Industrial Engineering Letters
ISSN 2224-6096 (Paper) ISSN 2225-0581 (online)
Vol.4, No.6, 2014

'Technology' and 'Environment' as Main Determinants of CDSS for Affective Decisions by Physicians of both Public and Private Hospitals in Developing Countries (DCs)

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Abstract

ICTs in healthcare sector are considered as a key element to improve decision-making in hospitals by improving the healthcare delivery services. The hesitation of having new technologies is still one of the biggest issues in developing countries for both the developers and users of hospital IT systems. This paper is intended to investigate the CDSS as one of the emerging technologies which are being used in decision-making of both the public and private hospitals by physicians and doctors for their decisions to be declared as rational ones. Data was collected from public and private hospitals of Peshawar city KPK, Pakistan. Two organizational factors (environment and technology); an enabling technology (CDSS) and three decision-making steps (intelligence, design and choice) have been used in designing the framework of the study. Data analysis reveals that only the technology factors is significantly related with the decision making process, with technology as a main predictor of decision support systems for the doctors and physicians. Decision making process and enabling technology are significantly positively related with effective decision making with the enabling technology (CDSS) as the highest predictor.
Key words: Technology, Environment, CDSS and Decision Making.

Introduction

In the era of globalization and information age, healthcare industries are intensely promoting and adopting ICT to improve patient care. When more and more patients as health consumers seek and prioritize quality in their lives through enhanced healthcare treatments and services, it places great demands on the health care industry's information-handling abilities and infrastructure (Ali & Horikoshi, 2002). According to a World Bank (2006) report, Reliable information and effective communication are crucial elements in public health practices. The use of appropriate technologies can increase the quality and the reach of both information and communication.

In a similar frame of mind, healthcare service organizations also seek for optimal strategies and solutions to increase their medical services. When introducing ICT, these organizations need to consider carefully the challenges that arise from it such as whether the organizational culture is supportive towards any ICT adoption and implementation, whether the organization can build ICT infrastructures that are efficiently and effectively, and whether the organization is willing to recruit, select, and employ competent human resources to use ICT as tools (Alvarez, 2004). organizations like hospitals have now realized the potential of integrating ICT into their organization. Technology is reshaping organizations by blending their information systems with rapidly advancing telecommunication technology. In addition, management teams feel that having ICT integrated into their systems will improve and strengthen healthcare systems in the future (Braa et al, 2007).

Successful ICT adoption will lessen errors considerably, if not totally eliminate them. ICTs are only one category of the vast array of technologies that may be of use, but given the right policies, organization, resources and institutions, ICTs can be powerful tools in the hands of those working to improve health (WHO, 2004). Growing use of IT in healthcare in developed countries has been driven by the belief and the evidence that these systems can help enhance the quality of health care. The health care systems and use of IT in developed countries have been in existence for at least two decades more than the developing countries and these countries pose a much greater challenge in implementing computerized decision support systems World Bank (2006). An enabling technology like clinical decision support system (CDSS) is regarded as an application of decision support system (DSS) which takes patient data as input and generates patient-specific advice. These knowledge-based systems through a process of reasoning techniques generate diagnostic and treatment options and care planning (Ash *et al.,* 2012).

Problem Statement

This academic research is basically aimed at measuring the attitude of physicians towards organizational factors responsible for adopting the enabling technology CDSS (clinical decision support system) for making effective decisions in both public and private hospitals of Peshawar city KPK, Pakistan.

Literature Review

Decision-making

Decision-making can be regarded as the cognitive process resulting in the selection of a belief or a course of action among several alternative possibilities. Every decision-making process produces a final choice . Decision-making is the study of identifying and choosing alternatives based on the values and preferences of the decision maker. A key to good decision making is to explore and compare many relevant alternatives. The more alternatives there are the more computer assisted search and comparisons are needed (Turban et al., 2004:544).

