Post-Implementation Evaluation of HealthCare Information Systems in Developing Countries

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Abstract: Information and Communication Technology (ICT) project managers require accurate and reliable evaluation to allocate and control project resources. In addition, many private hospitals indicate that a number of their projects have failed; and between one and two thirds of ICT projects exceed their budget and time. Further, about half of the expensive ICT projects at the end will be considered out of control and cancelled. Justifying ICT investments is a long standing problem, and managers for the past decades have expressed concerns about the value they are getting from their investments, and they have been searching for ways to evaluate and justify these projects. Hence, evaluation of ICT is therefore becoming an important issue for both managers and practitioners. This paper aims to investigate the current practice of both types of evaluation: Prior Operational Use evaluation -POUe- and Operational Use evaluation -OUe- in Jordanian private hospitals to better understand what is required for the evaluation process and its associated benefits; secondly, to collect information about how hospitals carry out the evaluation process. In doing so, we attempts to answer specific questions, such as: How prevalent is POUe and OUe? What criteria are being used in both types of evaluation? What are their main benefits and uses of each type of evaluation? Results suggest that most decision makers do not place much importance on OUe of their IT/IS. Most managers tend to think of it only as a formality rather than a proper evaluation process. Without adopting a formal OUe the cost of future health informatics would seem likely to be less accurately estimated.

Keywords: healthcare information systems, health informatics, evaluation, developing countries, Jordan

1. Introduction

Many organizations in developed and developing countries -in both private and public sectors- turned to Information Technology/Information Systems (IT/IS) to meet the increasing demands on organizations to increase their efficiency and effectiveness (Jones and Hughes, 2000). This implies that investment in IT/IS is high, which has been a problematic issue for more than one decade. In addition, there is a contradictory evidence as to whether or not IT/IS expenditure has resulted in creating economic value for the organizations (Willcocks and Lester, 1999; Eldabi et al., 2003; Irani et al., 2002; Al-Yaseen, et al., 2006; 2008). Investments in IT/IS are growing extensively in most organizations; managers worry about the fact that benefits from IT/IS investments may not be as high as expected as large amounts of money are invested in IT/IS and there is not enough return from this expenditure (Irani et al., 2002; Kumar, 1990; Remenyi et al., 2000; Al-Yaseen et al., 2007).

Organizations specialized in healthcare are no exception as they have also joined in building information systems that also require investments in IT/IS (Wetter, 2007). These systems are known as healthcare information systems which focus on optimizing and using information to increase efficiency and effectiveness in healthcare organizations (Reichertz, 2006; Hayrinen et al., 2007).

This paper investigates the evaluation process of health information systems implemented in Jordanian hospitals and explores the main issues related to the evaluation process such as: how prevalent prior operational use and operational use evaluation; main uses and benefits of adopting both types of evaluation.

The paper is organized as follows. Section 1 is an introduction about the importance of ICTs in healthcare information systems. Section 2 discusses healthcare systems evaluation and the need for justification. The details of the research methodology used are presented in section 3. Section 4 presents data analysis and preliminary findings of the adoption of IT/IS evaluation types in healthcare sector. Finally, the discussion and conclusions are presented in section 5.

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2. IT/IS evaluation and justification

Justifying expenditure on IT/IS is a long standing problem, and managers for the past few decades have expressed concerns about the value they are getting from IT/IS investments; moreover they have been searching for ways to evaluate and justify the use of IT/IS (Gunasekaran et al., 2006; Al-Yaseen, et al., 2007; 2008). Such a continuous increase in investment coupled with continuous need for justification presents a challenge to the IT/IS community. Many organizations reported that they are uncertain about how to measure the impact and the outcomes of their IT/IS investments (Bradford and Florin, 2003; Eldabi et al., 2003; Farbey et al., 1993; Gunasekaran et al., 2001; Lin and Pervan, 2003; Liu et al., 2003; Skok et al., 2001; Al-Yaseen et al., 2007).

