Chapter 24
Accentuated Factors of Handheld Computing

Bo Andersson and Stefan Henningsson

1 Introduction

The recent years of rapid development of mobile technologies create opportunities for new user groups in the mobile workforce to take advantage of information systems (IS) based on mobile technologies – mobile IS. However, to apprehend and harness these opportunities, it is crucial to fully understand the user group and the mobile technology (Zheng and Yuan 2007).

There are evidences in the form of IS failure supporting the opinion that we still have lessons to learn on how to design and develop mobile IS for the mobile workforce. For example, a large corporate group in Northern Europe within the heavy industry and haulage sector implemented a service order system for their 280 service technicians in Sweden, where the end-user platform was a handheld computer. 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 3 weeks to 3 days. The service technicians, however, deemed the system a failure owing to increased administration on their part from 20 to 90 min/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).

B. Andersson (✉)
Department of Informatics, Lund School of Economics and Management, Lund University, Ole Römers väg 6, SE-22363 Lund, Sweden
e-mail: bo.andersson@ics.lu.se

S. Henningsson
Center for Applied ICT, Copenhagen Business School, Howitzvej 60, 2000 Fredriksberg, Denmark
e-mail: sh.caict@cbs.dk

R. Pooley et al. (eds.), *Information Systems Development: Reflections, Challenges and New Directions*, DOI 10.1007/978-1-4614-4951-5_24,

Similar stories in the business press and academic literature indicate that the example above is not an isolated anecdote but a typical example of how mobile IS projects do not harness the potential due to failure in understanding the use situation and the nature of the handheld computing device (Allen and Wilson 2005; Blechar et al. 2005; Luff and Heath 1998; Norman and Allen 2005; Steinert and Teufel 2005). This is the motivation behind this chapter and its focal point in the concept of mobility and what characterizes mobile IS from a designer's perspective.

2 Objectives

This chapter is based on the proposition that mobile IS has distinctive characteristics compared to the more traditional IS in the shape of stationary IS (Fällman 2003; Lyytinen and Yoo 2002). Our purpose is to develop and evaluate a framework for capturing aspects of handheld computing to be of importance during the analysis and design phases of mobile IS development. The intended use of this framework is in the design phase of the construction of a mobile information system for the mobile workforce. The intended user is a person working with the early design and requirement specifications. Consequently, pure technological aspects such as antennas, roaming and handover are not dealt with. The focus is neither differences in the IS content, that is, potential distinction of what kind of IS applications are being used in traditional and mobile IS, nor by which purpose. We are interested in entities that may be managed, or dealt with, in an IS design and development situation.

A specification of the core topic is warranted here. We are principally discussing handheld computing although in the majority of research, the term mobile computing have more or less been equated with handheld computing. In this chapter, the framework is only applicable on handheld devices where the Small Form Factor (Fällman 2003) is applicable. Another important aspect is that the context for this research is the mobile workforce; an effect of this is the treatment of mandatory versus voluntary use. The assumption is that in the workforce setting the use most often is mandatory and that this will influence use and design.

In the first step, this chapter deductively synthesizes a tentative analytical framework for capturing the accentuated factor of mobile IS, based on previous research on aspects on mobility and approaches to analyse mobile IS use and technology in IS design. 'Accentuated' in this chapter refers to factors that are new, factors that have gained importance or factors where the meaning have changed.

In the second step we use interviews with IS designers and developers to evaluate the framework's qualities. Thereafter we evaluate the framework based on criteria of completeness, distinctiveness and simplicity (see Sect. 4).

3 Related Literature

Much research has been done on mobile IS and mobility per se (Dahlberg 2003; Kristoffersen 1998; Perry et al. 2001), but the conceptualization of the term and what implication mobility has for IS design 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 and Yuan's (2007) framework with the entities' mobile workers, mobile context, mobile tasks and mobile technologies is developed to describe differences between stationary and mobile contexts. Kakihara and Sörensen's (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 design of mobile IS, and furthermore, they are not evaluated. They are more or less a loosely coupled set of factors assembled by the author. A comprehensive and evaluated analytical framework informing system designers is still missing.

