2010

Developing Mobile Information Systems: Managing Additional Aspects

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Journal:	*18th European Conference on Information Systems*
Manuscript ID:	ECIS2010-0203.R2
Submission Type:	Research Paper
Keyword:	Design/design science, Information system development, Pervasive computing/ubiquitous computing, IS design

DEVELOPING MOBILE INFORMATION SYSTEMS: MANAGING ADDITIONAL ASPECTS

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Abstract

Despite the numerous stories in academic journals and the business press of systems that fail to deliver anticipated benefits, mobile information systems (IS) are still gaining ground. The nature of mobile IS introduces additional aspects that require attention during the development process, compared to more traditional information systems built for stationary computers. The underlying assumption in this paper is that successful management of these aspects is crucial in order to harness the possibilities of mobility. This paper presents the AUDE- (Application, User, Device, Environment) framework; an analytical framework that addresses the additional aspect of mobile IS. The framework integrates previous research on mobile IS and is tested retrospectively on a case with mobile service technicians. Of the 19 attributes covered by the AUDE framework 2 attributes were not applicable in the investigated case. Of the remaining 17 attributes only 6 were actively handled (3 of them only partly), 8 were not taken into account, and for 3 we were not able to retrieve data. With the ignorance of specific attributes for mobile IS development it was possible to explain why the developed IS did not meet expectations and was considered a failure by its users.

Keywords: Mobile Computing, Mobile Information Systems, IS development,

1 INTRODUCTION

A large corporate group in northern Europe within the heavy industry and haulage sector implemented a mobile service order system for their 280 service technicians in Sweden. Savings due to shorter lead-time from ordered service to sent invoice was one of the main reasons for developing and implementing the system. The desired benefits were achieved when the time from order to invoice was cut from three weeks to three days. The service technicians, however, deemed the system a failure owing to increased administration on their part from 20 to 90 minutes per day and lack of support for the service technicians' vital information needs. Post-implementation evaluation showed that the production loss caused by the technicians spending more than one hour less per day actually performing service could have been avoided if the system had been adapted to how the technician performed service order administration in the field (Andersson 2008).

Similar stories in the business press and academic literature indicates that the example above is not an isolated anecdote but a typical example of how mobile information systems (IS) projects do not harness the potential due to failure in understanding the use situation (Allen and Wilson 2005, Blechar et al. 2005, Er and Kay 2005, Fussell and Benimoff 1995, Kay and Er 2005, Luff and Heath 1998, Norman and Allen 2005, Steinert and Teufel 2004, Steinert and Teufel 2005). This is the motivation behind this paper and its focal point in the concept of mobility and what characterizes mobile IS use from a developer's perspective. Much research has been done on mobile IS and mobility per se (Dahlberg 2003, Kristoffersen and Ljungberg 1998, Perry et al. 2001), but the conceptualization of the term and what implication mobility has for IS development is still limited. Several frameworks have been developed in order to describe or explain aspects of mobility and IS use in a mobile context. Zheng & Yuan´s (Zheng and Yuan 2007) framework with the entities' mobile workers, mobile context, mobile tasks and mobile technologies is developed to describe differences between stationary and mobile context. Kakhira & Sörensen´s (Kakihara and Sørensen 2002) discusses mobility and includes temporal, spatial and contextual mobility into mobility as a phenomena. Focusing on design Tarasewich suggests context to be divided into three categories: activities, environment and participants (Tarasewich 2003). All of these frameworks are important contributions to the field of mobile IS, but they are not specifically developed and focused on the development of mobile applications.

The paper is based on the proposition that mobile IS use has distinctive characteristics compared to the more traditional IS use in form of stationary IS use (Fällman 2003, Lyytinen and Yoo 2002). Our purpose is to develop a framework for capturing aspects of mobile IS use to be of importance during the analysis and design phases of mobile IS development. Consequently, pure technological aspects as platform proliferation, roaming, and handover are not dealt with. We are neither focusing differences in the IS content, i.e. potential distinction of what kind of IS applications are being used in traditional and mobile IS and by which purpose. We are interested in entities that has to be managed in a IS development situation.