3. IT/IS evaluation types

Evaluation can be defined as: 'to judge or determine the significance, worth, or quality' (Webster's Dictionary). Willcocks (1992) defined IT/IS evaluation as the 'process of establishing by quantitative and/or qualitative techniques the worth of IT/IS projects to the organizations'. Or the process of assessing the worth of something (Beynon-Davies et al., 2000). Evaluation can also be considered in terms of the effectiveness of the IT system in situ – what a system actually accomplishes in relation to its stated goals (Al-Yaseen *et al*., 2004, Eldabi *et al*., 2003). We take the stance that evaluation is a process that takes place at different points in time, or continuously, explicitly searching for (quantitatively or qualitatively) the impact of IT projects (Eldabi et al., 2003). The value of this latter definition is that it explicitly recognises the different stages in the full lifecycle of an IT/IS project in which evaluation is performed, and provides the opportunity to discriminate between two decidedly different views of the evaluation process, each serving different aims. The evaluation process is a fundamental and critical activity and needs to be thoroughly conducted in any phase of the system's life cycle (Galal et al., 2000). Furthermore, it is increasingly acknowledge that evaluation of information systems is recognized as a complex and challenging activity, and there is no agreement on an ideal way to evaluate or how to make the evaluation process better (Dabrowska and Cornford, 2001).

Evaluation types can be classified into two types with regards to the development stage of the system or the timing of evaluation (Eldabi et al., 2003). Type A is a Prior Operational Use Evaluation; sometimes referred to as ex-ante; formative, or Prior-Implementation Evaluation; or as we shall refer to it, 'Prior Operational Use evaluation' (POUe). POUe is a 'predictive' evaluation performed to forecast the impact of the project. This type of evaluation is carried out prior the system becomes into operational use –through the development stages of IT/IS- to justify the investment. Type B of evaluation is carried out when the system becomes into operational use; this form of evaluation draws on real rather than projected data, and can be used to justify adoption (Love and Irani, 2001; Irani, 2002); estimate the direct cost of the system, estimate the tangible benefits of the system (Liu et al., 2003); ensure that the system meets requirements (Irani, 2002); measure the system effectiveness and efficiency (Poon and Wagner, 2001); measure the quality of programs and to estimate indirect costs and other costs (Love and Irani, 2001); or to measure the quality of programmes (Eldabi et al., 2003). We shall refer to this type as 'Operational Use evaluation' (OUe). Figure 1 shows these forms of evaluation with respect to the system's life cycle from a system's inception to the end of its useful life.

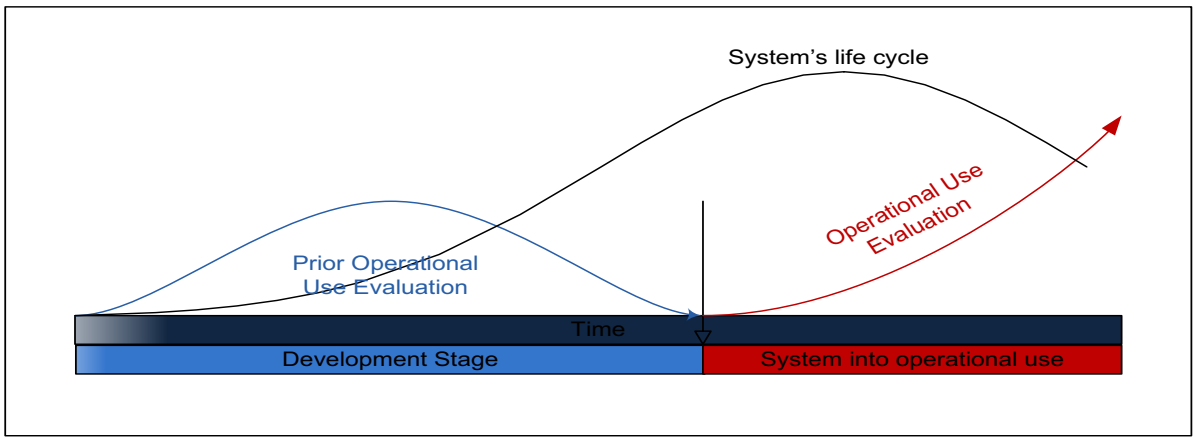

Figure 1: **IT/IS evaluation types in the systems' life cycle**

There are also a number of empirical studies – such as those reviewed by (Ballantine et al., 1996) – which examined ex-ante evaluation (POUe), yet only a few {for example Kumar (1990) and to some extent Beynon-Davies et al., 2004)} that have explored the ex-post evaluation (OUe).