One of the few attempts to illustrate factors related to mobile IS design and development, with an intended audience of designers, is the *additional dimensions of mobility* by B'Far (2005). As a consequence of this, in the construction of the basic framework, we departed from B'Far's (2005) framework of additional dimensions of mobility. Why we only depart from these dimensions, and not solely use them, is because these seven dimensions are not exhaustive; this will be discussed in the following section. B'Far identifies seven different dimensions as a result of mobility: *active transactions*, *limited device capabilities*, *Wireless Connectivity*, *location awareness*, *limited power supply*, *large variety of platforms* and *multimodal and variant user interfaces* (Fig. 24.1).

3.1 Some Issues with B'Far's Framework

However, there are some issues with the consistency in B'Far's (2005) framework; some of the different dimensions are of different magnitude or quantity. *Wireless Connectivity, Multimodal and Variant UIs* and *Location Awareness* are healthy, but *Limited Device Capabilities*, *Limited Power Supply* and *Large Variety of Platforms* are values on some scale and *Active Behaviour* is a desired interaction pattern. A more detailed description and motivation for altering dimensions are presented below. Another issue is the edges (lines) between the dimensions; B'Far (2005) does not explain their contribution to the dimensions. Is it that every dimension affects all other dimensions? If so, do they affect in the same magnitude in every case?

Another crucial aspect is our rejection of the concept 'dimension'; using *dimension* implies equivalent units of measure that are not easily constructed. We argue

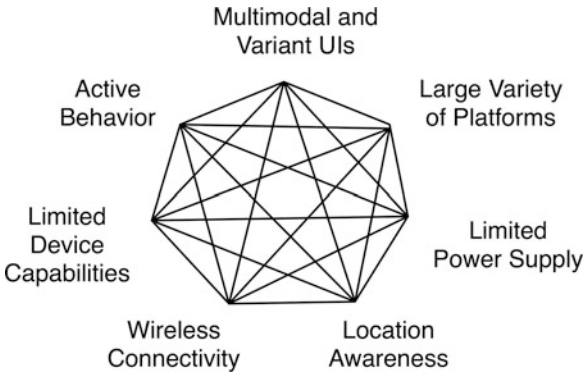

Fig. 24.1 The additional dimensions of mobile computing according to B'Far (Fallman et al. 2004)

that 'factor' is more descriptive, that is, 'a factor is one of the things that affects an event, decision or situation' (Sinclair 1995, p. 595). In this context, the factors in the framework can affect the outcome of a built system depending on how it is managed in the design and development of the system. And *factor* will be used henceforth.

Active Behaviour: Active Behaviour illustrates an interaction pattern a mobile application is supposed to have accordingly to B'Far. (2005). The mobile user is anticipated to benefit on short interaction sequences, short time periods of use and reluctance against long boot sequences, and Active Behaviour is patterned to manage this. The main reason is that the mobile workforce is often occupied with other tasks than working with their computer, a view supported by Marcus and Chen (2002), Pascoe et al. (2000), and Kristoffersen and Ljungberg (1999). However, Active Behaviour is one interaction pattern among others, and the factor is relabelled as *Interaction Patterns*. That is, the mobile user may, or may not, have tasks that will benefit on the interaction pattern of Active Behaviour.

Multimodal and Variant UIs: This factor is complex and regards the Small Form Factor with small screen and limited keyboard but also the increased interaction possibilities as using voice, sound and motion as input and output devices and the variation of different settings as differences between different keyboards or different screen resolution. Keyboard may be missing or is offered with limited set of keys compared to an ordinary keyboard (B'Far 2005; Fallman et al. 2004). This factor is relabelled to *Small Form Factor: Interface;* the main reason to relabeling it is that Small Form Factor is a well-known concept in mobile and handheld computing.

Large Variety of Platforms: The mobile industry is characterized with a large and heterogeneous set of actors and stakeholder. This creates a complex ecosystem with competing technologies and standards that in turn affect designers trying to design systems functional on different platforms. In respect of this set of actors and in the case of mobile applications, the platform variation is large, meaning large variations of operating systems among the handhelds and large variation of hardware configurations (B'Far 2005; Andersson and Hedman 2007). These aspects remains in this factor, however, renamed as *Platform Variation* removing the adjective *large* because it implies a value. There may be cases where the variation is small.

