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Factors For The Adoption Of ICT and Wireless Technology In Healthcare Environment

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Abstract

The use of recent developments in the digital technologies and their implications to the healthcare industry has increased in the 21st century. The use of wireless handheld devices is on the rise in almost every industry and healthcare is not an exception. However, due to the higher level of risk associated with the healthcare industry, adoption of such technologies in the healthcare domain needs to be studied carefully and understood thoroughly. This research study was conducted to understand the determinants for the adoption of latest digital innovation in the healthcare environment. A Mixed methodology was adopted to collect data from India, Pakistan and Australia. The research found that there were a number of external and internal factors that can influence the implementations of such technologies in a healthcare setting. These factors have been identified in this research paper. The finding of this research is limited to only three contexts and further research is needed to generalize the finding of this research.

Keywords (Minor Heading)

Wireless Technology, Healthcare Setting, Digital innovation, ICT, and Adoption

INTRODUCTION

The Australian National Office of Information Economy has predicted that Australia is aligned to take advantage from the emerging information economy. It is true that Australia is among the leading countries in terms of internet infrastructure and other technological developments. However, in comparison with other countries such as Finland, Canada, USA, and Sweden, Australian healthcare service providers have been extremely slow to implement ICT technological developments such as wireless technology. Various contributing factors have been identified to explain the slow adoption of ICT technologies by researchers in this area, including a lack of management support, training and policies (Thompson, 2005, Leung et al., 2003, Lapinsky et al., 2001, Schneider, 2001); the perceived lack of complexity and cost (Hafeez-Baig and Gururajan, 2010, Gururajan et al., 2007, Hu et al., 2002, Williams, 2001); sensitive nature of information and the logistics involved in healthcare facilities (McAlearney et al., 2004, Lee, 2004, Guadagno et al., 2004, Bent et al., 2002); the nature and type of risk involved (Williams, 2001); pressure for high quality of care, high litigation costs and a lack of infrastructure and other resources (McAlearney et al., 2004). Countries such as India and Pakistan have also caught up with advanced healthcare system because of health tourism, and comparable to many western healthcare organisations in terms of ICT sophistication.

In spite of the slow rate of adoption of ICT technology in many healthcare systems, there is very little empirical research into this area (Gururajan, 2007). Internationally, researchers have an increased interest in this area; however, most of the research is dedicated to the technical and operational areas of ICT. There is very little empirical research into the factors that would lead to the successful adoption of ICT technologies in a given healthcare environment. Knowledge of critical success factors relating to the adoption of ICT technology will not only help to address other issues of adoption in the Australian healthcare system; it will also move forward research in this domain to develop a framework for such adoption.

RESEARCH OBJECTIVES

This research is limited to only healthcare environment, focusing on the wireless technology implementation in that context. Therefore, specific objectives that will be achieved in this research publication are to understand the determinants for the adoption of wireless technology in the healthcare setting. It is anticipated that findings of this research will have implications for the adoption of other ICT technologies in the healthcare environment. Thus, the overarching research question posited in this study is:

What factors influence the implementation of ICT applications in a healthcare environment?

THEORETICAL BASIS OF THE STUDY

Typically, background aspects of this study rely on earlier research into adoption, implementation, and innovation diffusion theories relevant to technology in general, and including information systems, information technology, and computer technology. Wireless technology is not identical to any of these areas; therefore, any study which has concentrated on identifying factors or frameworks for the adoption of technology in general has limited applicability in the case of wireless technology for the healthcare system. Owing to the limitation on published results in this area, this study will be exploratory in nature. The long term objective of this study is aimed towards developing a framework for the adoption of wireless technology in the Australian healthcare system, identifying the relevant factors relating to this adoption.

As an initial starting point, we considered Rogers' theory of innovation diffusion, as this is considered useful for understanding the facilitators and inhibitors of implementation of technology in a given environment, as the theory provides insight into the factors that influence the adoption of innovation. Further, Roger's theory has been applied to many non ICT domains and so it is hoped that healthcare will also be a domain that has relevance to this theory.