We ground our research on previous research on aspects on mobility and approaches to analyze mobile IS use in IS development. This is accounted for in the next section. Based on the previous research we develop a tentative analytical framework for capturing the use aspects of mobile IS. We then test and validate the framework with a retrospective cases study of failed development of mobile IS to see if our suggested framework would had been able to capture the causes for failure. Finally, we draw conclusions on our research and discuss the generalisability of our findings.

2 A DEPARTURE FROM SYSTEM DEVELOPMENT

Studying development of mobile IT some entities are of value. Often used entities in system development are (if not explicit but easily discernable) *Environment*, *User*, *Application* and *Device*

(i.e. platform) (Bansler 1990, Checkland and Holwell 1998, Fitzgerald et al. 2002, Mathiassen and Franzén 2001). The *Environment* is in this paper considered as the organisational settings surrounding the user, application and platform. If the application is supposed to be used in a B2E or a B2C environment aspect as structure and agency will affect the use. The *User* can be a physical individual or another system. We regard only the physical individual as a user in this text. The *Application* is an application or a service offering functionality to the user, from our perspective there are no major difference between an application and a service. Regardless if it is a remote service that is called upon or a local application it is always some kind of software involved offering an interface to the user. The *Device* is dividable into the actual unit and the input and output devices. It can be a stationary computer, laptop or a handheld computer. The input devices can range from keyboard and pointers to microphones, touch screens, motion detectors et cetera. Due to the focus on mobility handheld devices are of certain concern and aspects of stationary computing is excluded in this study. As a consequence of this focus the limitations and features caused by the small form factor of handheld devices is vital.

A considerable amount of work has been done on technological aspects that are of less concern in this paper. They are all relevant to mobile computing since they constitute the boundary condition for mobile computing but out of scope in this paper. It may for example regard processor capabilities (Clark 2002), migrating (Artsy et al. 1987, Artsy and Finkel 1989), battery capacity (Panigrahi et al. 2001), roaming (Minghui et al. 2004), or positioning (Adusei et al. 2002).

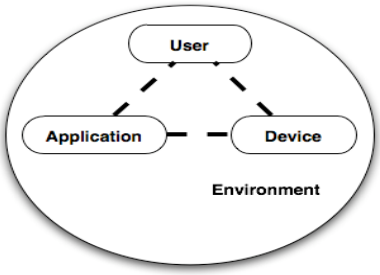

Figure 1. Initial framework: four prominent entities often used implicit in system development.

3 CONCEPTUAL CLEANSING OF MOBILITY

Mobility and use of mobile computers or mobile devices are a large and versatile topic. What and whom are mobile? Mobility have a range of meanings, an *application* can be regarded as mobile in consideration that it is possible to move between different devices or platforms (portability). Mobility can also be understood as "possible to carry" – meaning that the *device* is supposed to be carried around. Mobility can also be valid in respect of the user. The *user* can be mobile and can use the same resource in different places at different nodes (Makimoto and Manners 1997, Weiser 1991). Another angle is the intended use, a user may run the same application on a laptop as on a stationary computer in the same office settings with no actual difference in functionality. In this paper mobile means that the user is mobile i.e. is outbound and works in different places using a handheld device to accomplish task due to information and data processing. This duality of mobility (the user and the device) calls for applications that is suitable for be used at handhelds.

The label *User* in the continuance refers to a physical person with a role as a user of a computerized information system. Different user roles can be separated in the aspect of modalities. A person can be regarded as stationary when working at the desktop but is still mobile in the sense of being able to leave the desktop, travel and visit other sites. The point is in which extent the user is mobile when using the information system. The ability of mobility ranges from non-mobile to completely mobile that is free of any physical limitation such as buildings or geographical areas. In between these ideal states there are different modes of mobility. To identify and categorize mobility is intricate if the context is not accounted for. A medical doctor (in a user role) may be stationary when using a desktop