Limited Power Supply and *Limited Device Capabilities*: Both of these factors relate to hardware capabilities. Limited Power Supply is a factor that is highly relevant for mobile devices, since in practice they require to be battery powered and independent of the fixed-power networks. Limited device capabilities regard chiefly the effects of miniaturization on hardware. Effects are reduced processing capability, limitations in storage, etc. (B'Far 2005). However, these two factors are strongly related to each other that they are placed in the same factor and the value (limited) is deleted, renaming it to *Small Form Factor: Hardware*.

Location Awareness: Handheld devices are mobile and therefore able to appear in different places, and they can by different means use information of its physical location. This location awareness can be achieved by GPS, triangulation, accessing nodes or other techniques (B'Far 2005). There has been a considerable amount of work on location-based services mainly of conceptual type or for marketing (Tilson et al. 2004), but lesser work has been done on supporting the mobile workforce with applications using location awareness. This factor remains unchanged in *location awareness*.

Wireless Connectivity: The factor Wireless Connectivity illustrates the unpredictability of quality of service both in transmission rate and connectivity. With wireless networks, disconnection is a factor to manage. Temporary disturbances as sun flares, road tunnels, interference and skip zone affect the transmission (B'Far 2005; Dunlop and Brewster 2002). These factors, possible variation in transmission rate and possible variation in connectivity, remain in the unaltered factor *Wireless Connectivity*.

3.2 Extending B'Far

When performing a literature review, some other factors surface. By adding these factors, we are gaining a more comprehensive framework on accentuated factors.

Field-Use Condition: For the mobile workforce most work is obviously done at the field, rendering a use situation often labelled field use conditions. Field-use conditions could incorporate social settings, supporting technologies, supportive colleagues, etc. However, we argue that field-use condition regards the physical surroundings as quiet or noisy environments, sunlight, darkness, heat or low temperature all influencing the field use in their own ways. The lack of a predefined workplace is also a part of this factor; mobile workers need to adapt to different and diversified workplaces (Perry et al. 2001; Brown and Kenton O'Hara 2003; Marcus and Gasperini 2006). This factor is labelled *field-use conditions*.

Anywhere: Anywhere is almost a trademark of handheld computing and depictures freedom of place. However, there is some ambiguity in the interpretation of anywhere; does anywhere illustrate the mobility of the user? or the mobility of an application? or the mobility of a document (Perry et al. 2001; Makimoto and Manners 1997; Siau and Shen 2003)?

In this chapter, anywhere illustrates the mobility of the user; however, in a work situation, the interpretation of freedom of place can be questioned. We argue that for the mobile workforce and mandatory use, the user most likely is not allowed to choose the place; on the contrary, the place may be specific. A 'just on place' requirement is more applicable, for example, it may be important that a doctor is at a specific place to do something. For clarity of the possible restrictions on anywhere, the alternative label *Place Critical* is put forth and will be used in the forthcoming framework.

Anytime: Anytime is closely related to anywhere and usually describes that the user can access certain information, a service or an application when the user wants a freedom in time (Perry et al. 2001; B'Far 2005; Makimoto and Manners 1997). The same ambiguity as for anywhere surfaces; to contrast the conception of freedom in time, when users actually do need information, it is often relatively a time-critical information such as the repair status on a machine or a some purchasing status just before a client meeting. For the same reasons as for anywhere, 'just in time' is a more accurate term to illustrate the mobile workforce and mandatory use relation to freedom in time. For clarity of the possible restrictions on anytime, the alternative label *Time Critical* is put forth and will be used in the forthcoming framework.

Security Issues: In wireless communication, security issues are present due to the risk of interception. These may be the different types of threats as masking, listening, browsing and distortion (Elliott and Phillips 2004; Nikita et al. 2001). Another security issue is the Small Form Factor and its omnipresence. The handheld device's small size opens up to the factor to be carried along in a greater extent than, for example, a laptop computer. This frequent exposure increases the risk of it being stolen or lost (greater exposure in foreign environments) than, for example, a desktop computer (Elliott and Phillips 2004; Ravi et al. 2002). These two security issues, wireless transmission threats and the increased risk of device being lost, are merged in the factor *security issues*.

Supporting Technologies: Compared to the office worker, the mobile workforce accessibility to supporting technologies is often limited. Important documents may not be easily accessed and displayed through a handheld device. File management, servers, fax machines, written manuals, written ledgers or other support systems may not be available in the same extent as in an office environment (Zheng and Yuan 2007; Brown and Kenton O'Hara 2003). This factor is labelled *Supporting Technologies*.

