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Critical Success Factors for Wireless Hospital Bed Management Systems: The Case of MARGE

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Abstract

The fast growing deployment of mobile information technologies in the healthcare sector presents valuable opportunities to explore the impact of mobile technologies in this industry. As the demand on the health dollar increases, many healthcare providers throughout the world are starting to take advantage of mobile technologies as part of their key initiatives to provide better quality of service. The purpose of this study was to identify the critical factors that contribute to the success of the MARGE Wireless Bed Management System (WBMS) in a New Zealand hospital. The study found that factors, such as Hardware Selection, System Usability, Mobility, Integration, Information Quality, Efficiency, Improved Patient Care and Positive Organisational Image all contributed to the success of the MARGE WBMS.

Keywords

Healthcare, wireless, mobile, critical success factors, case study

INTRODUCTION

The adoption of mobile technologies by organisations around the world has generated a profound impact on the way business processes are managed and accomplished (Frichol 2001; Siau, Lim et al. 2001; Balasubramanian, Peterson et al. 2002; Scornavacca and Barnes 2003; Barnes 2004; Siau, Nah et al. 2004). Mobile applications are known as an important source of competitive advantage – given its ability to increase staff efficiency and business performance (Barnes 2003).

According to research from the Centre of Medicare and Medicaid Services (CMS), the health industry was worth \$500 billion in 2003 in the United States of America alone. This represented one of the largest spending sectors in the that country (PricewaterhouseCoopersLLP 2005). Healthcare providers and technology vendors are increasingly perceiving mobile technologies as a necessary element for adaptive, flexible and responsive healthcare organisations (Fisher, Lutz et al. 2004). As a result, the healthcare industry has been vigorously embracing mobile Information Systems (IS) in the past five years (Larkin 2001; Lawrence, Culjak et al. 2003; Rao and Parikh 2003; Varshney 2004; Rowley 2005).

The aim of this paper is to identify the critical success factors associated with the implementation of the MARGE Wireless Bed Management System (WBMS) in a New Zealand hospital. The MARGE WBMS was the first of its kind to be implemented in a New Zealand hospital.

The next section of this paper reviews the literature relevant to this study. This is followed by presentation of the research methodology and organisational background. The findings of the research are then provided in conjunction with the case analysis. Finally, the paper ends with conclusions and suggestions for future research.

MOBILE TECHNOLOGY IN HEALTHCARE

Barnes (2003) found that wireless technologies entail eight core benefits to organisations: efficiency, connectivity, flexibility, ubiquity, location awareness, interactivity, effectiveness and business transformation. Mobile technologies such as PDAs, Laptops or Tablet PCs can be of great value in hospitals and healthcare facilities by allowing better access to critical information – e.g. patient status, staff and patient location and facilities availability (Simpson 1996; Nelson 1999; Larkin 2001; Banitsas, Istepanian et al. 2002; Chau and Turner 2004; Varshney 2004; Rowley 2005). Healthcare facilities that choose to adopt such technologies may be able to not only perform better but ultimately provide more efficient and better quality of care for patients (Bahlman and Johnson 2005).

In order to maximize the benefits of mobile technologies, healthcare providers need to make certain considerations when deciding to implement these technologies (Bullard, Meurer et al. 2004). Subsequently, Nelson (1999) posits that having constant, up-to-date, good design, reliable and accurate information at the caregiver's hands are important enablers for the success of wireless systems in healthcare. In addition, the author suggests that in order to ensure success of those systems, the end-user and IS department perspectives need to be considered in a set of critical factors described below:

User Perspective:

Safety and Mobility - The device must be durable and is equipped to accommodate for the type of environment its being intended for.

Battery Life - Operating time and recharging procedure should be considered.

Ergonomic Design – Data should be easy to be read on the screen. An adjustable screen size makes for easier viewing, reduces glare and accommodates users of different heights.