and mobile during ward round and using a PDA. If the doctor only can use the PDA on a specific ward or hospital she is not globally mobile, just locally mobile. The main argument is the typical use of IT within a certain role. We are not looking at persons but on roles. When writing of person the role is the characteristic. The doctor in her office is one role and the doctor on round is another role. We argue that depending on type of role and its degree of mobility, different aspects have to be considered. Kristoffersen and Ljungberg (1998) coins the terms *travelling*, *visiting* and *wandering* in their reference model for mobile use of IT. Travelling is the transportation from place A to place B. It can range from car driving to airplane commuting. Visiting means spending time at a remote location for a period of time. It can be a visiting professor working at another campus or a hired consultant working at a costumer's office. Wandering is local mobility within a predefined area as a building, for example IT-support staff wandering around on a site helping users. Kristoffersen & Ljungberg's (1998) framework have come to some age and the technology evolution have altered the map somewhat. In recent years the number of mobile devices in form of PDA's and Smartphone's with capabilities to function as small computers on the market has grown. By 2009 the mobile devices significant exceed the desktop computers and this difference is increasing (Rupnik 2009). In the same pace as the mobile devices has become more frequent the geographical coverage and transmission capabilities of the wireless networks have increased (Stafford and Gillenson 2003, Urbaczewski et al. 2003). The technological shift will affect a large group of users that in turn will have major economical consequences due to among other factors Metcalf's law describing increasing marginal utility (Shapiro and Varian 1999). The mobile workforce on a global perspective is also increasing, an IDG report predict that by the end of 2011 75% of the U.S. workforce will be mobile and worldwide 1 billon workers will be mobile by the end of 2011 (Framingham 2008). This workforce ability to use wireless communication will be even more prosperous when the next generation of mobile data communication network with transmission rate up to 100 Mbit/s is implemented in the operators' networks .

As a consequence of these mentioned changes in mobile computing during the last decade there is a need to extend Kristoffersen & Ljungbergs (1998) framework with the ever-outbound user: The digital ranger. This mode depictures a user that almost never visits the home base. The digital ranger relies on the information system offered on a mobile device and is in most cases relying on a wireless connection to exchange information with the home base. An example would be the field worker starting her work from home and visiting clients or sites to repair equipment. The increased availability of handheld computers combined with the digital ranger depictures a truly mobile digital ranger. In figure 2 two axes are joined into a diagram displaying different modes of mobility. In this model not only the modalities but also the device is displayed. The X axel is comparable with Kristoffersen & Ljungberg´s (1998) modalities and the Y axel displays the devices and its ability to be mobile. Depending on a specific use situation, i.e. a certain position in the diagram, specific design aspects are to be managed.

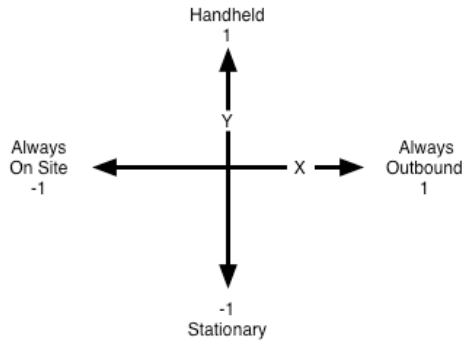

Figure 2. Two dimensions of mobility: the user's mobility and the mobility of the device. 1,1 would depicture the digital ranger an ever-outbound field worker using a handheld device meanwhile -1,-1 could depicture an office worker using a desktop computer. -

1,1 could depicture support staff working in a specific building, i.e. wanderers. 1,-1 can depicture transport staff using vehicle mounted computers.

4 LOADING THE FRAMEWORK

4.1 Environment

The motivation to elaborate the environment is the differences in the settings affecting the use of a certain device or application. If the environment is B2C the user (the customer) will in greater extent have the possibility to choose not to use a certain technology, i.e. *voluntary use*. The opposite is valid in the B2E environment there an employee in some case do not have any other opportunities than to use a suggested solution, i.e. *mandatory use*. These aspects are not easily managed by the system developer therefore this aspect is a kind of background aspect that the developer should be aware of when developing an application. For example, a mandatory use and an application not aligned with information work processes may be an obstacles if no alternative paths are available. This is making the *environment* an aspect to deal with for a developer.

