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Poor Quality Information Systems: is this the way of the future for Health Care Organisations?

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Abstract

This paper investigates the quality of Hospital Information Systems (HIS) within health care organisations. Traditionally software and information systems quality is viewed as a product, in terms of use, as a process and from an organisational viewpoint. This paper suggests that the use view of quality is most relevant when examining information systems within health care organisations. The existing literature on quality is explored in terms of applicability to an emergency department's HIS. Factors such as the high level of distrust and resistance toward systems together with strong beliefs and values of health care staff, impacted on the way information systems were perceived. Adopting a use view of quality in the case study could gain an insight as to how well the systems serves the user and how it would ideally operate if they had input into its development. It is evident from the findings in this study that health care professionals need to take a new approach to information systems development to produce high quality HIS.

Introduction

Imagine you have just had a heart attack. You arrive by ambulance to the emergency department. Painfully you wait while the nurse enters your personal details into the Emergency Department Hospital Information System (EDHIS). The nurse is taken away from your bedside to attend to the process of admission. This is the process for how at least one emergency department operates. Is the delay because of the nurse's poor keyboard skills or does the problem lie much deeper? Is the EDHIS inappropriate for use within the emergency department? In either case the problem is one of Information Systems quality. This paper aims to explore the literature on Information Systems and software quality in order to identify the concepts most relevant to HIS.

Hospital Information Systems (HIS) are defined as "groups of systems used within a hospital or enterprise that support and enhance patient care" (Hebda et al, 1998). They are becoming more and more important for health care organisations to remain competitive. Health care organisations need to adapt to the changing environment and have long been lagging behind other businesses in the use of information systems (Ribi re et. al, 1999). The focus now is on creating business-orientated environments in which the patients are the customers and the doctors, nurses and support staff are the customer service representatives. The success of information systems within health care organisations is critical. Investments are usually large for information system development, maintenance and operation. It is therefore essential that the information system is as useful as possible to the organisation for its intended use and purpose (Eriksson and T rn, 1991). The quality of HIS is therefore a very important issue. Investing in quality reaps enormous rewards such as higher productivity, quicker delivery of products, better reliability and improved morale (Thompson, 1996).

The existing research on information systems quality within health care organisations is limited. Much of the work is concerned with the acceptance of new technologies and tools

that have been developed to measure customer satisfaction (Rivière et al, 1999; Succi and Walter, 1999). To establish an appropriate concept of quality for a health context, a comprehensive review of the information systems and software quality literature is required. A review of the literature led to a categorisation of the quality literature according to four different perspectives: *product, use, process and organisational*. The *product* view focuses on the technical aspects of producing a quality product. The *use* view as the name suggests, represents the user's point of view towards the use of information systems. Quality standards are used in the *process* view to develop systems. The *process* view is closely related to the *product* view because of the focus on producing a quality product through processes. The *organisation* view encompasses the whole organisation in quest to achieve holistic quality. This paper suggests the *use* point of view is most applicable to HIS.

There are special factors to consider when examining quality in HIS. There is a strong degree of distrust within health care organisations toward new technologies, even to the point where they are rejected (Rivière et. al, 1999.). HIS need to be adapted to the health environment, not visa versa. Systems cannot be too complex to use or understand and it is imperative that it be user-friendly. If these basic requirements are not met the systems could be sabotaged or ignored (Rivière et. al, 1999.). For instance, the research site involved in the case study uses a medical journal called MIMS on CD-ROM. The MIMS journal provides a detailed list of all available prescriptions with the effects of drugs etc. From the nursing staff interviewed, the majority could not access the MIMS due to a lacking of basic computer skills. Instead an out-of-date paper issue is consulted. The information retrieval part of the information system is being ignored.

An exploratory study is performed to investigate the quality of HIS. This paper examines the literature on software and information systems quality in terms of its relevance to HIS. The paper refers to a case study carried out by the author of a HIS used in an emergency department of a large public hospital in Australia (Clark, 1999).

The Case Study

The hospital that participated in the study is an adult public hospital. It is one of a group of six public and private hospitals and is 4 kilometres from the centre of Brisbane. The other hospitals in the group include 2 childrens hospitals (public and private), 2 mothers hospitals (public and private), a full private hospital and a medical research institute. They are all located in close proximity. The hospitals care for more than 70 000 inpatients and 400 000 outpatients and ambulatory patients each year. The hospitals are owned and administered by the Brisbane Congregation of the Sisters of Mercy who work in partnership with the State Government. The hospital first began caring for patients in the year 1906. The hospital aims at providing a compassionate service to the sick and needy promoting a holistic approach to health care to meet the changing needs of the community. The hospitals all foster high standards in health-related education and research.