Input Devices – The device is “self-sufficient” or may require any attachments or other forms of additional hardware. Users should use a full-sized key board for high-volume data entry and make sure it is compatible with other applications.

On Board Storage – The device has enough physical storage for attachments, such as stethoscopes, blood pressure cuffs, wire baskets and other clinical instruments that are required for patient monitoring and diagnostics.

Theft Prevention - Most mobile devices today are very expensive and because equipment can be expensive, having adequate protection against thieves is a must.

IS Department's Perspective:

Compatibility -The device must fit in with the IS operating system that is currently installed and should run on the current network without inadequacies.

Processing Power- The unit should be able to run current and future applications. It should be able to be upgraded to handle new applications.

Safety Certifications- Certifications for the use of the devices are generally required for users to comply with.

Support Information- A help desk and on-site support should be available.

Warranty and Service- The supplier should provide a field service technician for onsite repairs. Avoid units that require depot repairs.

Furthermore, Simpson (1996) points out that there are three contributing factors that are associated with the success of wireless systems in healthcare:

Coverage: To the end-user the range of mobile devices is very important. Healthcare providers must never break connection or be ‘stuck in a dead spot’ in a critical moment. All hospital emergency wards especially need coverage on a full time basis due to the volatile and intense nature of work. Radio waves that carry the data back and forth to mobile devices are subject to interference from other objects (e.g. Microwaves, cellular phones and other telemetric devices). A typical solution to this sort of problem is to offer technologies, such as a frequency-hopper rather than direct-sequence technology. Using frequency-hopper technology allows the data to ‘hop’ to different frequencies when it is interrupted rather than direct-sequence (where the data is spread over a series of frequencies). This allows for much less interference from other outside sources.

Performance: Here the health caregivers must have access to a whole range of information including other applications (i.e. web tools, intranet tools and medical libraries) at hand if they wish to. Also the speed quality of the system should operate at higher speeds and surpass the 2.4 GHz worldwide bandwidth standard. The

system needs to provide its users with alerts, alarms and statistical data regarding the network so they can stay up-to-date and stay on top of the wireless network if any down-time does occur. Regarding the physical functionality of the device, the important aspect of a mobile device is to consider its weight and dimensions for its intended purpose. If a member of staff is carrying the mobile device during their entire work shift then the handheld computers must be light and durable enough to be practical.

Service: Due to the critical nature of the point-of-care computing, it is imperative that vendors offer adequate support and service as required. Any new technology brought into the current working environment can be unsettling or, in some cases, traumatic for staff, which require adequate training before they are totally comfortable with the new system.

Both Nelson (1999) and Simpons (1996) studies present a good theoretical foundation for this study as it closely relates to the success of wireless devices in healthcare.

Table 1 presents a summary of CSF found in the literature on wireless health information systems literature.

Table 1: Summary of CSF on wireless health information systems literature

Author	Aspects of Success for a Wireless in Health Context
Nelson (1999)	IS User's Perspective <ul style="list-style-type: none"> • <i>Safety and Mobility</i> • <i>Battery Life</i> • <i>Ergonomic Design</i> • <i>Input Devices</i> • <i>On Board Storage</i> • <i>Theft Prevention</i>
	IS Department's (function) Perspective <ul style="list-style-type: none"> • <i>Compatibility</i> • <i>Processing Power</i> • <i>Safety Certifications</i> • <i>Support Information</i> • <i>Warranty and Service</i>
Simpson (1996)	<ul style="list-style-type: none"> • <i>Coverage</i> • <i>Performance</i> • <i>Service</i>

In addition, the literature also describes some current limitations that deterrent the quality of service of wireless information systems in the healthcare – e.g. battery life or processing power of device, unpredictable and spotty coverage of users, the quality information displayed and reliability of patient monitoring (Gururajan and Vuori 2003; Fisher, Lutz et al. 2004; Varshney 2004; Bahlman and Johnson 2005).