Rational decision making

This classical approach presupposes that a number of alternative are available, based on mathematical analysis and logic. This approach considers reason as a superior source of knowledge and expands the ability of the manger to avoid unsought and undesired consequences. According to Stoner et al. (2006: 248) "the rational decision-making process which is usually used for non programmed decision-making, involves recognizing and defining the decision situation, developing the alternatives, evaluating the alternatives for selecting the best one and finally the implementation and monitoring of the decision". Mathew (2005) is of the view that since rational decision making model is used for non programmed decision-making physicians and doctors require sufficient information to effectively handle health-related problem situation, a computer based information systems e.g. CDSS (clinical decision support system) can generate enough information that provides exact picture about internal and external environment of the organization.

ICTs and decision-making

There is mounting literature on both the technological innovations in ICT for decision-making and project stories of different organizations, experimenting with these new ICT-based artifacts. The documents on the enabling technologies present varying approaches in the development and use of different supporting technologies for varying decision-making environments. It is obvious that for most of the part traditional decision making is now being replaced by a systematic research and analysis preceding every decision (Weihrich and Koontz, 1999:199). Decisions are based on the availability of relevant information. Currently, it has become impossible to 'manually process' the available facts because: The number of alternative to be considered is ever increasing, due to innovations in technology, improved communication, the development of global markets and the use of the internet and e-Business, More decisions must be made under more time-pressure, increased fluctuations and uncertainty in the decision making and it is often necessary to rapidly access remote information, consult with experts, or have a group decision making session, all without large expenses (Turban et al., 2004:544).

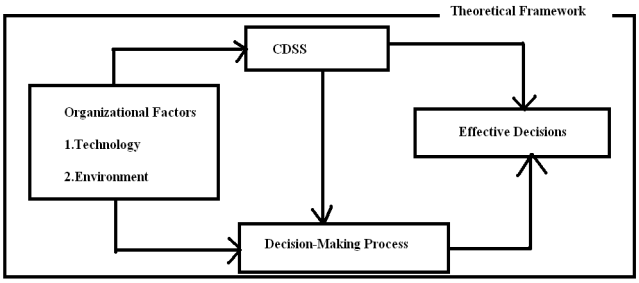
Forty years ago Drucker (1974:298) remarked "Information is the tool of a manager." This is more relevant today than ever before. Several forces have dramatically altered the business environment for decision making over the past decade including: 1: Emergence and strengthening of the global marketplace and 2: Transformation of major industrial economies into information-based service economies (Boiney, 2000:33). The major functional areas in many companies are the production/operations, marketing, human resources, accounting and finance departments. Traditionally, information systems were designed within each functional area, to support it by increasing its internal effectiveness and efficiency. However, traditional hierarchical structure is no more usable because certain business processes involve activities that are performed in several functional areas (Turban et al., 2004:298). The core function of a computer-based information system (CBIS) is to transform data into information and knowledge that can be used to create competitive advantages (Eom, 2000:496).

ICTs normally include computers, telecommunication technologies, and associated software and operating systems (Walsham, 2000:105). On the basis of these technologies modern research has engendered frameworks, such as the management support system (MSS), that are designed to provide comprehensive and integrated support for the decision making process (Forgionne and Kohli, 2000). Decisions are increasingly made in a more decentralized fashion, often by teams that may be geographically dispersed across the globe, and in the face of over-whelming amounts of information and limited time (Boiney, 2000:32).

Enabling technologies for mangers are also called Management Support Systems (MSS), which consist of several software tools for decision-making that Provides central repositories for decision data, models, and knowledge; Incorporates a user-extensible knowledge-representation scheme that links information, knowledge, and models; Delivers models that support an organization-oriented view of strategic decision making; Assists staff in understanding business decision making tasks, events, and processes; and Serves as a learning tool for future business policy decision makers (Forgionne and Kohli, 2000).