Support Situation: The fact that a considerable part of the mobile workforce is working by themselves on the field renders a lack of interaction of colleagues within an informal fashion. The coffee room interaction (Orr 1996) is missing and furthermore, offering IT/IS support can be more problematic due to the sheer distance (Andersson 2011). This factor is labelled *Support Situation*.

Information System Dependencies: IS dependencies regards the mobile workforce high reliance on their information system. If an implemented application is the only application the user may access, and this application is crucial for the user to conduct the work, the reliance on this application is high. If the application

malfunction, or that the implemented workflow, does not match the actual/real workflow, these problems will have extensive negative impact on perceived usefulness and productivity (Andersson 2008; Andersson and Carlsson 2009). The options to 'bypass' problems with post-it notes or other IS application are often lesser. This factor is labelled *Information System Dependencies*.

3.3 A Tentative Framework

Departing from B'Far's (2005) seven dimensions, and by a literature review extending it, a framework of 13 aspects was built. Some of the labels from B'Far's framework were altered to reduce logical inconsistencies as being of different magnitude or quantity.

The tentative frameworks based on previous research on factors concerning handheld computing are *Field-Use Conditions*, *Information System Dependency*, *Interaction Patterns*, *Location Awareness*, *Place Critical*, *Platform Variation*, *Security Issues*, *Small Form Factor: Hardware*, *Small Form Factor: Interface*, *Support Situation*, *Supporting Technologies*, *Time Critical* and *Varying Connectivity*.

We deliberately choose not to illustrate the factors in a graphical notion as B'Far just because we do not want to confuse the reader as we were imposing relations between factors.

4 Method

The framework put forth in this chapter is an example of theory for analysing and describing (Gregor 2006). The framework in form of a collection of individual factors can be considered as a theory for describing the components of handheld computing, that is, 'The theory does not extend beyond analysis and description. No causal relationships among phenomena are specified and no predictions are made' (Gregor 2006, p. 620). The evaluation criteria for theory for analysing suggested by Gregor are applied. 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. 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 (Gregor 2006).

Table 24.1 Informant profiles

Job title	Employer	Year of experience of mobile development
Senior developer	Cybercom	8
Software engineer	Mashmobile	6
CEO	Qubulus	11
Development consultant	Stratal	7
Program owner	Cybercom	11
Senior developer	Mobimation	14
Software engineer	Yahm	4
Software engineer	QlikTech	5
Software developer	Databolaget	6
Program manager	Logica	5
CTO	WIP	12
Program manager	Sigma	3
Program manager	Sogeti	12

The empirical data required to assess the frameworks usability was gathered by semi-structured face-to-face interviews. Thirteen informants with experience of design and development of handheld applications were interviewed (see Table 24.1).

The interviews had an average duration of 1 h and 30 min. All interviews revolved around what the informant considered being significant in the design of mobile information systems, the differences between stationary/desktop design and about the importance of the factors derived from literature and the applicability of a framework as such. All interviews were recorded and transcribed. After each interview, transcriptions were coded into groups related to factors and analysed chronologically in order to identify eventual saturation. The QDA software HyperRESEARCH was used during analysis. Saturation here refers to that no additional, unknown comments or suggestions regarding the three evaluation criteria came up during the interview, and saturation was reached after five interviews. Due to saturation, after nine interviews the interview guide was modified, aiming to also find dependencies between factors; however, the interviews still revolved the factors and were possible to analyse in line with the preceding nine interviews.

5 Framework Evaluation

The empirical evaluation of the framework was in large extent in favour of the tentative framework; however, regarding completeness, suggestions on adding one factor were put forth (see following section). Concerning distinctiveness, suggestion on the separation of aspects in one factor was also put forth (see following section). Concerning simplicity, all informants allege they understood the factors (see Table 24.2).