ORGANISATIONAL BACKGROUND

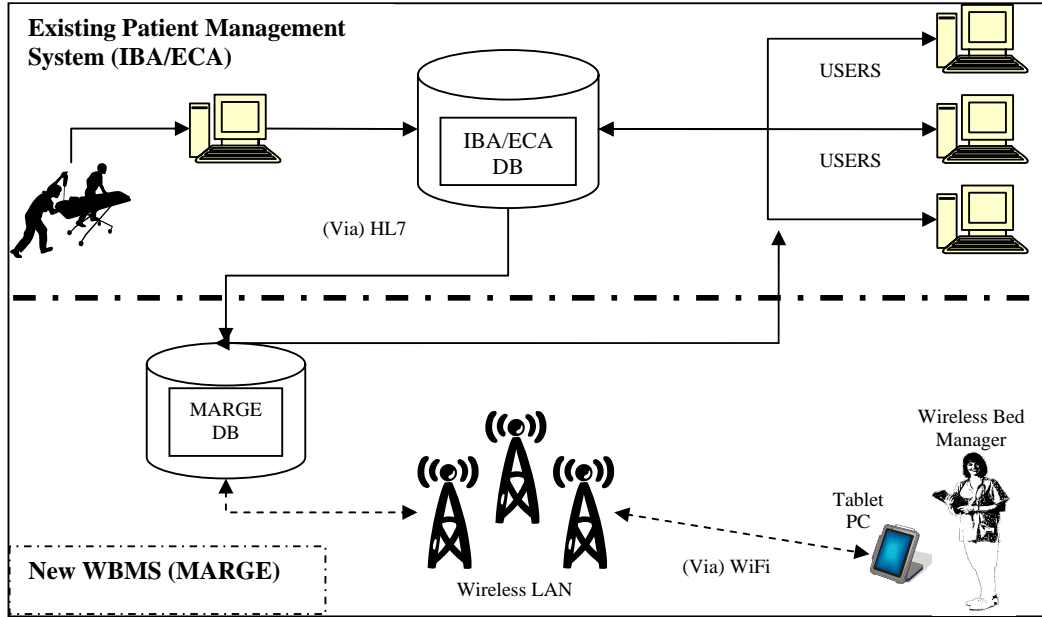
The organisation studied was a medium (i.e. approximately 340 beds) hospital situated in Hastings, located in northern New Zealand. MARGE is a wireless standalone Information System, linked via the hospital's LAN and interrogates the main IBA database (primary patient management system). From the IBA, the patient/bed information is then sent in real-time using a secured HL7 protocol (i.e. common healthcare standard) to a Tablet PC carried by the Bed Manager.

Its primary function is to bring together the existing IBA data on patients and the information about bed occupancy levels to a single point – i.e. the Bed Manager. The Tablet PC has a standard Microsoft Windows style operating system and consists of a touch screen, which visually displays each of the hospital's areas, units, wards, beds and other relevant patient information. When used constantly, the device can last up to 3-4 hours; however a battery change is required throughout a typical 8-10 hour shift.

Currently two Tablet PCs exist although only one is used as the other is for backup. A traffic lighting indicator using a 0-100% range indicates to the Bed Manager the bed occupancy levels real time. MARGE is similar to a web type application where the Bed Manager can wirelessly retrieve, send and update data without having to modify the data in the hospital's IBA patient management system. Although the MARGE WBMS, in this instance, has been developed for the use of the Tablet PC it can also be used by other portable devices, such as a WAP capable phone or PDA. There are also desktop PCs situated around each ward that provide a secondary

source of processing information for MARGE - in case the wireless system fails. Figure 1 below illustrates the MARGE Bed Management System at the hospital.