4.2 User

Another aspect of mobile IS use is anywhere and anytime. *Anywhere* describes the opportunity to access the IS without restrictions to a certain location. *Anytime* refers to access whenever the user needs a certain service or information. This is not related to synchronous or asynchronous communication instead it is an aspect of omnipresence (B'far 2005, El-Kiki and Lawrence 2008, Makimoto and Manners 1997, Perry et al. 2001, Zheng and Yuan 2007). The user may be in different *modes* of mobility; travelling, visiting, wandering or ranging (Kristoffersen and Ljungberg 1998, Marcus and Chen 2002). These aspects will be labelled *user*/*mobility*.

When being mobile the user is often involved with other tasks than just using a computer. The mobile user can be considered as being *off-task* compared to a stationary user meaning that the main occupation is off the computer. (B'far 2005, Frank 2006, Tarasewich et al. 2002, Zheng and Yuan 2007). And as the mobile user works at different places on the field the *lack of supporting technologies* such as photocopiers and faxes is a circumstance to consider (Perry et al. 2001). The user may also be *outbound* in the sense of a solitary mode with less opportunities to interact with colleagues (Orr 1996) These aspects will be labelled *user*/*context*.

4.3 Device

Device limitations as in limited processing capacity, limited memory capacity and limited power supply is likely the most discussed topic within mobile computing and handheld devices. *Limited processing capacity* affects the calculating capacity making a calculating application slow or even impossible to run on a handheld device. The main reason to this is miniaturisation of the processor. Processes easily run on stationary computers are not certain to run smoothly on handheld devices forcing the developer to reduce the processor load. *Limited memory capacity* affects the possibilities to build applications requiring large amount of memory. Expansion memory may handle some storage problems but this type of memory is seldom suitable for running applications. *Limited power supply* is a crucial aspect though the intended use is without a wired power supply (B'far 2005).

The vast range of input and output variants or multimode compared to desktop or laptop affects how to build an application. At the desktop the keyboard, mouse and screen is used for interaction between the user and the application. The traditional mouse is often missing on mobile devices. Different models may have *different user interfaces* making the development more cumbersome compared to develop for one or fewer user interfaces. If existing, the keyboard is smaller and with few keys and the

screen is considerably smaller due to the *small form factor* making input more cumbersome. The screen size restricts the amount of running applications, too many applications quickly clutters the screen making navigation cumbersome (B'far 2005, Frank 2006, Holmquist 2007, Marcus and Chen 2002, Prammanee et al. 2006). These aspects will be labelled *device/attributes*.

As a consequence of the handhelds small form factor and intended use they are carried along in varying use situations. This making it *easy to loose* the device or that it becomes stolen. If critical information is reached trough the device or if the handheld device with its IS is vital this is a considerable security risk (Ravi et al. 2002). These aspects will be labelled *device*/*security*.

4.4 Application

When accessing the IS the user's needs are of rather time-critical nature compared to stationary desktop computing. For example, a service technician's request of documentation on a certain machine just in time for the service. If the information is not accessible the service technician may be forced to wait until the information is available, this property is often labelled intermediacy or *immediacy (B'far 2005, Frank 2006, Sacher and Loudon 2002)* . Considering the range of services available to the user the mobile IS is more often than the opposite the only IS available and as a consequence the user relies heavily on just that IS. File management, editing programs and other supplementing applications are seldom present in the same extent as in stationary computer use, making high *reliance on application* an important fact (B'far 2005). *Field use conditions* in form distortion as noise, different lightning conditions also come with mobile IS use because the variation of places is larger than compared to stationary desktop computing (B'far 2005, Lamming et al. 2000). Using different technologies the mobile device can calculate its position - it is context aware. The *context awareness* can be divided into region and place awareness (adapted from B´Far 2005). The region concerns aspects as time zones, tax zones or legislations zones. Given a certain location some conditions are applicable. Place awareness describes the device ability to be aware of its actual position at a specific moment. The main difference between region and place is that region may be determined in advanced with some setting meanwhile place cannot be determined in advanced. But the application can easily store information of visited places and can communicate its position to other devices (B'far 2005, Froehlich et al. 2008, Marcus and Chen 2002). This will be categorised as *application/context.*