CDSS (Clinical decision support system)

The use of ICTS in health care practices is mainly for two purposes: creating and maintaining electronic medical record of each patient and integrating those records using computerized decision support systems to generate specific medical advice. IT-applications in hospitals are regarded as a key element to enhance decision-making of physicians and doctors for the improvement of the quality of medical care. CDSS uses include: alerts and reminders, diagnostic assistance, therapy critiquing and planning, prescribing decision support, information retrieval and image recognition and interpretation. **Clinical decision support system** (**CDSS**) is an interactive Expert system Computer Software, which is designed to assist physicians and other health professionals with decision making tasks, such as determining diagnosis of patient data. A Clinical Decision Support systems link health observations with health knowledge to influence health choices by clinicians for improved health care (Tomasi et al,2004).The main purpose of CDSS is to assist clinicians at the point of care. This means that a clinician would interact with a CDSS to help determine diagnosis, analysis, etc. of patient data. Previous theories of CDSS were to use the CDSS to literally make decisions for the clinicians (Aggelidis & Chatzoglou,2009). The clinicians input the information and wait for the CDSS to output the "right" choice and the clinician would simply act on that output. Typically the CDSS would make suggestions of outputs or a set of outputs for the clinician to look through and the clinician officially picks useful information and removes erroneous CDSS suggestions (Ash *et al.* 2012). The health care systems and use of IT in developed countries have been in existence for at least two decades more than the developing countries and these countries pose a much greater challenge in implementing computerized decision support systems. There are many critical reasons cited for the problems of low usage of CDSS in developing countries: reluctance of physicians to use the system, computer illiteracy of physicians and cost of purchase and implementation.



List of hypotheses

1. The two independent variables significantly explain variance in CDSS (enabling technology).
2. The two independent variables significantly explain variance in Decision-making process.
3. The four independent variables significantly explain variance in effective decisions.

RESEARCH DESIGN

A research methodology is set up to decide on among other issue how to collect further data, analyze and interpret those data and, finally to provide an answer to the problem (Sekaran, 1999: 28). The population of this study consists of all doctors and Physicians from public and private hospitals of Peshawar city of KPK, Pakistan, where 155 respondents were selected through convenience sampling technique. The primary data was collected through questionnaire and the secondary data was collected through all available material from books,

newspaper and online resources. The data collected was analyzed using multiple regression analysis to test the hypotheses.

Findings and discussions
Hypotheses Testing

Three hypotheses have been developed and tested through the application of Multiple Regression. The results are significant if their probability of occurrence (P-value) is equal to or less than 0.05 levels. The results of these tests and their interpretations are discussed below.

1. The two independent variables significantly explain variance in CDSS (enabling technology).

Multiple Regressions

Dependent variable	Independent variables	R	R Square	df	F-value	P-value	Beta Score	Significance
CDSS	Environment	.612	.37	2 152	22.412	.000	.399	.000
	Technology						.515	.000

The results of regression analysis for the two independent variables against the CDSS the enabling technology can be seen in the above table. The second column of the table lists the two independent variables that are entered in the Regression model and R .612 is the correlation of the two independent variables with the dependent variable. The R Square (.37), which is the explained variance, is actually the square of the multiple R (.612). The F value 22.412 is significant at 000a levels. In the df (degree of freedom) in the same table, the first number represents the number of independent variables (2), the second number (152) is the total number of complete responses for all the variable in the equation (N) minus the number of independent variables (K) minus 1. (N-K-1) (155-2-1) =152. The F statistics (22.412) is significant at 000a levels. What the results mean is that 37% of the variance (R-Square) in the enabling technology (CDSS) has been significantly explained by the both independent variables. Thus Hypothesis has been substantiated.

The calculated Coefficient helps us to see which of the two independent variables influence most the variance in the enabling technology (CDSS). If we look at the Beta column, we see that the beta is .515 for the technology, which is significant at the .000 levels. It may also be seen that the beta is .399 for environment, which is significant at .000 levels. The positive Beta weight indicates that for the introduction, the development, use and maintenance of enabling technologies like CDSS for sectors and physicians in hospitals is indispensable.