Figure 1: Hawke's Bay Hospital Wireless Bed Management System (MARGE)



Bed Management (BM) incorporates many other conventional roles; from checking and allocating bed occupancy levels, administrative and data collection tasks to preparing staff resources and surgery wards. They are the core people responsible for the coordination, communication and allocation of patient to beds. Previously the Bed Manager used to carry around bits of paper based information and would constantly be on the phone to retrieve extra information on patients and beds. In an intensive and fast paced environment, this method was often inefficient and stressful especially as often the information was inaccurate or kept changing. The introduction of the wireless PC Tablet has made the Bed Manager's work less intensive, more efficient and freed up time for other tasks.

METHODOLOGY

Case study research typically combines multiple data collection methods (Benbasat, Goldstein et al. 1987; Eisenhardt 1989; Creswell 2003). Therefore the three main forms of data collection for this study entailed obtaining background documents, making observations in the hospital and through conducting face-to-face interviews with the participants. Collecting different types of data by different methods from different sources produces a wider scope of coverage and may result in a fuller picture of the phenomena under study than would have been achieved otherwise (Benbasat, Goldstein et al. 1987; Eisenhardt 1989; Creswell 2003). The primary data collection was based on drawing out the experiences of the Bed Manager and IT person within the context of mobile/wireless technology (i.e. MAREGE WBMS) in the hospital. This study undertook notes on the experiences of the subjects through interviews using open-ended questions and observations in their natural setting (i.e. the hospital).

Before the actual face-to-face interviews took place, the researcher spent considerable time shadowing (i.e. following and observing) the Bed Manager throughout the hospital and wards. This part was necessary to gain better insight and understanding of the types of processes and events that occurred with respect to wireless Bed Management. Additionally, it gave the researcher a much more comprehensive understanding of the participants' surroundings and context within the system (Eisenhardt 1989; Creswell 2003). The primary data collection included the Bed Manager and the IT support person for the MARGE WBMS.

CASE ANALYSIS AND FINDINGS

Overall both the Bed Manager and IT systems support person regarded the WBMS as a successful Bed Management tool. A number of key success factors emerged from the interview transcripts during the data analysis procedure. Specifically, factors such as Hardware Selection, System Usability, Mobility, Integration, Information Quality, Efficiency, Improved Patient Care and Positive Organisational Image were all common themes found essential to the success of this system. These factors are discussed below alongside its relation to existing literature.

Hardware Selection: Selecting the appropriate device was considered by the Bed Management as one of the most important issues in the deployment of the system. She considered it important for the mobile device to have a balance between portability and functionality. Also, while being easy to carry, the device should simultaneously provide the adequate level of functionality in order to support her task portfolio. She mentioned:

“We’ve tried other devices, we’ve tried the little portable Palm pilot...which is fine for the night shift but for the afternoon shift you need something bigger (i.e. screen size) so we’ve tried a different one. I really like the portability [mobility] of it...I could check my emails and do other things with it while working and that was great. That’s really the only thing I could see as having an advantage over a PC. The portability of it was great because most areas you are connected wherever you are.”

Consistent with Nelson (1999) and Barnes (2003), the specific aspects such as, safety and mobility (portability of device), battery life, ergonomic design, weight and input devices were important factors to consider in selecting a device for Bed Management from a user perspective.

System Usability: The portability of the device, inter-face layout, navigation and colour-coding screen contributed highly to the success and usability of the system. The Tablet PC provided sufficient visual data while also being small enough to carry (e.g. device size & weight). In addition, the touch screen and foldout keyboard were perceived as elements that improved the usability of the system. The bed manager mentioned:

“Probably the display of the screen and colour-coding is also one of the biggest things. I can see each individual ward and look at it straight because of the colour-coding and it gives you a good visual [interface] of what’s going on. Yeah, it makes it easy and I think visually it’s really easy to use...”

In addition, the background documents as well as the observations made onsite before the interviews provided to the researcher with a deep understanding about the system and how it was being used including the visual aspect of the device and its technical scope. Having the right combination of hardware (i.e. physical feature of the device) and software (i.e. functions and of the application) made the Tablet PC to be perceived as more user-friendly. Usability (i.e. ease of use of device) and mobility (of the user) has also been recognised as a key enabler for successful use of wireless devices (Barnes 2004). Having the right interface design and functionality can affect the usability aspects of success for wireless IT systems in health as identified by Simpson 1996 and Nelson 1999 critical success factors.