Table 24.2 The informant's evaluation on factors

Informant	Completeness	Distinctiveness	Simplicity
A	Add high-velocity environment	Agree	Agree
B	Agree	Agree	Agree
C	Agree	Agree	Agree
D	Agree	Agree	Agree
E	Agree	Division of SFF interface and multimodal interface	Agree
F	Agree	Agree	Agree
G	Agree	Agree	Agree
H	Add high-velocity environment	Division of SFF interface and multimodal interface	Agree
I	Agree	Division of SFF interface and multimodal interface	Agree
J	Agree	Agree	Agree
K	Agree	Agree	Agree
L	Agree	Agree	Agree
M	Agree	Agree	Agree

High-Velocity Environment was suggested as an additional factor. It illustrates the fast-changing environment with competing vendors, manufacturers and content providers, and it was argued that this factor is more fierce and withstanding than within stationary computing. High-Velocity Environment exists in stationary computing but the importance of this factor is greater in handheld computing. The life cycle of an application is shortened on a handheld device due to shorter expected lifetime of the device, more frequent changes in operating systems versions (with low degree of backward compatibility) and faster changes in carrier's platforms etc. However, the label *High-Velocity Environment* on this factor implies a value and to be consistent it is relabelled to *Industry Dynamics*.

Another factor created from the evaluation was Multimodal Interfaces. This aspect already exists in the framework in Small Form Factor: Interface; however, it was argued that a separation of concerns was necessary. Small Form Factor: Interface should concern the reduction on interface due to the Small Form Factor. Multimodal Interface, however, is not a consequence of Small Form Factor; it is a set of new I/O possibilities as motion control or LDR sensors and therefore should be distinguished by an own factor: *Multimodal Interface*.

To summon the evaluation of the accentuated factor framework, the informants supported the tentative framework although with the extension of two factors. Some comments on the framework applicability were that they regarded the framework as highly useful for senior designers with project management assignments and for persons responsible for procurement of IS/IT solutions and likes, both in design/development and in benchmarking of existing competing systems in a procurement process. As two informants put it:

This framework would be useful for anyone procuring a mobile IS, assisting that person to evaluate if all, for that specific case, important factors are recognised. (Senior developer, Cybercom)

Useful to use this framework and to specify the important factors in design, and also to evaluate an existing system and see if it matches the needed requirements. (Senior developer, Mobimation)

The final frameworks of accentuated factors for mobile information systems are Field-Use Conditions, Industry Dynamics, Information System Dependency, Interaction Patterns, Location Awareness, Multimodal Interfaces, Place Critical, Platform Variation, Security Issues, Small Form Factor: Hardware, Small Form Factor: Interface, Support Situation, Supporting Technologies, Time Critical and Varying Connectivity.

6 Conclusions

With the ambition of improving mobile IS design and development, we have in this chapter put forth a framework for describing accentuated factors in IS design for handheld computing from a designer's perspective.

Theoretically, we add to the existing knowledge base on mobile IS design in two regards. First, we apply a holistic approach on the accentuated factors by synthesizing previous literature into a comprehensive framework; second, we evaluate and expand it based on evaluations by experienced designers.

Practically, the proposed framework was evaluated based on the criteria that it should help mobile IS designers to better apprehend the properties of handheld computing. It can be used as an analytical tool in the design process to ensure that the accentuated factors are appropriately recognized, or as a tool for analysing competing solutions in the procurement process.

In this chapter we commence a theorization process aimed at analysing and describing accentuated factors of mobile IS design, with the final goal of providing mobile IS designers with tools to dealing with the particular problems with mobile IS design.

We foresee that the next steps in a cumulative process towards this ambition would be furthering of the empirical basis for drawing conclusions of the interdependencies between factors, that is, how do different factors affect each other and more in-depth analysis of the importance of the factors – finding critical factors. For example, explanatory theory to design artefacts fitting the work context of mobile IS designers will be needed.

References

Allen D, Wilson TD (2005) Action, interaction and the role of ambiguity in the introduction of mobile information systems in a UK police force. Mob Inf Syst-Bk 158:15–36