Rogers' theory (Rogers, 1995) is primarily concerned with finding the factors that influence the extent of adoption, and not the adoption process itself. Previous studies have defined three stages in the technology innovation cycle; adoption, implementation and post implementation (Rogers, 2003, Venkatesh et al., 2003, Dennis et al., 2003). Our study only concentrates on the adoption to implement ICT aspect, where the actual decision is made on the ICT implementation in a healthcare facility. The decision to adopt purely depends on the drivers and inhibitors of the use of the chosen technology in a healthcare facility. It is anticipated, once the decision to implement the technology is taken, that the process of implementation will start. Once the technology has been implemented and used successfully, then the process of post implementation will begin, in order to understand further the use of technology and the facilitation of its adoption. We followed this approach as many business process cycles follow the notion of planning, implementation and review, and the adoption, implementation and post implementation appear to suit the business processes and workflow.

This study did not investigate the processes involved in the implementation of a technology, but assumed that a choice will be made to implement a technology in the healthcare facility, on the basis of identified business drivers. It is also anticipated that effective implementation will not take place at the time of delivery or installation of hardware or software applications; rather, it will happen over a time span dictated by drivers and inhibitors and supported by familiarity, knowledge base, policy framework, infrastructure, level of commitment, and trust, in order to be established and supported by various stakeholders.

RESEARCH METHOD AND DESIGN

(Morgan, 1997) mentions the use of qualitative approaches in social science research as a self-contained method, used as a supplementary source of data, or used in multi-method studies. While many techniques are available to capture data, in this study we employed multiple case studies, expert interviews and a survey technique to understand various issues influencing ICT usage in healthcare organisations. This combined approach was employed in order to elicit open-ended responses, to obtain factors that are not constrained by the pre-determined identification of constructs found in traditional surveys, as well as to determine the importance of such pre-determined factors (Zikmund, 2003, Neuman, 2003). Further, due to the exploratory nature of this study, this research is designed to capture a cross-sectional snapshot and a dynamic longitudinal picture of ICT usage in healthcare. Therefore, the research is carried out in in multiple phases.



Figure 1: Research Methods & Design

MULTIPLE CASE STUDIES:

A multiple case study was conducted to identify possible motivators for ICT implementation in healthcare organisations. Twenty private and public healthcare organisations were chosen randomly through the help of the local administrative/ supervisor in India, Pakistan and Australia with a total number of 80 staff were interviewed in these organisations. We chose these organisations in these three countries as we are conducting funded research in these three countries and have connections in the healthcare sector. The focus of the interview was to explore factors that motivate and limit ICT implementation. Hence, the unit of analysis is ‘organisational ICT factors or issues, including both internal and external factors’. Basic information of the interviewees is summarised in Tables 1 and 2. Table 1 indicates that the interviewees cover three main job levels: senior executives; middle managers; and operational staff. Table 2 summarises the seniority of interviewees. The percentage of interviewees who worked in the organisations for more than two years is over 90 per cent. This assisted the interviewers in better understanding the organisational environment and its working culture.

Table 1. Descriptive analysis of the interviewees

Job Position of Interviewee	Frequency	Percentage
Proprietors, Partners, & Executive	24	30.00%
Middle Managers & Professionals	39	48.75%
Operational Staff	17	21.25%
Total	80	100%

Table 2. Summary of demographics

Seniority	Frequency	Percentage
2 years or under	5	6.25%

Over 2 and under 5 years	22	27.5%
Over 5 and under 10 years	16	20%
Over 10 years	36	45%
N/A	1	1.25%
Total	80	100%

Table 3 builds the linkages between the body of literature and the case study. The enablers of organisational ICT implementation factors were identified from the interviews throughout the multiple case studies. We used text analysis software for extracting these enablers. The enablers mainly represent management aspects, and congruent to business processes followed in the respective organisations. The results are illustrated in Table 3.