Mobility: This was considered one the most prominent factors for the users. Being mobile meant that the Bed Manager could perform her duties from anywhere and anytime within the hospital. This provided more flexibility as well as efficiency. She mentioned:

“Mobility, speed, up to date information, constantly on tap, not having to record the same information day after day, having it all in one place, all in one view. I think the system is really awesome... I’ve wanted this sort of thing for so long and it does make my life so much easier.”

The IT person added to this point

“The thing I like about it is the portability of it [Tablet PC]. Of course you’re kind of confined to where ever the wireless setup is so there are certain black spots but the portability of it was great because most areas you are covered...when I was testing it and getting used to it, it was just really cool to use it... I could check my emails and do other things, and that was great. That’s really the main thing (i.e. mobility and portability) I could see as having an advantage over a PC.”

Flexibility through mobility was also extensively recorded in the mobile business literature (Simpson 1996; Simpson 2002; Pica and Kakihara 2003; Scornavacca, Barnes et al. 2006; Scornavacca and Barnes 2006; Scornavacca, Prasad et al. 2006).

Integration: The IT systems support person explained that the ease of integration of MARGE with existing systems was an advantage. The compatibility of a new wireless system to fit in with the current IS operating system impacted on the overall success of MARGE. She also mentioned that most healthcare organisations are lagging in their IT initiatives as they often have existing legacy systems and standards (e.g. HL7), which can be a barrier to implementing new IT systems (Fisher, Lutz et al. 2004). The ease of integration, as with MARGE, is an important part of an organisations successful use of that system (DeLone and McLean 2003).

Information Quality: Instead of chasing up bits of dispersed information, the Bed Manager had exactly what she needed always available on the Tablet PC. The bed manager illustrated:

“I think it [MARGE] has definitely sped things up. It does give me better information, it’s meant that I can chase the wards staff about length of stay and discharge information quickly. That and the time saved from Emergency Department (ED) was something we didn’t expect to get out of the Bed Management System (BMS)... I’m really dependent on them giving sufficient information and that really varies...it gives constant, up-to-date information because that’s the whole point of it is to have, current, up-to-date, constant information”

The quality of information has been recognised as pertinent toward the success of an information system (DeLone and McLean 2003). Currently, the Bed Manager is able to receive accurate, fast, real-time, relevant and complete information making her job a lot more effective and easier. As well as documented in the literature, conventional paper based systems in healthcare have the propensity to result in inaccurate, incomplete and time consuming processes when gathering information about patients (Gururajan and Vuori 2003; Bahlman and Johnson 2005; Rowley 2005).

Efficiency: The introduction of MARGE into the hospital has increased the productivity of the bed management process. Efficiencies at the operational level were realised through a reduction in time taken to allocate beds to patients, faster patient/bed information and discharges, which ultimately reduced costs.

“I think it [MARGE] has definitely increased the efficiency...the number of long stay patients have dropped. Now they can send me the information on the computer [Tablet PC]. The Tablet PC has freed staff, they can now concentrate and do other things - it has saved at least 1 FTE (full time staff member) in the emergency department. So that’s 1 full-time, 40 hrs a week member”.

The IT support person also mentioned

“...probably now the stress levels of the BM is lower...they’ve got more time to do their real job rather than waste it on the phone or looking for bits of paper”.

In convergence with existing literature, efficiency gains at the operational level are also realised with wireless technologies (Zhang and Yuan 2002; Barnes 2003; Gururajan and Vuori 2003; Bullard, Meurer et al. 2004; Bahlman and Johnson 2005; Rowley 2005). In particular the costs savings through increased productivity by introducing wireless technologies have also been identified in previous studies (Heitman and Stanoevska-Slabeva 2003; Stanoevska-Slabeva 2003; Bahlman and Johnson 2005; Scornavacca and Barnes 2006).