The focus of the larger research study is a large emergency department within the adult public hospital, which has 18 patient beds with 8 critical bay areas. The department receives approximately 35 000 admissions per year. This makes it one of the largest emergency departments in the Brisbane metropolitan area. Admissions to the emergency department are typically critical.

The whole spectrum of a patient's admission is recorded in the EDHIS, from when they arrive to their discharge. The EDHIS is mainly used as a support tool for work roles. There are four main systems included in the EDHIS (Table 1). There are other applications such as email (Internet Explorer), Microsoft Office, an intranet of hospital services (library, administrative) included in the EDHIS. A MIMS journal is provided on CDROM that lists all medications is available. There are 4 PCs (personal computers) (486) located throughout the Doctor/Nurses station. The HAS software is networked on all PCs as is the BMS rostering system but they are not connected to the network outside the emergency department. The system for radiology and pathology tests is a stand alone machine. HIBISCIS is networked through the entire adults public hospital.

System	Description
HAS – Health Administration Solutions	HAS records patient details such as name, address, date of birth, sex, medical record number, diagnosis, injury surveillance, trauma data, allergies, treatment, etc. HAS has been designed especially for emergency departments.
A system for radiology and pathology tests (no specific name)	Radiology and Pathology tests can be ordered and tracked via this system.
HIBISCIS	HIBISCIS is a clerical system stores patient's personal details, diagnosis and administrative details such as medical insurance, charges etc. This system is not linked to HAS.
BMS Rostering	BMS Rostering is a staffing tool that allocates and stores what nurses are on each shift. (3 per day – morning, afternoon, night). There are codes for each shift e.g. DX means day shift (7.00am – 3.30pm).

Table 1. The Emergency Department Hospital Information System

As a management tool the EDHIS is used to determine workload patterns, allocate rosters, and data extracted from the system is collated and presented to a governing body, Queensland Health for funding allocation. Statistics are collected about the casemix (type of admissions), and patient waiting times in order to determine workload patterns and to forecast rostering needs.

The Quality Literature

How do organisations implement quality practices when there is a lack of consensus as to what actually constitutes the term 'quality' (Nielsen, 1995)? The quality literature is categorised in this paper as representing the different viewpoints as mentioned earlier. Quality is explored from the perspectives of *Product, Use, Process and Organisation*. These perspectives are not mutually exclusive.

Product view

The traditional product view of quality is appropriate for functions that support generic user environments. The focus is on the technical quality of products from the customer/client's point of view. The influential paper by Garvin (1984) on the eight dimension of quality can be categorised here. Products and services are the focus and are measured through eight dimensions: performance, features, reliability, conformance, durability, serviceability, aesthetics and perceived quality (Garvin, 1987). These eight dimensions are widely referenced in the literature on quality (Eriksson and Törn, 1991; Eriksson and Higgins, 1994; Myers et. al, 1997; Dahlberg and Jarvinen, 1997;) and form the grounding for quality discussions. Aesthetics is related to the user-based approach and could be applicable to health care organisations as it deals with how a product looks, feels, sounds, tasted or even smells (Garvin, 1984). This dimension could be explored further as the nursing staff at the research site have expressed views about the look, feel, sound of the EDHIS during interviews.

The product view of quality is covered considerably in the field of software engineering. Software quality is based on the technical measurement of products in terms of correctness, reliability, modularity and self-descriptiveness (Eriksson and Higgins, 1994). Models have been created to assist in the software development process. Dromey (1995) has developed a software product quality model to address both software products and quality models. The model specifically focuses on the quality carrying attributes of software such as functionality, reliability, efficiency, usability, maintainability, portability, reusability and process-mature (based on the standard ISO9126). The hierarchical model based on the works of Boehm et. al (1978), is a well-known quality model that has been represented as an IEEE standard (Eriksson and Higgins, 1994). This model has three levels with quality factors, quality criteria and the lowest level contains measurable quality metrics (Eriksson and Higgins, 1994). The hierarchical model depicts the product view of quality but has a rather process view underlying the its' design techniques and tools (Eriksson and Higgins, 1994).

The main goal of the product process lies in building faster, cheaper, better software products. The software engineering view towards product-based quality is not appropriate for health care organisations due to the product being concerned with 'human lives' and caring for the sick.

Use View

"...Quality is not something you can buy; it's something you must attain through people" (Wilkin and Hewett, 1997). The use view of quality is highly subjective as opposed to the objective product view (Leffler, 1982 in Eriksson and Higgins, 1994).