2. The two independent variables significantly explain variance in Decision-making.

Multiple Regressions

Dependent variable	Independent variables	R	R Square	df	F-value	P-value	Beta Score	Significance
Decision Making	Environment	.836	.698	3 148	286.217	.000	-.105	.916
	Technology						.3954	.000

The results of regression model are given in table 4.17. The results indicate that 69% of the variance (R-Square) in the decision-making has been significantly explained by the two independent variables. Thus Hypothesis has been substantiated. If we look at the Beta column, we see that the highest beta is .3954 for the technology, which is significant at the .000 levels. The positive Beta weight indicates that for the decision-making process technology (CDSS) in the hospitals is unavoidable. The negative beta is -0.105 for environment, which indicates that environments of the health organizations especially in public sector must be free from interruptions in their decision-making process, all sorts of political interruptions from outside, must be neutralized.

3. The four independent variables significantly explain variance in effective decision making

Multiple Regressions

Dependent variable	Independent variables	R	R Square	df	F-value	P-value	Beta Score	Significance
Effective decisions	Environment	.949	.901	4	222.818	.000	.021	.548
	Technology						.063	.115
	Decision-making						.469	.000
	Enabling Technology			147			.734	.000

Multiple regression analysis was done to test the above hypothesis. The results of the test are presented in the above table. The results show that four independent variables significantly explain variance in the dependent variable, as the calculated F value 222.818 is significant at 000 levels. Thus **Hypothesis has been substantiated.**

The calculated Coefficient helps us to see which of the four independent variables influence most the variance in the Effective decisions. If we look at the Beta column, the highest beta .734 is for enabling technologies which is significant at .000 levels. The next heist beta .469 is for the decision-making, which is significant at the .000 levels. The results indicates that for rational and effective decisions enabling technologies must be incorporated in the decision making process. The outcomes project that the rationality of decisions in health organizations purely depend upon the utilization of enabling technologies at all the three levels of management in general but in the health organizations both public and private healthcare organizations in particular.

DISCUSSION

Several studies have evaluated the impacts of ICTs on decision-making process in both public and private health organizations (see for example, Ahlan, 2005; Adebayo, 2007; Macleod, 2007; Bradley, 2006; Mathew, 2005 and Hughes, 2003) but there is a lack of empirical studies that integrate ICTs and effective decision making in Pakistan. Since the Pakistani governments continue to provide huge IT investment for its designated e-government agencies, the need to understand the impacts of ICTs on effective decision making becomes more important. This study attempts to provide a better understanding of the impacts of enabling technologies in decision-making process of both public and private health organizations in Pakistan. The quantitative data was collected from the public and private healthcare organizations to observe variations in the adoption and usage of IT. Furthermore, empirical data has been gathered about the organization factors (environment and technology) to pinpoint their influence on enabling technologies (CDSS) success in e-government initiatives in Pakistan.

The influence of organizational factors on the information system (IS) success is well documented (see for example, Ahlan, 2005; Andrew Georgiou et al., 2002). Given this as mentioned earlier two organizational factors that influence IS success are identified to be used in this study. The two factors are environment and technology. The environment of an organization contains both supportive and antagonistic forces. An organization system derives support from clients or customers who need its products and services and from society's protection of property and other rights. But the organization is also subject to the constraints of public regulations, demands for social responsibility, and meeting multiplicity of demand that are often conflicting (McFarland, 1979: 290). It is part of every manager's responsibility to be alert about the forces of external environment that affect an organization and its goal. However, findings of the study indicate that the management of private health organization is more capable to fight with both external and internal environment to meet their desired objectives than to its counterparts.

