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Abstract

Interest in mobile computing applications has been increasing over the past few years. The Healthcare sector has begun recognizing the potential for providing at "point-of-care" access to applications through mobile devices. This paper explores the impact of mobile computing in the evaluation of the performance of an Emergency Medical Services organization in Australia. The paper concludes that the use of a mobile system enables an emergency service organization to speed up data capture and more efficiently provide data that can be used to the advantage of paramedics and the organization. It also has the potential to enable the organization to more effectively manage various aspects of the organization.

Keywords

Mobile Computing, Healthcare Systems, Emergency Medical Services, IT investment evaluation, Case Study

INTRODUCTION

Interest in mobile computing applications has been increasing over the past few years. One indication of this is that by 2003, Microsoft had registered 11,000 applications, and now has more than 380,000 professional Windows Mobile developers worldwide (Smith, 2004). The mobile computing applications of most interest to corporations are email, calendars, sales force automation (SFA), customer relationship management (CRM) and field force automation (Smith, 2004). The Healthcare sector has also begun recognizing the potential for providing at "point-of-care" access to applications through mobile devices, for the healthcare professional (Burley & Scheepers, 2004; McCreadie, Stevenson, Sweet, & Kramer, 2002; Rothschild, Lee, Bae, & Bates, 2002).

Emergency Medical Services (EMS) around the world are under increasing pressure to increase the efficiency and effectiveness of their resourcing and improve accountability (Baragwanath, 1997; DepartmentofHealth, 2005; MAS, 2005; O'Meara, 2005). One of the major drivers for this is the ongoing annual increase in the volume of calls. There are several ways Emergency Services are attempting to face these challenges. Firstly, to look at performance frameworks for ambulance services to enable a broader set of measures rather than simply tracking response times (O'Meara, 2005). Secondly, to look at supporting the drive for professionalism of paramedics (Reynolds, 2004), Thirdly to increase research and data collection as a basis for evidence based practice (Callaham, 1997; Jacobs, 2000; Shapiro, 2000).

There is a growing interest in measuring performance across the health system (NHPC, 2001). O'Meara (2005) used the NHPC framework and tailored it specifically for ambulance services. The key dimensions are: *effectiveness, appropriateness, safety, capability, continuity, accessibility and equity, acceptability and efficiency* each with associated structure, processes and outcomes (O'Meara, 2005). The main driver for a new performance framework is to move away from the concentration on response times which is often used as the sole measure of effective ambulance service performance.

The case study investigated the pilot implementation of a mobile clinical information system, VACIS at MAS branches in the Northern suburbs of Melbourne, Australia. 140 paramedics were part of the pilot group trained

by MAS senior paramedics to use VACIS and the case study explored both the management and the paramedic perceptions of the value of VACIS prior to using the system and after using the system for three months.

Given the drive to increase effectiveness and efficiency in EMS, the paper attempts to answer the following research question: In what way do mobile systems deliver value in emergency healthcare organizations?

The rest of the paper is structured as follows: In the following section we review the literature on mobile technology in health care organizations and the business value derived from mobile technology. In the next section we outline our research methodology, and present the case study. This is followed by a discussion in which the implications of the use of the mobile system for emergency services are outlined. Finally, we conclude the paper, and offer suggestions for further research and practice.

LITERATURE REVIEW

The literature review provides an overview of current research in business value of information technology, followed by a review of literature sources that have specifically addressed the value of wireless and mobile technologies. This is followed by a section reviewing the use of information technology in the health care sector.

Deriving Value from Information Technology

In this section, we review literature sources that have examined aspects of business value derived from information technology at an organizational level. There has been much debate over the years about what the business value of IT is and how this can be evaluated (e.g. (Kohli & Devaraj, 2004; Strassmann, 1990). In a recent review, Melville et al. (2004) have argued that business value is dependent on the context of the organization and the type of technology that is implemented. Melville et al. (2004) categorized the research in business value of IT on three levels: the focal organization (including intra-firm business processes), competitive environment (e.g. industry) and macro environment (e.g. country characteristics). As such, Melville (2004) define organizational performance as consisting of business process performance as well as organizational performance. Given the scope of this paper, we focus mainly on literature that has examined business value at the level of the focal organization.