Improved Patient Care: With respect to service, the Bed Manager claimed an increase in the quality of service provided to patients.

“When people are wanting beds, we can see at a glance and say - ‘ah yes we’ve got 1 or we’ve got 2, not a problem’, rather than go shuffling through a whole lot of paper so we get a lot of satisfaction out of that...it does reduce stress”

More efficient and effective Bed Management has meant that when patients are admitted into the hospital do not have to wait so long to be allocated to a bed. The Bed Manager added:

“It’s absolutely vital to know when the patient is discharging etc. I can see that using the colour coding. When you’re operating at a 100% plus occupancy it becomes vital, when you’ve got 10 patients in the ED waiting for a bed and you know you’ve got 15 elective patients. It’s that morning time when you got to keep that flow [turn-over of beds] going.”

MARGE’s ability to promptly assess the bed occupancy status in the hospital for incoming patients has meant that, not only has the rate of patient to bed allocations increased, but also the quality of service. Better services offered as result of the deployment of mobile applications in healthcare organisation have also been found in the previous literature (Larkin 2001). Service was also identified by Simpson (1996) as a critical success factor for wireless patient care.

Positive Organisational Image: Lastly, the reputation (image) of the hospital was perceived as a contributor to the overall success of MARGE. According to the Bed Manager and IT systems support person, the WBMS has

brought a sense of pioneering and innovation to the other stakeholders in the hospital (i.e. clinical staff and patients). The IT support person mentioned:

"I think if we can get the Clinical Charge Nurse to use it. It will help them a lot. They're always on the floor... they can use TrendCare [i.e. nursing resource tool] but with this [MARGE] they can see visually what is happening. I think if they can see what it's doing to others [patients], it could be a little bit inspiring for them."

This was further strengthened by observations and time spent 'shadowing' the Bed Manager, where the researcher noticed that there was a positive feeling towards the technology from the nursing staff. The hospital staff mentioned that patients commonly notice and also acknowledge existence of the new system – the Bed Manager mentioned *"when they see a new technology like the Tablet PC, they are immediately curious about it"*. Both BM and IT person also felt that the status (e.g. image, reputation) of the hospital has increased. According to the Bed Manager it gives the patient a feeling of the hospital using advanced, up-to-date technology. Increases in an organisations image through innovative mobile technologies have also been found in previous studies (Larkin 2001; Barnes 2003; DeLone and McLean 2003; Heitman and Stanoevska-Slabeva 2003; Stanoevska-Slabeva 2003; Fisher, Lutz et al. 2004; Scornavacca, Prasad et al. 2006).

In summary aspects, such as Hardware Selection, System Usability, Mobility, Integration, Information Quality, Efficiency, Improved Patient Care and Positive Organisational Image have been key enabling factors for success of wireless bed management. Further, it is interesting to note that the factors that contribute to the success of MARGE WBMS can be divided into two main categories. The primary set of success factors, such as Hardware Selection, System Usability, Mobility, Integration, Information Quality and Efficiency, which were all factors *"directly"* related to the bed management system. The second set of success factors - Improved Patient Care and Positive Organisational Image, which were related to the *"environmental"* aspects in which the system was deployed.

Some of the critical success factors described above have also been supported by previous studies (Simpson 1996; Nelson 1999; Larkin 2001; Zhang and Yuan 2002; Barnes 2003; DeLone and McLean 2003; Heitman and Stanoevska-Slabeva 2003; Stanoevska-Slabeva 2003; Barnes 2004; Bullard, Meurer et al. 2004; Bahlman and Johnson 2005; Rowley 2005; Scornavacca, Prasad et al. 2006). Specifically the factors that relate to Hardware Selection of the system, such as those identified by Nelson (1999), were particularly pertinent to the success of the WBMS. Selecting the appropriate device (e.g. portability, screen size, interface design, weight) and making sure there is an appropriate level of integration with the existing legacy system are vital steps for the success of the bed management system. In accordance with Simpson (1996), Mobility, Information Quality and Efficiency were all aspects that related to better coverage and performance, which resulted in the successful use of MARGE.