Table 3. Summary of variables

Enabler Identified	Distributions (Ranked)	Percentage
Learning	49	61.25%
Incentives & Rewards	42	52.50%
Information Technology Infrastructure	19	23.75
T-Shaped Skills	12	15.00%
Non-Formalisation	11	13.75%
Mutual Trust	9	11.25%
Non-Centralisation	7	8.75%
Leadership	5	6.25%
Collaboration	3	3.75%

EXPERT INTERVIEWS

Once initial motivators (enablers) were identified, a focus group was conducted with an arbitrarily selected group to drill down the factors, with a view to understanding the ICT implementation aspects relating to these enablers. Seven individuals were selected from the 20 healthcare organisations, and these individuals were interviewed in order to explore their perception regarding the motivating and limiting factors of ICT implementation in their respective organisations. The selection was based on size of the organisations, and involved healthcare organisations having at least 1000 beds. The group consisted of senior healthcare academics, clinical staff, health IT managers and management practitioners. These individuals were chosen because they were involved, either directly or indirectly, with the ICT implementation in their organisations. Each interview was conducted over 2 hours, and the questions were open ended. This provided direction to identify factors that influenced the ICT implementation. The primary objective of this exercise was to come up with an agreed upon, unique set of items under the heading of 'factors influencing the implementation of ICT in healthcare environment'.

The above set of motivating (Drivers) and limiting (Inhibitors) factors provided the scope for the study and a survey was administered based on these two sets of factors identified in the table above.

Table 4. Summary of Drivers and Inhibitors

Drivers	Inhibitors
Attract more practitioners	Administrative constraints
Better quality of service	Benefit evaluation barrier
Delivery of high quality information	Communication with colleagues
Easy access to data	Communication with physicians
Efficiency in communication	Complications in note taking due to difficult to read & write screens
Improved clinical flow	Device usage barrier
Improved clinical performance	Electronic medical records
Improved delivery of information	Electronic prescribing
Improved public image	Legal barriers
More contact time with patients	Patient education
Positive impact on patient safety	Problems in obtaining lab results
Reduced inaccuracies	Resource barrier
Reduced medical errors	
Reduced overall cost	
Saving effort	
Savings in time	
Reduced workload	

Stage 2 – Survey (evaluative): A survey instrument consisting of questions and multiple item scales were developed from the interview transcript. The main reason for this approach was that the initial set of participants (20 people) stated that previously tested instruments were inadequate for the purpose of this study. The data from interviews were used to develop a specific range of questions to gather a more detailed view from the wider population. The newly developed instrument was pilot tested to capture the information reflecting the perceptions and practices of the industry, and particularly focused on what internal and external environmental factors shape the implementation of ICT and the extent of their influence. Prior to administering the survey, traditional validity checks such as face validity and peer review were performed. These checks were performed with people that have experience in questionnaire design methods.

The participants were chosen randomly from the internal telephone directory of the chosen organisations. The survey was then distributed to over 300 people in the chosen organisation. A total of 97 participants completed the survey. The reliability analysis returned “Cronbach’s Alpha” value of 0.894, indicating a very high level of reliability(Hair et al., 2006). Therefore, data collected from the survey was considered reliable and suitable for further statistical analysis. Furthermore to be able to understand and identify the natural grouping of items from the questioners, an initial factor analysis was conducted on the data to identify factor groupings.

Table 5. Summary of factor analysis

<i>Descriptions</i>	<i>Technology</i>	<i>Data</i>	<i>Improved</i>	<i>Efficiency</i>	<i>Software</i>
	<i>Management</i>	<i>Managemen</i>	<i>Outcome</i>		<i>Limitation</i>
Save Time				.829	
Save Effort				.759	
Enhance Clinical Flow				.784	
Enhance Clinical			.878		
Attract More Patients			.751		
High Quality Information			.774		
Easy Access to Data			.800		
Improve Patient Safety			.776		
Electronic Medical Record		.822			
Medical database referral		.834			
Electronic Prescribing		.801			
Daily scheduling of		.794			
Obtain lab results		.845			
Billing and account		.802			
Disease State Management		.766			
Administrative purposes		.815			
Generating “Exceptions”		.771			
Patient education		.695			
Note taking		.720			
Drug administration		.642			

Communication with	.662	
Communication with	.678	
lack of solution		.748
Inadequate resources		.693
Migration issues		.684
Device stolen		0.6

An iterative process was employed to arrive at the five factors, Technology Management (TM), Data Management (DM), Improved Outcomes (IO), Efficiency (E), and Software Limitations (SL). In deciding these factors, a loading value of 0.6 was set with varimax rotation. The groups were given appropriate titles in an arbitrary fashion based on the types of factors in each group. This final factor grouping is shown in the Table 5 above.