Since the 1980s, much controversy has surrounded the debate about whether investments in IT translate into business value (from an economics perspective). Brynjolfsson (1993) coined this controversy 'the productivity paradox' – despite significant spending on IT across the board, no evidence could be found of resulting economic productivity gains (Brynjolfsson, 1993). Others at the time have echoed this argument (e.g. (Barua, Kriebel, & Mukhopadhyay, 1991; Strassmann, 1990). The paradox is captured in the aphorism of the Nobel laureate economist Solow: "…you see the computer age everywhere but in the productivity statistics" (Solow, 1987) cited in (Triplett, 1999). Brynjolfsson (1993) has argued that the productivity paradox can be explained due to 'mismeasurement of inputs and outputs', 'lags due to learning and adjustment', 'redistribution and dissipation of profits' and finally 'mismanagement of information and technology'.

Given the debate about the productivity paradox, suggestions were made to explore productivity gains at an organizational level. Despite the organizational focus, mixed evidence of the business value of IT was reported. Issues came into play that impacted the value that organizations' derived (or didn't derive) from their IT spending, for example the competitive environment in which these organizations operate; alignment between business and IT strategy, and IT strategies (Barua et al., 1991; Barua & Lee, 1997; Belleflamme, 2001; Brown, Gatian, & Hicks, 1995; Hitt & Brynjolfsson, 1996; Melville & Kraemer, 2004).

The debate of the value of technology for organizations is again under the spotlight with the advent of mobile technology. Scheepers and McKay (2004) pointed out that the marketing of mobile devices has concentrated on the individual use of mobile devices and very little focus has been placed on the value of mobile computing at an organizational level. Clarke (2001) listed four value propositions which may be derived from mobile technology – ubiquity, convenience, localization and personalization (Clarke, 2001). However, as Scheepers and McKay (2004) argue, these all come from the interaction between the organization and the customer who is using the mobile device. This view is therefore limited in understanding other areas of potential impact from mobile technologies. Scheepers and McKay (2004) introduced another value proposition - that of internal value for the organization as well as external value. The internal value proposition involves improving the effectiveness and efficiency of the staff within the organization through mobile computing. The external value is derived from the interaction of the staff using mobile computing and their clients (see figure 1). Based on these value propositions three levels of outcomes can be identified: managerial, mobile staff and customer.

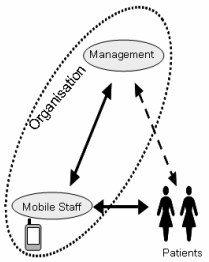

Figure 1: Mobile technologies enabling internal and external value propositions (Adapted from (Scheepers & McKay, 2003)

Use of information technology in healthcare

In this section, we review literature sources that have examined the use of information technology in Health care, specifically focusing on the use of mobile technology in health care.

In 1998, the British National Health Service (NHS) issued a report outlining a strategy for making health information shareable between health providers and allowing individuals to view their own health record (NHSIA, 1998). A major part of the strategy was to provide a lifelong electronic health record for every person in the country by 2005. A report – *Building the Information Core,* issued in 2002, addressed the steps required to bring the 1998 vision into reality (NHSIA, 2002a). A further report – *Share with Care*, also issued in 2002, researched patients and the public attitudes to patient consent and confidentiality.

The importance of the availability of information is outlined in the *Share with Care* as follows:

"*Without access to appropriate information, a health system is, at best, inefficient and frustrating and, at worst dangerous. Modern healthcare services cannot function without those involved having the information they need to provide and receive care*." NHS Information Authority, 2002b (NHSIA, 2002b)

Healthcare is an information intensive industry. As noted by Cho and Choi (2003), the healthcare industry is facing constant challenges to provide healthcare professionals access to patient information wherever and whenever it is required. They say this access can be achieved through mobile computing (Cho & Choi, 2003). Several recent studies have discussed the use of Personal Digital Assistants (PDAs) to document healthcare services at the point-of-care (Brody, Camano, & Malony, 2001; Clark & Klauck, 2003; Lau, Balen, & Lam, 2001; Lynx, Brockmiller, Connelly, & Crawford, 2003; Paradiso-Hardy, Seto, Ong, Bucci, & Madorin, 2003; Reilly, Wallace, & Campbell, 2001; Scheepers & McKay, 2004; Silva, Tataronis, & Maas, 2003).