Andersson B (2008) About appropriation of mobile applications – the applicability of structural features and spirit. Paper presented at the proceedings of the European conference on information systems (ECIS), Galway
Andersson B (2011) Harnessing handheld computing – managing IS support to the digital ranger with defensive design. In: Proceedings of the sixth international conference on design science research in information systems and technology (DESRIST 2011), Milwaukee
Andersson B, Carlsson SA (2009) Designing for digital nomads: managing the high reliance on single application. Paper presented at the proceedings of the global mobility roundtable, Cairo
Andersson B, Hedman J (2007) Developing m-services: lessons learned from the developers' perspective. Commun Assoc Inf Syst 20(1):605–620
B'Far R (2005) Mobile computing principles: designing and developing mobile applications with UML and XML. Cambridge University Press, New York
Blechar J, Constantiou I, Damsgaard J (2005) The role of marketing in the adoption of new mobile services: is it worth the investment? ICMB 2005: international conference on mobile business, pp 370–376
Brown B, Kenton O'Hara B (2003) Place as a practical concern of mobile workers. Environ Plan A 35(9):1565–1588
Dahlberg P (2003) Local mobility. Diss Göteborg Univ, 2003, Department of Informatics, University of Göteborg
Dunlop M, Brewster S (2002) The challenge of mobile devices for human computer interaction. Personal Ubiquitous Comput 6(4):235–236
Elliott G, Phillips N (2004) Mobile commerce and wireless computing systems. Pearson Education, Harlow
Fällman D (2003) In romance with the materials of mobile interaction: a phenomenological approach to the design of mobile information technology. Umea University, Umeå
Fallman D, Lund A, Wiberg M (2004) Scrollpad: tangible scrolling with mobile devices. p 6
Gregor S (2006) The nature of theory in information systems. MIS Q 3:611–642
Kakihara M, Sørensen C (2002) Mobility: an extended perspective. Paper presented at the 35th annual Hawaii international conference on system sciences (HICSS'02)
Kristoffersen, Ljungberg (1998) Representing modalities in mobile computing – a model of IT use in mobile settings. In: Proceedings of interactive applications of mobile computing, Rostock
Kristoffersen S, Ljungberg F (1999) "Making place" to make IT work: empirical explorations of HCI for mobile CSCW. Paper presented at the proceedings of the international ACM SIGGROUP conference on supporting group work, Phoenix, Arizona, United States
Luff P, Heath C (1998) Mobility in collaboration. Paper presented at the proceedings of the 1998 ACM conference on computer supported cooperative work, Seattle, Washington, DC, USA
Lyytinen K, Yoo Y (2002) Research commentary: the next wave of nomadic computing. Inf Syst Res 13(4):377–388
Makimoto T, Manners D (1997) Digital nomad. Wiley, Chichester
Marcus A, Chen E (2002) Designing the PDA of the future. Interactions 9(1):35–44
Marcus A, Gasperini J (2006) Almost dead on arrival: a case study of non-user-centered design for a police emergency-response system. Interactions 13(5):12–18
Nikita B, Ian G, David W (2001) Intercepting mobile communications: the insecurity of 802.11
Norman A, Allen D (2005) Deployment and use of mobile information systems. Mob Inf Syst II 191:63–78
Orr JE (1996) Talking about machines: an ethnography of a modern job. ILR Press, Ithaca
Pascoe J, Ryan N, Morse D (2000) Using while moving: HCI issues in fieldwork environments. ACM Trans Comput-Hum Interact 7(3):417–437
Perry M, O'hara K, Sellen A, Brown B, Harper R (2001) Dealing with mobility: understanding access anytime, anywhere. ACM Trans Comput-Hum Interact 8(4):323–347. doi:http://doi.acm.org/10.1145/504704.504707

Ravi S, Raghunathan A, Potlapally N (2002) Securing wireless data: system architecture challenges. Paper presented at the proceedings of the 15th international symposium on system synthesis, Kyoto, Japan

Siau K, Shen Z (2003) Mobile communications and mobile services. Int J Mob Commun 1(1):3–14

Sinclair J (1995) Collins COBUILD English dictionary. Harper Collins, London

Steinert M, Teufel S (2005) The European mobile data service dilemma – an empirical analysis on the barriers of implementing mobile data services. Mob Inf Syst II 191:63–78

Tarasewich P (2003) Designing mobile commerce applications. Assoc Comput Mach Commun ACM 46(12):57–60

Tilson D, Lyytinen K, Baxter R (2004) A framework for selecting a location based service (LBS) strategy and service portfolio. pp 5–8

Zheng W, Yuan Y (2007) Identifying the differences between stationary office support and mobile work support: a conceptual framework. Int J Mob Commun 5(1):107–123