4. Research methodology

In order to gather as much data as possible to understand the whole picture about prior operational use and operational use evaluation as practices within Jordanian private hospitals and to understand the benefits and obstacles of these two types of evaluation; the following data sources were used:

- General information on healthcare systems in Jordan (Government websites such as: Ministry of Health –MOH-, Private Hospitals Association –PHA-, 2009)
- Data from a survey: we administered a survey instrument to all private hospitals. Questionnaire contains four stages: designing and testing the questionnaire; followed by data collection and then data analysis; and finally the preliminary findings of the questionnaire. The survey was sent to 60 private hospitals in Jordan.

In doing so, the following questions need to be answered by practitioners who are involved with IT/IS evaluation in healthcare sector:

- How prevalent is prior operational use and operational use evaluation of healthcare systems in private hospitals in Jordan?
- What criteria are being used in order to evaluation healthcare systems?
- What are the main uses and benefits of adopting the two types of evaluation of healthcare systems?

We analyzed the data from the responses of the questionnaire using a combination of the parametric statistical methods, Descriptive Analysis and Factor Analysis (Pett, et al., 2003). Respondents were asked to select from the list the closest choice of many variables. Each of these variables were measured using a five point Likert scales (1 = not important and 5 = very important).

For technically interested readers we report that a factor analysis technique was employed in order to identify possible categories. Factor analysis was performed in three steps (following Berthold and Hand, 2003):

- A matrix of correlation coefficients for all possible pairings of the variables was generated.
- Factors were then extracted from the correlation matrix using principal factors analysis.
- The factors were rotated to maximize the relationships between the variables and some of the factors and minimize association with others using Varimax Kaiser Normalization, which maintained independence among the mathematical factors. The Eigenvalues determined which factors remained in the analysis. Following Kaiser's criterion, factors with an Eigenvalue of less than 1 were excluded. A Screen plot provides a graphic image of the Eigenvalue for each component extracted.

5. Data analysis and preliminary findings

This section presents aggregated results from direct answers to the research questions mentioned above. The basic issues considered here are: reasons for adopting either type of evaluations, criteria used for evaluations, and uses and benefits of adopting the two types of evaluation of healthcare systems.

Of the 60 questionnaires addressed to all private hospitals, 19 completed questionnaires were returned for a total response rate of 31.6%. The average IT/IS costs for the private hospitals in the research sample is ($328,000); while within the sample, 15% had implemented systems that cost more than ($1,140,000). 26.3% of the respondent hospitals have adopted IT/IS as a response to problem(s), while 73.7% of the respondent hospitals have adopted IT/IS systems searching for ways of improving their efficiency and effectiveness.

6. Reasons for adopting POUe in healthcare systems

The results are presented in Table 1. Using a factor analysis cut-off level of 0.5, four factors were considered the main reasons of adopting Prior Operational Use evaluation, which we described as 'system completion and justification', 'system costs', 'system benefits', and 'other reasons'.

Table 1: **Reasons for adopting Prior Operational Use evaluation – factor analysis**

Reasons	Factors			
	System completion and justification	System costs	System benefits	Other reason
System meets requirements	0.767			
System effectiveness	0.782			
System usage	0.791			
System efficiency	0.786			
Justify adoption	0.750			
System security	0.742			
System performance	0.772			
Quality and completeness of system documentation		0.670		
Hardware performance		0.655		
Quality of programs		0.666		
Operational costs		0.598		
Training costs		0.619		
Maintenance costs		0.584		
Upgrade costs		0.542		
Reduction in clerical salaries			0.649	
Reduction in other staff costs			0.630	
Other expenses saved			0.652	
Direct costs			0.682	
Indirect costs			0.676	
Other costs			0.686	
Tangible benefits			0.525	
Intangible benefits			0.611	
Other benefits				0.578
Barriers of adopting the system				0.542
Note: Only loadings greater than 0.50 are shown				

The first factor 'System completion and justification' is highly correlated with seven variables, the second factor 'system costs' is highly correlated with seven variables, and the third factor 'system benefits' are highly correlated with eight factors, whilst the fourth factor 'other reasons' is highly correlated with two variables 'Other benefits' and 'barriers for adopting the system' which was also found to be the least evaluated reason in practice, as shown in Table 1.