DISCUSSIONS

The data analysis indicates two clear trends. The first one is that organisations are little concerned about “Software Limitations” and “Data Management” as these were shown to be not significant and have negative influence. An explanation for this trend may be that organisations have matured in terms of licensing aspects, and that the organisations considered for this study included large organisations and these organisations are familiar with data management aspects. Further, many healthcare organisations collect data on a daily basis and comply with many regulatory requirements in terms of data reporting, and these practices could have contributed to these insignificant results.

On the other hand, Technology Management, Improved Outcomes, and Efficiency have been identified as significant for ICT implementation. In our previous studies, ‘efficiency’ has been identified as one of the main reasons for implementing ICT in healthcare. Many reports also point to this fact. Improved outcomes is perceived to be a direct benefit of ICT implementation as ICT can provide clinical, customer relations, accounting and nursing benefits. In fact, a 2004 report of health and ageing indicated that consumers expect that ICT will improve outcomes and this is reflected in this study. The qualitative data also has pointed this aspect and there is consistent view on this aspect.

In terms of technology management, many health practitioners have asserted that ICT implementation once properly understood and carried out, will result in proper technology management. While there is ample evidence to this claim, what is not clear is the type of technologies. It is not clear whether respondents of this study indicated clinical technology or generic ICT types. We were mainly concentrating on innovative aspects, and the discussion was mainly on emerging type technologies. So, it could be possible that respondents could have implied that emerging technologies would help to manage technology by realising integration of clinical and other data systems. In fact, in many of our previous health informatics studies conducted in Australia, India and Pakistan, the integration of clinical and consumer data integration were highlighted as a direct benefit of CT integration.

The three variables, Technology Management, Improved Outcomes, and Efficiency, point to the motivation of ICT implementation and the statistical results point to strong support. These variables are also correlated significantly. The limiting factors such as administrative constraints did not play a crucial role. These indicated the positive sentiments exhibited by the respondents. Thus it is possible to conceive the following framework:

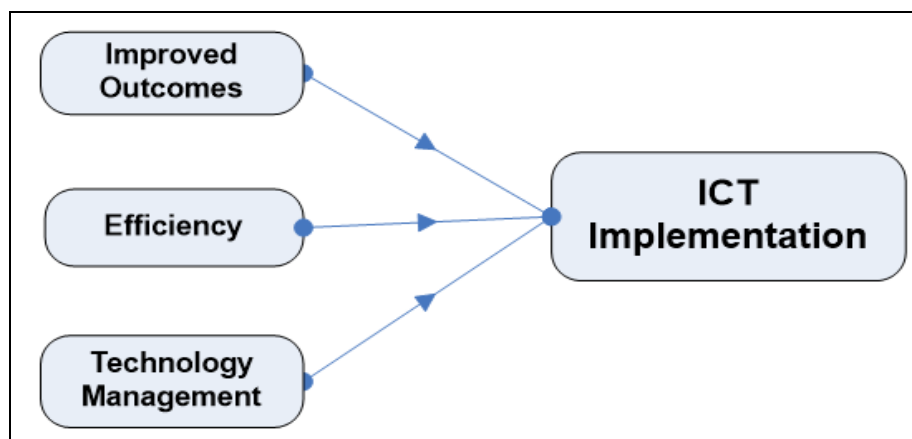


Figure 2: Initial framework for the factors related to the adoption of wireless technology in healthcare.

CONCLUSION

This research paper provides some initial findings of the factors that motivate and limit ICT implementation in healthcare organisations. A list of themes was identified, which can influence the ICT implementation in a healthcare environment. Some of the themes were already identified in the literature review. However this research also identified new themes, in the form of internal and external factors, which contributes to the general research domain.

FUTURE RESEARCH AND LIMITATIONS

In this paper, the initial findings of the first phase of data analysis are presented. Findings are aligned with the previous research. However, the findings of this research will be used to develop further qualitative instruments, a survey questionnaire, in order to test these factors in depth. As indicated earlier, there is lack of clarity as to the type of technology management and we have decided to investigate these aspects in depth. The research team is already working on this phase of the study. The findings of this research are limited to specific healthcare domains in Australia, India and Pakistan. Further research is still needed to test the findings to generalise the outcomes.