With the exception of Brody et al (2001), the studies found that documenting healthcare interventions on PDAs provided an advantage over more traditional (ie paper-based) documentation methods. The advantages listed were:

- more complete and standardized documentation (Clark & Klauck, 2003; Paradiso-Hardy et al., 2003; Scheepers & McKay, 2004)
- greater efficiency (Clark & Klauck, 2003; Scheepers & McKay, 2004)
- more interventions recorded (Clark & Klauck, 2003; Silva et al., 2003)
- greater user satisfaction (Clark & Klauck, 2003)
- increased visibility and recognition of work done by staff (Lynx et al., 2003; Paradiso-Hardy et al., 2003).

The time taken to record an intervention was found to be about the same for both PDA and paper-based systems (Clark & Klauck, 2003). An additional advantage was the ability to generate reports on the data collected. Paradiso-Hardy et al (2003) stated that "unlike the paper-based system, the PDA based data collection sheet standardizes documentation and generates reports that are comprehensive and consistent" (Paradiso-Hardy et al., 2003). A limitation noted by Paradiso-Hardy et al (2003), however, was the limited view of data on the PDA.

However, there are challenges to achieving the above benefits in health care institutions. As Dickerson (2003) states, the implementation of IS systems "reflect a larger non-technical business-process change, but IT is often the front-line messenger of such change" (Dickerson, 2003). Even if the system produces productivity improvement according to objective measurements, the end-users will often complain that it slows them down.

Dickerson (2003) suggests that the best way to alleviate this is to ensure that end-users get the training they need for the new system and also basic IT training.

Furthermore, it helps to have a healthcare professional system "champion" providing encouragement, training and support. Wolf (2003) outlines the reasons for a successful implementation of a CPOE (Computerized Physician Order Entry) system in a US hospital. They were detailed planning, executive commitment, a dedicated physician leading the effort, early-adopter physicians providing training to others, financial resources past implementation, and ongoing user support (Wolf, 2003).

There is a growing interest in measuring performance across the health system (NHPC, 2001). As stated in the vision of the National Health Performance Committee in Australia:

"The vision of the NHPC is for a health system that searches for, compares, learns from the best and improves performance through the adoption of benchmarking practices across all levels of the system. Its goal is to extend the national performance indicator framework for services other than acute inpatient services to include not only indicators of the overall health system's performance, but also for services such as community health, general practice and public health". p3, (NHPC, 2001)

O'Meara (2005) used the NHPC framework and tailored it specifically for ambulance services. The key dimensions are *Effectiveness, Appropriateness, Safety, Capability, Continuity, Accessibility and Equity, Acceptability and Efficiency* each with associated structure, processes and outcomes (O'Meara, 2005). The main driver for a new performance framework is to move away from the concentration on response times which is often used as the sole measure of effective ambulance service performance.

"Finding desperately needed answers to many important questions in EMS is hopeless without the development of new ways to collect, link, and analyze valid, meaningful information. This is the very foundation of the future of EMS!" Daniel W. Spaite, MD Cited in (NHTSA, 1996)

RESEARCH METHOD

Case study research lends itself to the exploration of new areas of research (Eisenhardt, 1989) such as mobile computing. The research strategy allows for in-depth description of the relationships in context (Benbasat, Goldstein, & Mead, 1987; Galliers, 1993). The case research strategy was chosen here owing to the novelty of mobile technology applications within organizations and to examine individual use contexts in depth (Yin, 1994).

Thirty in-depth, half-hour to one-hour interviews were conducted. These were interviews with the information systems group - the CIO of the Metropolitan Ambulance Service (MAS), the Technical Project Manager of the VACIS system, the Systems Analyst of the VACIS system. There were interviews with Management – one with the Subject Matter expert for data for the VACIS system who was also Manager of the Clinical Support Officers at the time and one with a Clinical Support Officer. There were also interviews with ten paramedics and two team leaders obtaining their views prior to using the VACIS system and then after they had been using VACIS for at least three months. The interviews were semi-structured and the participants were free to discuss the main issues/advantages of the mobile computing initiative from their perspective. Each participant signed a consent form giving permission to be interviewed and to have the interview audio-taped. The interview was then transcribed and the transcript was sent back to the participant for review.

The interview script was based on a similar study done in another healthcare organization and centred on the staff member's perceptions of VACIS – importance, ease of use, management support, advantages and disadvantages of use and the implementation process. The interviews were conducted over a 6 month period from late Nov 2005 through to mid May 2006. The management interviews were conducted mainly in December 2005. The paramedic interviews prior to using VACIS began late Nov 2005. The next round of interviews for obtaining paramedic perceptions of VACIS after using it for around three months began mid February 2006.