In Garvin's (1984) eight dimensions of quality, the user-based approach is best suited in this category. The view is of the premise that individuals have different wants or needs and it is through their perception of what is high quality that the quality is measured (perception of Garvin, 1984). The use aspect is concerned with a more subjective perspective that is orientated towards individuals or groups sharing subjective expectations (Braa, 1995). The focus is on creating 'satisfaction' for the users of the system. The existence of high correspondence between users and developers signified a good quality product, while low correspondence between parties signifies the converse effect (Braa, 1995). Participatory Design incorporates these subjective perspectives into the design of information systems, even though use quality is not usually specified as a goal. The final aspect of the user-based

approach is the organisational one. The match between the organisational strategy and the output of the information system is examined. In other words, how the services of the organisation are perceived from the customers (Braa, 1995).

The concept of use quality can be categorised within the use view. It is concerned with how well the system serves the user and how the system should do the right things in a user-friendly way (Eriksson and Törn, 1991). The term use quality can be divided into what the system does for the user and how the interface is designed. The basis of this is evident in the use quality component of Eriksson and Törn's (1991) SOLE (Software Library Evolution) model. Eriksson and Törn (1991:153) state that a complete quality model should include: a structure of quality characteristics, measurement of attainment of quality goals, decisions on quality procedures, quality assurance, and management of the quality model. The SOLE model is based on the goal of maximising the utility of information systems within organisations.

With all the different viewpoints on quality in the field of information systems and software engineering, the most relevant to the empirical case study discussed in this paper, is the use view. Examining the user's point of view could be useful in determining the quality of HIS within the emergency department. The discussion section will explore this further.

Process View

The process view is closely related to the product view as the product is the main focus. System development is performed according to quality standards. In both the software and information systems field, quality standards have been widely accepted and used although they cannot guarantee quality improvement (Dahlberg and Jarvinen, 1997). Dahlberg and Jarvinen (1997) posit that the most widely accepted standards within the information systems field are ISO 9001 and its application ISO 9000-3.

All facets of health care organisations are documented in the policies and procedures. The emergency department of the case study is no different. The policies and procedures, which usually include continuous quality improvement, are devised internally and tailored to the individual needs of the health care organisation. In the case study, there is no existence of quality standards for the EDHIS. There are only user manuals for the systems.

Organisation View

The organisation view of quality is process driven rather than product and relies on management commitment and support. Total Quality Management takes an organisational viewpoint toward quality. The works of Deming (1986) has popularized the literature on Total Quality Management (TQM). Jarke and Pohl (1992) posit that Deming (1986) takes a radical stance on quality process versus product orientation. Dahlberg and Jarvinen (1997:809) describe TQM as “the idea of constantly improving performance and quality throughout the organisation – total quality management (TQM)”. The goal of TQM is to achieve quality throughout the organisation with methods such as Unit Optimisation, Horizontal Integration and Vertical Alignment (Dahlberg and Jarvinen, 1997).

Another important area within this view is includes information systems quality management models (ISQM). Eriksson and Törn (1991:153) articulate that a complete ISQM quality model should include the following: a structure of quality characteristics, measurement of the attainment of quality goals, decisions on quality procedures, quality assurance, and management of the quality model.

From the research collected, much of the Eriksson and Törn's (1991) complete quality model is present in the research site's overall quality practices. Observation revealed that quality practices were of high importance to the operation of the department. Although, there is an absence of a quality model for information systems within the health care organisation.

Research Site and Method

An exploratory study of the quality literature was performed to investigate any links between the existing quality literature and the quality of HIS. The research data and approach were adopted from the larger research project undertaken exploring the following research question: *"How does culture and structure influence Information System implementation within health care organisations?"*. A single holistic case study was utilised in the larger research investigation and only the data collected has been applied to this study. The larger case study used Davies (1990) adaptation of Allaire and Firsirotu's (1984) conceptual framework for organisational culture, incorporating Gidden's (1984) structuration theory, in an attempt to analysis the cultural and structural influences of information systems use in health care organisations (Clark, 1999). The analysis performed as part of the larger case study is not shown here as it is outside the scope of this paper. Data collection methods included: direct observation, hospital documentation review, in-depth interviews with organizational members and a survey instrument used in conjunction with the interviews in an effort to triangulate data. The empirical data will be discussed and interpreted from a quality point of view.

Discussion

The existing literature on quality is lacking in its applicability to the health care domain. The literature review indicated the use view of quality is most relevant when examining information systems within health care organisations and will be explored further.

