronic blackboards and sophisticated forms of groupware. There are hardly any technical obstacles for communication and collaboration across geographic boundaries as products and solutions are continuously improving. Unfortunately, good quality communication and collaboration tools are not enough to establish productive work environments. Working across borders in a team or doing your job in a mobile fashion does not come without problems. For instance, what happens to job satisfaction, social cohesion, random encounters and other informal activities without the direct contact with colleagues? Also, how about managing a mobile virtual workforce? Managerial handbooks are still promoting models that are based on traditional work models whereas most managers find themselves in complex distributed matrix structures where they manage processes and a growing number of distant employees. In this paper, we have illustrated the nature of mobile work in order to highlight that research is needed to gain a better understanding of the critical success conditions for mobile work. Mobility offers tremendous possibilities but it is not without a detailed understanding of its drivers and enablers that success in terms of innovation and productivity will be a reality.

Our approach was limited to five cases across industries in Europe. On basis of a detailed analysis of these examples, we have provided insight into the state of affairs of mobile working. It proves that mobile work has a great potential and - as tools and the usage of tools are improving - we shall experience a growth in its use. The cases show that mobile work solutions do not only improve current work practices in terms of better planning and efficiency but there are also benefits, such as an increase of safety levels and a better balance of work load for mobile workers. Through the cases we have been able to identify a number of key enablers and possible barriers for the success of mobile work environments. Apart from the ongoing development of technology-functionalities, companies can specifically improve the value creation by optimising their implementation and use management of new technologies.

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 come forward from the growing research into mobile work in practice.

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