7. Reasons for adopting OUe in healthcare systems

The results are presented in Table 2. Employing a factor analysis cut-off level of 0.5, three factors were considered. The most important reasons for adopting Operational Use evaluation were identified from a five-point Likert scale ranging from 1 (not important) to 5 (very important). The results are presented in Table 2. Three factors were considered as the main reasons of adopting Operational Use evaluation, which we described as: 'system costs', 'system benefits', and 'other reasons'.

Table 2: **Reasons for adopting Operational Use evaluation – factor analysis**

Variables	Factors		
	Other reasons	System benefits	System costs
Estimating of system life	0.751		
Justify system adoption	0.751		
Risks	0.741		
Barriers	0.612		
Tangible benefits		0.677	
Intangible benefits		0.678	
Other benefits		0.682	
Direct costs			0.646
Indirect costs			0.519
Other costs			0.522
Note: Only loadings greater than 0.50 are shown			

The first factor 'other reasons' is highly correlated with four variables, the second factor 'systems benefits' is highly correlated with three variables, and the third factor 'systems costs' is highly correlated with three variables 'direct costs', 'indirect costs', and 'other costs' which was also found to be the least evaluated reason in practice, as shown in Table 2.

8. OUe criteria used in healthcare systems

The results are presented in Table 3. Employing a factor analysis cut-off level of 0.5, four factors were considered. OUe criteria were identified from a five-point Likert scale ranging from 1 (not important) to 5 (very important). The results are presented in Table 3. four factors were considered as the main criteria of OUe, which we described as: 'system completion', 'system information', 'system impact', and 'other criteria'.

Table 3**: Operational Use evaluation criteria – factor analysis**

Criteria	Factors			
	System completion	System information	System impact	Other criteria
Internal controls	0.873			
Project schedule compliance	0.769			
System security and disaster protection	0.794			
Hardware performance	0.765			
System performance versus specifications	0.676			
System usage	0.873			
Quality and completeness of system documentation	0.773			
Accuracy of information		0.984		
Timeliness and currency of information		0.974		
Adequacy of information		0.979		
Appropriateness of information		0.874		
Quality of programs		0.842		
User satisfaction and attitude towards systems			0.959	
User friendliness of system-user interface			0.874	
System's impacts on users and their jobs			0.928	
System's fit with the impact upon organization			0.849	
Net operating costs (savings of system)				0.633
Note: Only loadings greater than 0.50 are shown				

The first factor 'system completion' is highly correlated to seven criteria, the second factor 'system information' are highly correlated to five criteria, the third factor 'system impact' is highly correlated to four criteria, whilst 'other criteria' is correlated to one criterion – net operating costs, which was also found to be the least evaluated criteria in practice. For more information, see Table 4 which shows the construct loadings for the reasons of adopting Operational Use evaluation.

9. Discussion and conclusions

All of the responding private hospitals have adopted a formal POUe, but only about a third (31.5%) currently perform a formal OUe IT/IS. This means that about two thirds (68.5%) of the private hospitals do not gather any evidence to establish how successful their IT/IS were, therefore cannot use such information from OUe to improve their evaluation techniques and outcomes and decrease deviation. Results suggest that most decision makers do not place much importance on OUe of their IT/IS. Most managers tend to think of it only as a formality rather than a proper evaluation process. For example, amongst the 6 hospitals who consider adopting OUe those hospitals that seriously perform it tend to gain considerable benefits, including the validation of their original POUe estimates. In some cases, OUe is adopted in order to move responsibility from developers to users and for formal closure. When performed, the most popular reasons for adopting OUe were related to formal aspects of signing off the project (based around traditional measures such as meeting requirements, and achieving agreed metrics for effectiveness, usage, efficiency, security, performance, etc.), and system costs. The two factors -systems' benefits and adoption barriers– were found to be less important. On the other hand, amongst the 19 private hospitals, the most frequent reason for adopting OUe was related to systems' benefits (both tangible and intangible). Most of the sampled private hospitals attach greater importance to the measurement of benefits rather than the measurement of costs. The most important claimed use and benefit of adopting OUe was system cost (operational cost, training cost, maintenance cost, upgrade cost, reduction in other staff cost, reduction in salaries, and other expenses saved).As for the criteria used, the most frequently cited criterion for OUe was

system information followed by system impact, especially user satisfaction and friendliness. This implies that hospitals focus more on what the system provides rather than system completion and some of the related factors. Having such information about the system, its impact and the information it provides is useful for the future as it provides managers with the negative and positive aspects of the current system and therefore, learn lessons for the implementation of other systems in the future.