The technologically environment of an application for a handheld device is more varied compared to environments of applications for stationary computers. Due to the vast range of operational system on handhelds and the vast range of hardware combinations, often labelled as *platform proliferation*. Different devices may interpret the same instructions in different ways making the development for cross platform applications cumbersome and error prone (B'far 2005). Even within the same manufacturer and product line differences may occur (Andersson and Hedman 2007). An application may be mobile in different dimensions. It can be used on mobile devices or that it can be moved along different devices. The user can access the functionality from different platforms and devices (Makimoto and Manners 1997). These aspects will be labelled *application/mobility*.

The quality of service regarding the wireless network is a crucial aspect of mobile computing. Type of connection (i.e. protocol), transmission rate and reliability is components of connectivity. A wired connection on a known location makes the quality of service stable. External aspects such as skip zones, solar flares, road tunnels, and large buildings make wireless connections *unpredictable and varying*. Wireless networks also rise concern of security in form of intrusion or distortion of information (Ravi et al. 2002). If the wireless network is preset it is easier to take security measures compared to the mobile users using different networks or providers making the transmission more vulnerable for *intrusion and distortion* (Ghosh and Swaminatha 2001, Pts 2006). These aspects will be categorised as *application/connection*.

5 INTEGRATED FRAMEWORK

Summoning the different aspects accentuated by mobility the AUDE-map is depictured in Figure 4. AUDE stands for *Application, User, Device,* and *Environment*. The framework was successfully tested against Mathiassen & Franzen's (2001) VATOFA-criteria, this to ensure completeness to system development. The AUDE-map may guide the developer in design considerations as what pattern or design proposal to elaborate further. We therefore suggest that it may be used as a framework for capturing aspects of mobile IS use to be used during the analysis and design phases of mobile IS development. All aspects are not likely to be mastered but the main point is to visualize the design space so the designer may do well argued design.

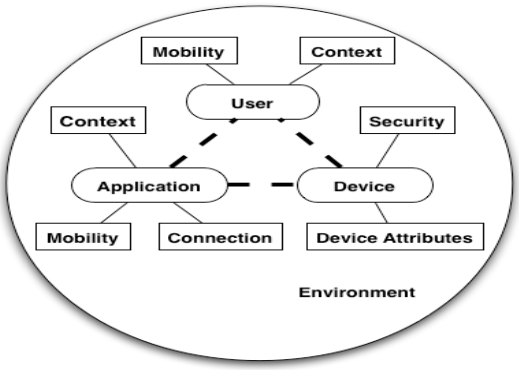

Figure 3. The analytical framework for mobile information systems development.

6 METHODOLOGY

6.1 Contribution and research approach

The theoretical contribution we want to make in this paper is theory for analyzing (Gregor 2006). Our outset was to develop a framework useful for identifying and describing aspects of mobile IS use. The value of our contribution thus lay in that using it, identification of important aspects currently not considered in development of mobile IS is possible. This is the overall criteria for assessment. Drawing on Gregor (2006), we conclude that the usefulness of this type of theory may be refined to be evaluated by its completeness, distinctiveness, and simplicity. Completeness means that important categories or elements should not be omitted from the classification system, that is, the framework should be able to capture all important resources. Distinctiveness means that boundaries between categories and characteristics that define each category are clear. The empirical phenomena encountered should be possible to categorize according to these criteria without too much difficulty (Gregor 2006). Simplicity refers to that which by making a model or framework too elaborated or comprehensive, it makes it hard to work with and in the end makes it useless for its purpose.

Our contribution in the form of a framework for aspects of mobile IS use clearly has an implicit normative element. The distance from arguing that some aspects are relevant in order to describe mobile IS use to arguing that these aspects should be taken into account when developing mobile IS is not far. Our contribution is implicitly leaning towards what Gregor (2006) refers to as theory for action, closely related to the concept of design theory. However, design theory says "how to do something" Gregor (2006). Although playing with words one might argue that by our framework we say how to do mobile IS development is by taking into account the aspects of our framework, this is a misuse of terminology. A design theory contribution on our topic would include instructions on how to assess and react upon the identified aspects. As a design theory our contribution would have been presented in a way digestible for practitioners thus making the knowledge "actionable".