Technology refers to how an organization transfers its inputs into outputs. Every organization has technology that converts financial, human and physical resources into products or services (Robins, 2006). The results of the study are validating the findings of the study conducted by (Haiman et al., 1985:37) that in private health organizations technology is fully compatible with the organizational systems because it is designed and adopted according to an existing work patterns and requirements of an organization. The literature reveals that technology is making the greatest impact on the nature of management thereby forcing the managers to adapt

themselves with the emerging new trends). Similarly, Boiney (2000:32) and Turban, et al. (2004:549) argues that the need to speed up, coordinate and improve the aspects of decision-making has led managers to adopt enabling technologies. In the emerging ICTs environment, IT elements such as e-mail and group support facilities improve the coordination among the members of an organization in decision making. The use of these enabling technologies improves the organizational communication, which ultimately leads to effective decision-making (Rockart and Short, 1989). The results of our study are supporting the findings of Keri (2007) that enabling technologies are very useful means for collection and dissemination of information that is why most of the executives and the managers of private health organizations use e-mails frequently because they believe that ICTs/ can convey things more effectively.

A parsimonious treatment is conducted altogether on the three hypotheses multiple regression analysis (see Table 7). The result indicates that for the 3rd hypotheses technology and environment are the robust predictors of enabling technologies (CDSS). Amongst them technology is a leading predictor followed environment with Beta score .515 and .399 ($p < .000$) respectively. This shows that well organized, up-dated technology and better environment is essential for the success of IS development and use. It is also identified that technology has been identified as the strongest predictors of decision-making also with beta score .395 ($p < .000$).

The results of the regression model for three hypotheses indicate that enabling technologies has been identified as the main forecaster of "effective decisions" followed by decision-making. The figures in the beta column of the table for enabling technology/ICTs and decision-making are significant at 0.000 levels. The findings of the study are supporting the results of the study conducted by Pluy (2004) that quick access to relevant and valid information is possible through computers and enabling technologies for example CDSS. Similarly Adebayo (2007) argues that information technologies provide information that is needed for effective decisions. Majority of the decision, makers try to be rational while making decisions but to do so they must follow the steps of rational making process (stoner et al., 2006:248).

Conclusions

The aim of the study was to investigate the role of ICTs in decision-making of public and private organizations in relation to effective decision-making. findings of the study provide a clear indication that organizational factors are, indeed, highly significant in the successful adoption of ICTs/enabling technologies in the context of both public and private health sectors but particularly for public health organizations. Successful implementation of enabling technologies depends upon the use, access to computers, valued perceived of computers and process simplicity. Results of the study reveal that "enabling technology (CDSS) is found as the most influential factor for effective decision making in both public and private health organizations. It is well documented that IT not only can be applied across all sectors of a given economies of the world, but it can also affect every function within the organization. Unlike other technological breakthroughs such as steam powers or electricity, IT can be both input and a final product. It is capable of revolutionizing the production and distribution of entire industries, services and organizational functions, but it also offers a vast range of new products and services of its own.

References

1. Adebayo, F.A. (2007) Management Information System for Managers. Ado-Ekiti: Green Line Publishers.
2. Aggelidis VP, Chatzoglou P: Using a modified technology acceptance model in hospitals. *Int J Med Inform* 2009, 78(2):115-126.
3. Ahlan, A.R. (2005) Information Technology Implementation: Managing IT Innovation in the Malaysian Banking Industry, Proceedings of the 12th European Conference on IT Evaluation (ECITE), Turky, Finland.
4. Ali, M. & Horikoshi, Y. (2002). Situation analysis of health management information system in Pakistan. *Pakistan J. Med. Res,* 41(2).
5. Alvarez, A. J. S. (2004). Challenges of information systems implementation in organizational change management: Insights from the health sector in Equador. *Electronic Journal on Information Systems in developing Countries*, 16(6):1-16.
6. Andrew, G. and Michael, P. (2002). The role of health informatics in clinical audit: part of the problem or key to the solution? Journal of Evaluation in Clinical Practice Volume 8 (2) :183-188 .
7. Ash JS, Sittig DF, Guappone AP, *et al.*: Recommended practices for computerized clinical decision support and knowledge management in community settings: a qualitative study. *BMC Med Inform Decis Mak* 2012, 12:6.