Interview details		
Number of interviews:	Formal interviews	30
	Informal interactions	5 VACIS training sessions 7 meetings with MAS staff
Range of interviewees	Information systems group	3
	Management	2
	Clinical support Officers	1
	Paramedics (before and after implementation interviews)	12 * 2 = 24

Table 1: Interview details

EMS mobile computing application – VACIS

The VACIS system records the clinical treatment of the patient and it is also an information tool containing Clinical Practice Guidelines, eMIMS drug reference, Clinical procedure animation and maps. It resides on a Panasonic Toughbook tablet PC in a magnesium alloy case with spill resistant keyboard. It had to be able to withstand the rigours of day-to-day use by paramedics and was tested to US military standards. The battery has a 3 to 3.5 hour life and can be recharged in the ambulance. Also spare batteries are available at the hospitals if required. It uses a digitized screen with a digitized stylus. Each paramedic also has their own larger digitized pen to use as well as the smaller pen which comes with the toughbook. Major hospitals have 802.11 wireless networked printers and each ambulance is equipped with a Canon IP90 printer which uses Bluetooth software to print the case sheet from the toughbook within a five metre range. The toughbook can be used as a standard laptop with keyboard or can have the top swiveled into a tablet. Having access to a keyboard and mouse was very important to some of the paramedics, whereas others were quite happy to use the pen and tablet. The VACIS system is very intuitive and reliable and the paramedics have been happy with the usability and reliability of the system overall.

The MAS management and the Information Management group were keenly aware of the importance of acknowledging the needs of the paramedics when designing the VACIS system. They conducted extensive consultation with the paramedics and ran several focus groups working through the requirements for the VACIS system from the paramedics' perspective. As noted by the Emergency Operations manager: "*VACIS is designed by paramedics for paramedics*". [Interview 020, Feb 2006].

MAS were also keenly aware of the possible anxiety that some paramedics may feel towards VACIS so they had an in-depth training session for every paramedic who was part of the pilot group for the initial rollout of the VACIS system. Once the paramedic was trained, a nominated trainer would go out with the paramedic on their first shift immediately following training and work with them as they used the VACIS system for the first time.

DISCUSSION

The discussion describes the role the mobile system plays in supporting an emergency service in their performance as outlined by the O'Meara framework.

Contribution of mobile technology in the Ambulance Service performance framework

Given the pressures that Emergency services globally are facing with increases in demand for their services it is becoming even more important to look for ways of improving the efficiency of the use of staff resources within EMS. The capture of various times throughout the life cycle of the "job" allows for deeper analysis of where the paramedic time is spent. VACIS provides easy collection of times such as Call received, Dispatched, Enroute, @Scene, @Patient, Patient loaded into car, Hospital notified, @Destination, Triage, Off-stretcher and Cleared. All treatment procedures of the patient is recorded and the times the procedure was performed. This time-stamping of events provides valuable data for MAS. All outcomes of treatment are recorded along with Vital Sign Survey data. Pain scores are also recorded and provide key data to MAS who are concentrating on improving pain management as one of their key focus areas for improvement.

During the interviews Paramedics expressed the expectation that the collection of data made possible by VACIS will lead to more funding, updated equipment, improved clinical guidelines in line with evidence-based practice and tailored paramedic training.

When attempting to determine the role that the VACIS mobile computing system can play in each of the performance framework categories (refer to Table 2) it became evident that the categories appeared to overlap. It was therefore necessary to go back to the original National Health Performance Committee Framework for clarification of each of the dimensions (NHPC, 2000). It is important to note that the emergency services performance framework was developed to evaluate structures and processes of emergency services in general. Through evaluating the responses from paramedics and management we were able to identify the role that mobile computing plays in performing these processes. In general the mobile system provides the organizations means to capture data more effectively and an expectation was expressed that this will provide a basis for further and more effective use of the information for the activities of the organization.