REFERENCES

- BENT, P. D., BOLSIN, S. N., CREATI, B. J., PATRICK, A. J. & COLSON, M. E. 2002. Professional monitoring and critical incident reporting using personal digital assistants. *The Medical Journal of Australia*, 177, 496-499.
- DENNIS, R. A., VENKATESH, V. & RAMESH, V. 2003. ADOPTION OF COLLABORATION TECHNOLOGIES: INTEGRATING TECHNOLOGY ACCEPTANCE AND COLLABORATION TECHNOLOGY RESEARCH.
- GUADAGNO, L., VANDEWEERD, C., STEVENS, D., ABRAHAM, I., PAVEZA, J. G. & FULMER, T. 2004. Using PDAs for data collection. Elsevier Inc., 17, 283-291.
- GURURAJAN, R. Drivers of wireless technology in healthcare: an Indian Study. In: (ED.), I. R. W., ed. *Proceedings of the 15th European Conference on Information Systems (ECIS2007)*, University of St Gallen., 7 - 9 June 2007 2007 St Gallen, Switzerland.
- GURURAJAN, R., HAFEEZ-BAIG, A. & KERR, D. 2007. Reactions and perceptions of healthcare professional towards wireless devices in healthcare environment in the developing world: a case of Pakistan. *ACIS 2007 18th Australasian Conference on Information Systems: the 3 Rs: Research, Relevance and Rigour - Coming of Age*. Toowoomba, Australia: University of Southern Queensland.
- HAFEEZ-BAIG, A. & GURURAJAN, R. (eds.) 2010. *An exploratory study to understand the drivers and inhibitors for the successful adoption of wireless technology in Australian healthcare systems.*: IGI Global.
- HAIR, J. F., BLACK, W. C., BABIN, B. J., ANDERSON, R. E. & TATHAM, R. L. 2006. *Multivariate data analysis*, Upper Saddle River, NJ, Pearson Education Inc.
- HU, P. J., CHAU, P. Y. K. & LIU, S. O. R. 2002. Adoption of telemedicine technology by health care organisations: An exploratory study. *Journal of Organisational Computing and Electronic Commerce*, 12, 197-222.
- LAPINSKY, S. E., WESHLER, J., MEHTA, S., VARKUL, M., HALLETT, D. & STEWART, T. E. 2001. Handheld computers in critical care. *Critical Care*, 5, 227-231.
- LEE, T.-T. 2004. Nurses Adoption of Technology: Application of Roger's Innovation-Diffusion Model. *Applied Nursing Research*, 17, 231-238.
- LEUNG, G. M., JOHNSTON, J. M., TIN, K. Y. K., WONG, I. O. L., HO, L.-M., LAM, W. W. T. & LAM, T.-H. 2003. Randomised controlled trial of clinical decision support tools to improve learning of evidence based medicine in medical students. *BMJ*, 327, 1090.
- MCALEARNEY, A. S., SCHWEIKHART, S. B. & MEDOW, M. A. 2004. Doctor's experience with handheld computers in clinical practice: qualitative study. *BMJ*, 328.
- MORGAN, D. L. 1997. *Focus groups as Qualitative Research*, Sage Publications.
- NEUMAN, W. L. 2003. *Social Research Methods: Qualitative and Quantitative Approach* Sydney, Pearson Education Inc.
- ROGERS, E. M. 1995. *Diffusion of innovations*, New York, Free Press.
- ROGERS, E. M. 2003. *Diffusion of innovations*, New York, Free Press.
- SCHNEIDER, T. 2001. Easy access to a world of information: using a handheld computer. *Journal of emergency nursing*, 27, 42-43.

THOMPSON, W. B. 2005. The Transforming Effect of Handheld Computers on Nursing Practice. *Nurse Admin Q*, Lippincott Williams & Wilkins Inc, 29, 308-314.

VENKATESH, V., MORRIS, M. G., DAVIS, G. B. & DAVIS, F. D. 2003. User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27, 425-478.

WILLIAMS, B. 2001. Handheld computers making the rounds with physicians. Devices put medical know-how-literally--in the palm of your hand. 94, 30-31.

ZIKMUND, W. 2003. *Business Research Methods*, Australia, Thomson.

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