Furthermore, in accordance with Rowley (2005) and Barnes (2003), Improved Patient Care and Positive Organisational Image where factors that enabled better patient care while also increasing the reputation of the hospital. Although not directly related to the MARGE WBMS, they were environmental factors that enabled the overall success of the system implemented.

CONCLUSION

The use of mobile information systems in the New Zealand health industry is still a relatively new area of study. This study aimed to explore the factors that contributed to the success of the MARGE Wireless Bed Management System in a New Zealand hospital.

A common set of success factors of the MARGE WBMS where identified from both the Bed Manager and IT systems support person. These are: Hardware Selection, System Usability, Mobility, Integration, Information Quality, Efficiency, Improved Patient Care and Positive Organisational Image. In addition, the system was able to eliminate paper based processes, reduce errors, increase employee productivity, reduce costs and increase customer service quality (Simpson 1996; Nelson 1999; Zhang and Yuan 2002; Barnes 2003; Gururajan and Vuori 2003; Heitman and Stanoevska-Slabeva 2003; Stanoevska-Slabeva 2003; Bullard, Meurer et al. 2004; Fisher, Lutz et al. 2004; Bahlman and Johnson 2005; Rowley 2005; Scornavacca, Prasad et al. 2006).

The previous literature found on success of mobile/wireless technologies did not present cases on Bed Management, more specifically cases within the New Zealand health and IT landscape. In this way this study has created value by adding uniformity in discovering that the impact of wireless technologies, in other contexts, can also be applied in this particular area. A study, such as this can provide useful insight for other healthcare providers wanting to implement wireless technologies.

The findings described in this research, while generalisable to its peculiar context, must be closely scrutinized in their application to other contexts. The research was conducted at a singular point in time and consisted of only

one round of data collection with two participants. The results were drawn solely from the interviewees' perspectives and thoughts.

Future research should aim to widen the current scope of this research focusing on other stakeholders in the hospital environment - i.e. upper level management as well as patients. In addition, a longitudinal study is also suggested in order to understand the sustainability of the CSFs and how they change over time.