It is clear that the practitioners are not appreciating the full benefits of OUe and need to be aware of such benefits. Such lack of appreciation is evidently behind the apparent shortage of implementations of OUe, which negatively feeds back into perceptions and so forth. This research focuses on the private sector of hospitals but it does not include any information about the public sector. Private hospitals in Jordan are more developed in terms of using IT/IS than public healthcare organizations. The results of OUe in private hospitals, if and when it is carried out could be useful for public healthcare organizations. In a developing country like Jordan which has limited resources, the lessons learnt from the implementation of information systems and the deviations that occur in such systems could be useful in estimating the budgets required for the implementation of such systems in the public sector, given the limited resources available for such organizations. It is understandable that the scope of systems for public healthcare is different; nonetheless, the results of OUe of systems in the private sector could still be useful for decision makers. Without adopting a formal OUe the cost of future health informatics would seem likely to be less accurately estimated. Our research results are entirely consistent with this observation. Without OUe how can we know whether this is true or not, or much else about what is going on? Our study confirms that diffusion of the importance of OUe amongst both the academic and practitioners' communities could play an important role in more IT/IS effectiveness and less disappointment and less healthcare systems failure.

References

Al-Yaseen, H., Al-Gweri, A., and Al-Jaghoub, S. (2007) IS/IT Investment Appraisal: Prior and Post Implementation Evaluation in Jordanian Firms, International Conference Applied Computing (IADIS), Spain.

Al-Yaseen, H., Eldabi, T., Lees, D. and Paul, R. (2006) Operational Use Evaluation of IT Investments: An Investigation into Potential Benefits, European Journal of Operational Research (EJOR), Vol. 173, Al-Yaseen, H., Eldabi, T., Paul, R. J. (2004) A quantitative assessment of operational use evaluation of information technology: benefits and barriers, in Proceedings of the Tenth Americas Conference on Information Systems, New York, August 2004, pp 688 – 692.

Al-Yaseen, H., Eldabi, T., Paul, R. and El-Haddadeh, R. (2008) Post-implementation evaluation of IT systems: A close review of practice. In Irani, Z. and Love, P. (2008) Evaluating Information Systems: Public and Private Sector, Butterworth-Heinemann, Oxford, UK.

Ballantine, J.A., Galliers, R. D., and Stray, S.J. (1996) Information systems/technology evaluation practices: evidence from UK organizations, Journal of Information Technology, Vol. 11, pp 129 – 141.

Beynon-Davies, P., Owens, I. and Lloyd-Williams, M. (2000) IS Failure, evaluation and organisational learning, UKAIS, Cardiff, pp 444 – 452.

Beynon-Davies, P., Owens, I. and Williams, M. D. (2004) Information systems evaluation and the information systems development process, Enterprise Information Management, Vol. 17, pp 276 – 282.

Bradford, M. and Florin, J. (2003) Examining the role of innovation diffusion factors on the implementation success of enterprise resources planning systems, International Journal of Accounting Information systems, Issue 4, pp 205 – 225.

Berthold, M. and Hand, D. J. (2003) Intelligent Data Analysis, 2nd Ed., Springer-Verlag, Berlin.

Dabrowska, E. K. and Cornford, T. (2001) Evaluation and Telehealth – an Interpretative Study. Proceedings of the Thirty-Fourth Annual Hawaii International Conference on System Sciences (HICSS)-34, Maui, Hawaii, Computer Society Press of the IEEE. Piscataway, N.J., June 2001.

Eldabi, T., Paul, R.J. and Sbeih, H. (2003) Operational use evaluation / post implementation evaluation of IT, UKAIS, 2003, Warwick.