The *Effectiveness* dimension determines whether the action taken by the paramedic achieves the desired results. O'Meara (2005) then suggests that capturing the process (ie interventions), response times will help to determine the effectiveness of the actions taken by the paramedics. Since VACIS captures every event and timestamps those events it will help with the analysis of the effectiveness of the actions by paramedics. The *Appropriateness* dimension determines whether the care the paramedics provide is relevant to the needs of the patient and follows established standards. VACIS is structured around the recommended practice guidelines for paramedics. It walks them through the data capture process ensuring that all mandatory information is completed before the case can be closed. The *Safety* dimension determines whether the potential risks to the patient from an intervention or from the environment are minimised. The information from VACIS can be used to profile hazardous situations. The *Capability* dimension determines whether the skills of the paramedic are appropriate for the care provided. In interviews with the paramedics they mentioned that they hope that the analysis of the data from VACIS will lead to ongoing training and upskilling for staff. The *Continuity* dimension determines the ability to provide coordinated care with other programs, organizations over time. The data captured in VACIS is printed at the hospital and provided to the triage staff. A future enhancement planned for VACIS is for paramedic teams to be able to automatically transfer the patient care record from their VACIS tablet to the tablet of any other paramedic team that arrive at the scene. This will further facilitate the continuity of care as the patient is transferred from the care of one paramedic team to the care of a MICA (Mobile Intensive Care Ambulance) paramedic team or other paramedic team. The *Accessibility and Equity* dimension determines whether the patient has been able to receive the care at the right place and time on a needs and equity basis. VACIS data will be used to assist with reviews into structured calltaking. The *Acceptability* dimension determines whether the care meets the expectation of the patient, community, healthcare providers and healthcare paying organizations. VACIS has no direct impact for this dimension. The *Efficiency* dimension determines whether the care given was done in a cost-effective manner with optimal use of resources. Resource allocation is a constant challenge for EMS organizations. At MAS there are limited numbers of MICA ambulances and MICA trained personnel and therefore these resources need to be used judiciously. Part of the aim for VACIS is to capture clinical outcomes data and match this against the original dispatch code for the job. This will then feedback to the dispatch process so that the number of Code 1 responses are at an optimum level. As noted in quote below:

'It [VACIS] underpins a lot of things that we need to deliver in our strategic vision that we have for the organization....Trying to match resources to demand...It's a fairly finely balanced game that you play… so we have contact with the patients on the telephone… and we run through structured call taking on the telephone and so we know something of the patient based on .. the telephone conversation and then we dispatch resources to that patient based on what we know. Now in the past there have been studies to close that loop back. But you can only do that on the sample of the information you've got. Once you've got all the data there about all the cases you can close the loop back.' Interviewee 004, Lines 135, 141-148

Dimensions	Structures	Processes	Outcomes	VACIS Impact
Effectiveness	Equipment Staff skills	Response Times Resuscitations Interventions	Mortality Survival	Timestamping of events throughout the lifecycle of the paramedic job (VACIS allows additional timestamping such as @triage,Off-stretcher which was not captured on paper PCR) Capture of all procedures done by paramedic Capture of pain scores throughout lifecycle of the paramedic job
Appropriateness	Staff configuration	Research Activities Time at scene	New knowledge Adverse Events	Conformance to clinical guidelines. Paramedics must complete data on all mandatory fields before they can close a

Dimensions	Structures	Processes	Outcomes	VACIS Impact
	Staff Level Evidence Base			case
Safety	Monitoring System	Safety Procedures	Accreditation Complications	Information collected can be used to assist in profiling hazardous situations for clinical practice guideline review
Capability	Appropriate Staff Equipment	Clinical practice guidelines and standards Preparedness for disaster	Impaired physiology Alleviation of discomfort	Capture of all procedures done by paramedic. Leading to the ability to analyse further training required by paramedic particularly for procedures which have not been done for a while.
Continuity	Sustainability Teamwork	Coordination Collaboration	Limitation of disability Accurate Information	Each paramedic team arriving at scene must open a VACIS case sheet. Future enhancement will be the automatic transfer of all data from attending team's tablet to arriving team's tablet. Legibility of Patient Care Record The patient care record is printed at the hospital printer and provided to triage staff.
Accessibility & Equity	Time to cases Distance to cases	Resource allocation processes	Utilization rates Availability Demand for services	VACIS data will assist with reviews into structured calltaking protocols and the dispatch grid to optimise resource allocation
Acceptability	Public participation Ethical standards	Respect for patient autonomy	Satisfaction Complaints	None
Efficiency	Staff to case ratios	Rostering systems	Affordability Cost-effectiveness	Data capture of initial dispatch code and any changes to dispatch code level throughout the lifecycle of the job. Analysis of dispatch data and clinical outcomes of case will lead to better allocation of resources. Paramedics have said that they hope there will be less "lights and sirens" Code 1 dispatches as a result of the VACIS data analysis.