REFERENCES

- Bahlman, D. T. and F. C. Johnson (2005). "Using technology to improve and support communication and workflow processes." Association of Operation Room Nurses **82**(1): 65.
- Balasubramanian, S., R. A. Peterson, et al. (2002). "Exploring the implications of m-commerce for markets and marketing." Academy of Marketing Science. Journal **30**(4): 348-361.
- Banitsas, K., R. S. H. Istepanian, et al. (2002). "Applications of medical wireless LAN systems (MedLAN)." International Journal of Medical Marketing **2**(2): 136.
- Barnes, S. J. (2003). The Mobile Commerce Value Chain in Consumer Markets. mBusiness: The Strategic Implications of Wireless Communications. S. J. Barnes. Oxford, Elsevier/Butterworth-Heinemann: 13-37.
- Barnes, S. J. (2004). Wireless support for mobile distributed work: Taxonomy and examples.... Hawaii International Conference on System Sciences, Big Island, Hawaii.
- Benbasat, I., D. K. Goldstein, et al. (1987). "The case Research Strategy in Studies of Information Systems." MIS Quarterly **11**(3): 369 - 386.
- Bullard, M. J., D. P. Meurer, et al. (2004). "Supporting clinical practice at the bedside using wireless technology." Academic Emergency Medicine **11**(11): 1186.
- Chau, S. and P. Turner (2004). Examining the utilisation of mobile handheld devices at an Australian aged care facility. 8th Pacific Asia Conference on Information System. Shanghai, China.
- Creswell, J. W. (2003). Research Design Qualitative, Quantitative and Mixed Methods Approaches. Chennai, India, Sage Publications.
- DeLone, W. H. and E. R. McLean (2003). "The DeLone and McLean model of Information Systems Success: A ten-year update." Journal of Management Information Systems **19**(4): 9-30.
- Eisenhardt, K. M. (1989). "Building Theories from Case Study Research." Academy of Management Review **14**(4): 532-550.
- Fisher, J., S. Lutz, et al. (2004). How will health care organisations move beyond clinical systems and towards a true digital hospital environment? . Global Technology Centre PricewaterhouseCoopers LPP.
- Frichol, M. (2001). "There's no business like e-business." IIE Solutions **33**(3): 38.
- Gururajan, R. and T. Vuori (2003). Lessons learned in developing a wireless system for a healthcare industry. International Telecommunications Society Asia- Australasian Regional Conference, Perth, Australia.
- Heitman, M. and K. Stanoevska-Slabeva (2003). Impact of Mobile Ad Hoc Networks on the Mobile Value System. Second International Conference on Mobile Business, Vienna, Oesterreichische Computer Gesellschaft.
- Larkin, M. (2001). "Can handheld computers improve the quality of care?" The Lancet **358**(9291): 1438.
- Lawrence, E., G. Culjak, et al. (2003). M-Enterprise technology: Diffusion of innovation awareness, adoption and uptake. Second International Conference on Mobile Business, Vienna, Oesterreichische Computer Gesellschaft.
- Nelson, L. (1999). "Step-by-step guide to selecting mobile wireless devices." Nursing Management **30**(11): 12.
- Pica, D. and M. Kakiara (2003). The Duality of Mobility: Understanding fluid Organizations and Stable Interaction. European Conference on Information Systems, Naples, Italy.
- PricewaterhouseCoopersLLP (2005). Reactive to adaptive: Transforming hospitals with digital technology, Global Technology Centre & Health Research Institute.
- Rao, B. and M. A. Parikh (2003). "Wireless Broadband Networks: The U.S. Experience." International Journal of Electronic Commerce **8**(1): 37.

- Rowley, R. (2005). "Practicing without paper charts: One clinic's experience." Family Practice Management **12**(2): 37.
- Scornavacca, E., S. Barnes, et al. (2006). "Mobile Business Research Published in 2000-2004: Emergence, Current Status, and Future Opportunities." Communications of the Association for Information Systems (AIS) **17**: 635-646.
- Scornavacca, E. and S. J. Barnes (2003). Mobile banking in Japan. International Telecommunications Society Asia- Australasian Regional Conference, Perth, Australia.
- Scornavacca, E. and S. J. Barnes (2006). "Barcode enabled m-commerce: strategic implications and business models." International Journal of Mobile Communications **4**(2): 163 - 177.
- Scornavacca, E., M. Prasad, et al. (2006). "Exploring the organisational impact and perceived benefits of wireless Personal Digital Assistants in restaurants." International Journal of Mobile Communications **4**(5): 558-567.
- Siau, K., E.-P. Lim, et al. (2001). "Mobile commerce: Promises, challenges, and research agenda." Journal of Database Management **12**(3): 4-13.
- Siau, K., F. Nah, et al. (2004). The Value of Mobile Commerce to Customers. Austin Mobility Roundtable, Austin, Texas.
- Simpson, R. L. (1996). "Wireless communication: A new frontier in technology." Nursing Management **27**(11): 20.
- Simpson, R. L. (2002). "Eyeing IT trends and challenges." Nursing Management **33**(12): 46.
- Stanoevska-Slabeva, K. (2003). Towards a Reference Model for M-Commerce Applications. European Conference on Information Systems, Naples, Italy.
- Varshney, U. (2004). Using wireless networks for enhanced monitoring of patients. Tenth Americas Conference on Information Systems, New York.
- Zhang, J. J. and Y. Yuan (2002). M-commerce versus internet-based E-commerce: the key differences. Americas Conference on Information Systems 2001, Dallas, Texas.

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