8. Asian Hospital & Healthcare Management, issue 12, 60-63.
9. Boiney, L G. (2000). Decision making and IT/S. In: Zeleny, Milan (ed.) The IEBM handbook of information technology in business. Business Press. Thomson Learning. US. 32-39.
10. Braa, J., O. Hanseth, H. A., Mohammed, W., Shaw, V. (2007). Developing health information systems in developing countries: The flexible standards. *MIS Quarterly*, Special Issue on IT and development, 31: 381-402.
11. Coiera E: *The guide to health informatics*. Madison Avenue, New York: Oxford University Press; 2003.
12. Drucker, P.F. (1974). Management: Tasks, responsibilities, practices. Heinmann: London.
13. Eom, S. B. (2000). Data warehousing. In: Zeleny, Milan (editor) The IEBM handbook of information technology in business. Business Press, Thomson Learning. Pp 496-503.
14. Forgionne, G. A. and Rajiv, K. (2000). Management support system effectiveness: further empirical evidence. Journal of the Association for Information Systems. Volume 1, (3).
15. Frenzel, C.W. & Frenzel, J.C (2004). Management of Information Technology, (4thed.). Boston: Thomson.
16. Haiman, T., WG. Scott and PE. Connor (1985). Management. 5th ed. Houghton Mifflin Co. Boston.
17. Keri, K. S. (2007). The Successive Use of Information and Communication Technologies at Work, Communication Theory, Volume 17 (4) : 486–507.
18. MacFarland, D.E. (1979). Management: foundations and practices. Mac Millan publishing co., INC, New York.
19. Matthew, I. E. (2005). Executive Information Systems and the top-officers' roles: An exploratory study of user-behavior model and lessons taught, Australasian Journal of Information Systems, Volume 13 (1).
20. Miller, R.H. & West, C.E. (2007). The value of electronic health records in community health centers: Policy implications, Health Affairs, 26(1), 206–214.
21. Nambisan, S. & Wang, Y.M. (1999). Roadblocks to web technology adoption? Communication of ACM 42 (1), 98–101.
22. Pluye, P. R and M. Grad (2004). How information retrieval technology may impact on physician practice: an organizational case study in family medicine Journal of Evaluation in Clinical Practice Volume 10 (3): 413–430.
23. Ragam, M.R. (2007). Information technology in healthcare creating a stronger healthcare system,
24. Ridderikhoff J, Van Herk B: Who is afraid of the system? Doctors' attitude towards diagnostic systems. *Int J Med Inform* 2000, 53:91-100.
25. Rockart, J.F. and Short, J.E. (1989). IT in the 1990s: Managing interdependence. Sloan Management Review, Volume 30 (3): 7- 17.
26. SekaranUma(1999). Research Methods for Business, John Waley and sons.
27. Stephen P., Robins and David. D. (2006). Fundamentals of management, Pearson Education.
28. Stoner, F. A., Edward, F. and Daniel, R.G. Jr. (2006) Management, prentice hall6th edition.
29. Tomasi E, Facchini LA, Maia MFS: Health information technology in primary health care in developing countries: a literature review. *Bull World Health Organ* 2004, 82:867-874.
30. Turban, E., Ephraim, M. and James, W. (2004). Information technology for management: Transforming organizations in the digital economy. 4th Edition.
31. Walsham, G. (2000). IT/S in developing countries. In: Zeleny, Milan (editor) The IEBM handbook of information technology in business. Business Press, Thomson Learning. Pp105-109.
32. Weihrich, H. and Harold, K. (1999). Management: A global perspective. 10th ed. McGraw-Hill. Inc.
33. WHO (2004). eHealth for Health-care Delivery: Strategy 2004-2007. Geneva: WHO
34. World Bank (2006). Connecting People, Improving Health: the Role of ICTs in the Health Sector of Developing Countries, pp.5-6.

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