Table 2: Mapping of VACIS impacts against Ambulance Services Performance Framework (O'Meara 2005)

Evaluation of investment

Efficiency

Interview data from all roles identified that there has been an increase in the efficiency of the capturing of data. Data (such as time in Triage, off-stretcher and cleared) that was previously not captured due to the onerous nature is now captured with more ease. This data becomes available for the organization to potentially provide paramedics further support in terms of training, trialling of new techniques and the evaluation of these techniques. The following are examples of statements made by interviewees:

'[The major advantages of using VACIS are] the clinical data research… the standardization of the MAS documentation so…you've got a legible ePCR and …the information is recorded in the same place and it is easy for the hospital to read and they know where to look for the information….as well as that you're streamlining the clinical definitions… so it's a method of documenting how you complete your case report… and everybody would need to conform to that standard and it's raise the standard I think… the organization will have a well-documented case…….Another huge advantage will be the ordinated data extracts and imports into other systems so the need for people trawling through PCRs won't be required.. to look at cardiac arrests and key them in to the cardiac registry.' Interview 005, Information systems group, Lines 343-349, 355-357

'Now on a personal and branch level you would be able to retrieve how many times in a year you have performed an RSI or an intubation. Look at your own individual skill set as you ... as an Officer as the Officers in a team and for training purposes you could use that to review what we need to focus on and practice' Interview 008, Paramedic, Lines 138-142

'When VACIS was first introduced I actually thought it was a very smart idea. Mostly because I have terrible handwriting.... But more it piqued my interest from a research perspective.... In that we would actually be able to trap the data. We can't trap the data now. Manual case sheet searching is... labour intensive and basically...isn't done very well.' Interview 009, Paramedic, Lines 34-38

Interview data from the management and information systems group interviews identified that there is potential for efficiency gains by reducing the amount of manual handling of PCRs for statistical analysis and for reduction Code 1 dispatches. The hope for the reduction in Code 1 dispatches and the tailored training encourages the paramedics to persist with VACIS. The following is an example of a statement made by an interviewee:
'(Easy) availability of data to improve response grid therefore decrease high number of unnecessary code 1 responses & dual responses (save money)' Paramedic comment, May 2006

Effectiveness

Interview data from all roles identified the future potential of the data collected from the VACIS system to improve Clinical Practice Guidelines on evidence based practice data. This may then lead on to better patient outcomes. The following is an example of a statement made by an interviewee:

'It's not going to help me...when I go out to treat a patient today..... having that computer will make absolutely no difference but..... I know that the data collected from the computer will probably help that patient in five years time....because they'll be able to go - Oh look at all this interesting information and it might change what we do..... But immediately no...like it makes no difference to patient care I don't think .... but in the long term because of the research they'll be able to do as a result of the data then it will make a difference.' Interview 015, Paramedic, Lines 97-103

CONCLUSIONS

The Healthcare sector is an information intensive industry. The use of mobile technology supports this need through the provision of information and the capture of at 'point of care' information. In the case study, we found that the use of a mobile system enhances efficiency and effectiveness on various fronts.

Our study makes the following contributions. First, we highlighted the impact the VACIS system had in terms of the Ambulance Services Performance Framework (O'Meara 2005). The case study indicates that the introduction of mobile systems can support ambulance services in providing more efficient and effective information that could potentially impact on their performance evaluation.

The evaluation provides valuable insight into the advantages that can be gained by introducing a mobile system. In the case study it became apparent the mobile system can provide advantage to paramedics as well as the organization. The system enables the faster and easier capture of data that can be utilised for more effective management. Potential advantages for paramedics are: training, trialling of new techniques and the evaluation of these techniques. The mobile information system also provides a wealth of information that will enable the organization to more effectively manage their activities.

The study has the following limitations. First, we interviewed the personnel of MAS and the views of other institutions or patients were not studied in this research. Second, further research needs to be done to explore the inhibitors for introducing the mobile system in an Emergency Medical Service organization. Third, the study was conducted in the Australian context. Research is needed to examine how the findings reported here manifest in different emergency services settings. Further longitudinal studies are needed to determine the long term affect the mobile system will have.

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