6.2 Empirical data gathering

Being theory for analyzing we are interested in whether our framework enlightens aspects of mobile IS use that is currently not considered in the development process. Two approaches are possible in order to verify the degree to which the framework meets this ambition. One way would be to study the development process and document all aspects considered during the process. A second, less resource demanding option was chosen. By investigating failed, or at least problematic, cases of mobile IS use we might investigate a) if the aspects identified by our framework are taken care of, and b) if doing so would have avoided to encountered problems. This way we will not be able tell whether or not the mobile IS under investigation would have function well using our framework but we will be able to tell whether or not our framework can help in avoiding some existing shortcomings. We thus use the retrospective case study approach to verify our framework.

The case selected is the service order system presented in the introduction of this chapter. It is crucial that the company is kept anonymous in this study in accordance with the agreements made with the firm's executives. The company has mobile service technicians (henceforth STs) who operate from the company service trucks (each contains a small workshop and spare parts). On an ordinary day, the ST leaves his (the ST is more often than not male) home, travels directly to the client's facility and starts working on the servicing of the client's machinery. After completing a day's work, the ST drives directly home. Ordering spare parts is done by phone and the postal service or a transportation firm delivers the spare parts. An elaborated description of the case is presented in Andersson (2008). The rich data collection enabled a retrospective application of our framework for mobile IS use.

The methods used to collect empirical data were a blend of several instruments, as suggested by Yin (Yin 2003) when carrying out case studies. The manuals, handbooks and teaching material handed out to the STs were read and analyzed in order to establish a view of the structural features of the technology. Observations were performed in order to reveal how the actual work with the handheld devices was performed. Interviews were carried out with four STs, the STs' foreman and two clerks who handled the administration of service orders. A total of 250 pages of written documentation were read and analyzed, eight hours of observations and four hours of telephone interviews were conducted.

7 FRAMEWORK APPLICATION

We will validate the use of our framework by applying it on a case of mobile IS development. The mobile application was built to run on the OS Windows Mobile 6 and devices designed for rough conditions. Input was performed on a touch sensitive screen with a stylus. The main functionality was to pick up service orders dispatched by customer service desk. The customer service desk personnel registered all orders in the company ERP system and a middleware developed by an IT-consultant company distributed the orders to the technicians using the built in Windows Sync function. To receive a service order the technician had to synchronize their handheld device with the main terminal. The network used was the GSM-network offered by Vodafone. When a service order was finished the technician opened up the order and filled in time spent, mileage and spare parts. The system also offered on-screen blue prints on machinery to help the technicians to identify the correct spare part.

The presented case seems at a glance as a rather straightforward information-processing task. However, after the implementation the technicians suffered increased administration on their part from 20 to 90 minutes per day and lack of support for the service technician's vital information needs. How could the time spent on administration increase as much as it did? Several minor features or malfunctions were identified.

Table 1. The different entities, their aspects and in what extent they were managed.

Entity	Aspect	Short description	Aspect managed?
Application	Connection	Varying connectivity	Not successfully managed
		Intrusion / Distortion	The built in features in Windows Sync was used to ensure protection
	Context	Context Awareness	Not managed
		Field Use Conditions	Yes, in some extension (sturdy device)
		High reliance on application	Managed with the possibility to send in additional information
		Immediacy	Not managed
	Mobility	Platform proliferation	Not Applicable due to the choice of one device and one carrier.
Device	Device Attributes	Small form factor	Not managed
		Limited power supply	Unsure in what extent it was managed
		Different user interfaces	Yes, managed in some extent
		Low processing cap.	Unsure in what extent it was managed
		Limited Memory	Unsure in what extent it was managed
	Security	Easy to loose	Not managed
User	Context	Off-task	Not managed
		Lack of supporting technology	Not managed
		Outbound	Not managed
	Mobility	Modalities	Not Applicable, always outbound, a digital ranger.
		Anywhere, Anytime	Yes, managed
Environment		Mandatory /Voluntary	Yes, Implemented as the only offered channel to back office.