Farbey, B., Land, F. and Targett, D. (1993) How to assess your IT investment: a study of methods and practice, Butterworth-Heinemann Ltd., London.

Galal, G. H., McDonnell, J. T. and Paul, R. J. (2000) The Role of Interpretative Evaluation in Engineering Information Systems Requirements. Proceedings of the Americas Conference on Information Systems (AMCIS) (10-13 August, Long Beach, Ca.), Editor: Chung, H. M., Association for Information Systems, Atlanta, Pp. 1102-1108.

Gunasekaran, A., Love, P.E.D., Rahimi, F. and Miele, R. (2001) A Model for Investment Justification in Information Technology Projects, International Journal of Information Management, Vol. 21, pp 349 –

Gunasakeran, A., Ngai, E.W.T., McGaughey, R.E. (2006) Information technology and systems justification: A review for research and application, European Journal of Operational Research, Vol. 173, Pp. 957-983.

Hayrinen, K., Saranto, K., and Nykanen, P. (2007) Definition, structure, content, use and impacts of electronic health records: A review of the research literature, International Journal of Medical Informatics, Vol. 77, No. 5, Pp. 291-304.
Irani, Z. (2002) Information systems evaluation: navigating through the problem domain, International Journal of Information and Management, Vol. 40, Pp. 11 – 24.
Irani, Z., Sharif, A., Love, P.E.D. and Kahraman, C. (2002) Applying concepts of fuzzy cognitive mapping to model: The IT/IS investment evaluation process, International Journal of Production Economics, Issue 75, pp 199 – 211.
Jones, S. and Hughes, J. (2000) Understanding IS Evaluation as a Complex Social Process. Proceedings of the 2000 Americas Conference on Information Systems (AMCIS) (10-13 August, Long Beach, Ca.), Editor: Chung, H. M., Association for Information Systems, Atlanta, pp 1123 – 1127.
Kumar, K. (1990) Post Implementation Evaluation of Computer Information Systems: Current Practices. Communications of the Association for Computer Machinery (ACM), Vol. 33, No. 2, N.Y., (January), pp 203 – 212.
Lin, C. and Pervan, G. (2003) The practice of IS/IT benefits management in large Australian organisations, International Journal of Information and Management, Issue 41, pp 13 – 24.
Liu, Y., Yu, F., Su, S.Y.W. and Lam, H. (2003) A Cost-Benefit Evaluation Server for decision support in e-business, Journal of Decision Support Systems, Issue 36, pp 81 – 97.
Love, P. E. D. and Irani, Z. (2001) Evaluation of IT costs in construction, Journal of Automation in Construction, Vol. 10, Pp. 649 – 658.
Ministry of Health (MoH) Jordan, www.moh.gov.jo/MOH/En/home.php, (Accessed March, 2009).
Pett, M. A., Lackey, N. R. and Sullivan, J. J. (2003) Making sense of factor analysis: the use of factor analysis for instrument development in health care research, Sage Publications, London.
Poon, P. and Wagner, C. (2001) Critical success factors revisited: success and failure cases of information systems for senior executives, Journal of Decision Support Systems, Vol. 30, Pp. 393 – 418.
Private Hospitals Association (PHA) Jordan, www.pha-jo.com, (Accessed March, 2009).
Reichertz, P. L. (2006) Hospital information systems – Past, present, future, International Journal of Medical Informatics, Vol. 75, No. 3-4, Pp. 282-299.
Remenyi, D., Money, A., Sherwood-Smith, M. and Irani, Z. (2000), The effective management and management of IT costs and benefits, Butterworth-Heinemann Ltd., London.
Skok, W., Kophamel, A. and Richardson, I. (2001) Diagnosing information systems success: importance-performance maps in the health club industry, International Journal of Information and Management, Issue 38, pp 409 – 419.
Wetter, T. (2007) To decay is system: The challenges of keeping a health information system alive, International Journal of Medical Informatics, Vol. 76, Pp. 252-260.
Willcocks, L. (1992) Evaluating information technology investments, research findings and reappraisal, Journal of Information Systems, Vol.2, pp 243 – 268.
Willcocks, L. and Lester, S. (1999) Beyond the IT Productivity Paradox, Wiley, Chichester.