Some aspect can benefit on further explanation, as the use of Windows Sync that caused major problems. Windows Sync apparently relies heavily on a stabile connection to function properly. The actual quality of service regarding connectivity was not considered appropriate. As a consequence the technicians were forced to keep double records, one on the handheld and one on paper. If or when the sync malfunctioned the customer service desks staff had to call the technician to correct the service order manually into the ERP. If the aspect of connectivity an unreliable connectivity had been addressed most likely another synchronization technique had been chosen. For example a simple transaction engine had avoided these problems.

Complaints on tedious input was made and the reason was that the service technician often bought consumables in any nearby store, may it be electrical cable, oil, bulbs and other items not in the service truck spar part repository. These items was not on the spare part list in the applications database therefore a verbose round trip in the application was required consuming time and temper on the technicians behalf. The aspect of only application was not properly managed, an email function or an more flexible service order form had managed these problems by allowing other than registered spare parts to be included into the service order.

8 FRAMEWORK EVALUATION

As argued in the methodological section, the framework's raison d'être should be evaluated through the general criteria that identification of important aspects currently not considered in development of mobile IS should be possible. In more specific terms, evaluation should be effectuated along three lines of completeness, distinctiveness, and simplicity.

Completeness in this case would mean that no important aspects were missed by the classification categories in the framework. Regarding the case presented above, the problems discovered during the study were all covered by the framework and no immediate extension is required. However, as discussed in the methodological section it lays not within this study to verify that all problems could be solved by taking into account our identified aspects. We can say by applying the framework as above that some of the roots that later caused problems would have been identified by our framework.

Distinctiveness, referring to the ease with which elements (aspects) could be classified into the proposed categories, was not perceived by the authors as problematic. However, it should be noted that the authors are the formulators of the categories and have an extensive understanding of the theoretical concepts included. As discussed in the methodology section, IS developers are potential users of knowledge in the area of this study. Most IS developers would not be able to use the framework in its current shape. The categories would require elaborated explanation and suggestions how to solve restrictions.

Finally, to maintain the simplicity of the framework, we choose to focus the aspect round the four entities Application, User, Device, and Connection. In the application of the framework above naturally not all aspects are present. A single case study of this kind will not reveal if some categories do not exist in practice.

9 DISCUSSION AND CONCLUSIONS

In this article we have introduced a tentative framework for capturing aspects of mobile IS use to be of importance during the analysis and design phases of mobile IS development framework. Using the framework we identified and described which aspects of mobile IS use a failed development project had ignored. Considering these aspects during the analysis phase of the project would have made possible to avoid the encountered problems. It is outside the scope of this paper to verify if these were the only shortcomings of the investigated IS, or if taking these aspects into account the IS would still not be appropriately adjusted to the situation in which it is supposed to be used.

Evaluating the suggested framework along the lines of completeness, distinctiveness, and simplicity revealed that the framework needs to be further tested in different academic and business trials. Further validation is needed along all three lines. The natural extension of our research is through the principles of design science. Our framework consists an appropriate kernel theory to develop an analytical tool to be used in the analysis phase of mobile IS development. Reworking the framework to an actionable design theory would enable testing to reveal the framework's completeness. The rework process would require that information was given to practitioners on how to interpret the entities and associated aspects. In the current form the framework is probably not understandable to most IS developers. The enabled real world testing should also reveal how the framework corresponds to the criteria of simplicity.

With this chapter we have provided a starting point for including the specific aspects of mobile IS use. Few doubts remains that as computer based IS no longer are limited to fixed, stationary settings they way IS are developed meets new challenges. These challenges are likely to be evolving as technology and application areas for IS evolves. It is therefore also likely that a framework such as the one suggested in this chapter never will assume a fixed and stable form that perfectly match the needs of the IS developers. The outset of capturing aspects of mobile IS use is the haunt for a moving target. Yet, providing developers with the best to date understanding of use of mobile IS is an important endeavour of significant practical and academic value.

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