As discussed earlier, there is a great deal of hidden complexities to consider in analysing the quality characteristics of information systems within health care organisations. Issues such as the strong beliefs and values of health care professionals can influence the acceptance of information systems in these types of organisations. The premise of the use view is that individuals have different wants or needs and it is through their perception of what is high quality that the quality is measured (perception of Garvin, 1984). If management of the emergency department were to adopt a use view of quality, they would be surprised on the results due to a misconception revealed during interviews. The manager of the emergency department has very strong computer skills and values technology as a useful resource. The emergency department staff have differing perceptions. There is a strong consensus among nurses that they have a different mindset as opposed to other professionals outside the health industry. The ritualistic behaviour of nurses caring for the sick has not changed throughout the history of the hospital. The nurses within the emergency department all agree that nursing will never change. It will always be a people trade with a high level of interaction between the nurse and the patient. It is only the environment around them will change as they are faced with the onset of technological change. The history of the hospital denotes a caring and religious purpose in caring for the sick. One of the hospital's major goals in the corporate plan is to promote an appreciation of history (Clark, 1999).

The EDHIS, is not considered by nursing staff to be of high importance in patient care. Rather that it is seen as a management tool that collects data on the work that they perform (patient admissions, patient waiting times etc). It was generally expressed that the information technology department is the section responsible for the EDHIS, not the actual staff in the department. It is not collectively seen as a means to improve or assist nurses in providing a high quality of nursing care, but just as an extra task that must be done as part of their work roles. The emergency department manager interprets the staff's point of view as "*.... yet another imposition on their time together with all the phone calls, paperwork obliged of their role. So the computer just becomes another mundane task*" (Clark, 1999).

Funds are distributed to each department through the process of decision making that occurs in the hierarchical levels of the hospital. Concerns were raised about the internal distribution of funding. Staff thought that there were too many management roles using funds and not enough for the nurses on the floor who are caring for the sick patients. A senior nurse posits "...the dollar is at the grass roots of operations" (Clark, 1999). Technology is not a priority for money to be spent on as it is only seen as a support function not as something that could add real value. Generally staff in the department thought money would be better spent on opening up new beds than on new computer systems. Data that is entered into the EDHIS is collated and presented to a governing body, Queensland Health for funding distribution. There is a conflict of interest here as management within the emergency department express that the data inputted into the EDHIS is constantly inaccurate. How can decisions be made from incorrect data? (Clark, 1999).

Through the use of a survey instrument the emergency department's computer experience were recorded and analysed for usage of computers outside work and what they thought about computers in general. Overall there was a strong lacking of IT skills held by nurses. By lack of IT skills I am referring to poor keyboard (typing) skills and poor general computer skills. This had a significant impact on the quality of care given to the patient as the waiting times of the patient were directly linked to the level of skill that the nurse had. For instance, when a patient is admitted to the emergency department the patient or relative verbally informs the admitting nurse of their personal details. This nurse types the information into the EDHIS as he/she hears the information. Imagine the difficulty for a nurse who types with one finger. If the emergency department is busy, not having the keyboard skills will impact on the nurse in the form of increased stress. In respect to the general computer skills this mattered in relation to things like being able to access the MIMS journal on CDROM or checking staff notices through internet email. Staff that did not possess general computer skills just asked another member of staff to do it for them. For some staff, keystrokes were just committed to memory. The Nurse Manager expresses: "*There are very basic things that people should be able to do, a lot of people in the department don't have computer skills and they don't see it as a part of their role and they don't want to*". To deal with the problems encountered with the EDHIS, staff developed shortcuts. In some instances updating systems was a last priority. The patient always came first. No maintenance was planned into the budget of the EDHIS implementation. Staff within the department often complained about the lack of training. Training was only provided when the information system was implemented. The Nurse Manager talking about managerial objectives about IT/IS implementation "*....they buy all these systems and they expect them to work magically*" (Clark, 1999).

It is evident from data collected from the research site that there is an awareness of the problems surrounding the EDHIS but no conclusive reasons, known to staff, about why they

are happening appear to be apparent. There are signs here of a poor quality information system. The EDHIS implemented in the research site was originally implemented to solve problems. The staff perceive it as having created an even bigger one. This is a major problem as "...quality is not intrinsic to a product; it is connected to a product in the service of a human being" (Törn and Eriksson, 1991:153). The EDHIS was implemented prior to the research study but is described as "We had a look at the system on a projected computer screen. We were asked the question "Do you want to go with it? We need a decision." That is just a ridiculous process to go through" (Clark, 1999).

More training is needed to support IT implementation to gain more positive quality expectations. The EDHIS have been implemented in the Emergency Department by higher management to save money. The staff perceive the EDHIS as a low quality useless tool that has not been adapted to the working environment but expects the working environment to adapt to it. Although it is difficult to measure the user's point of view, it should not be ignored (Garvin, 1984; Leffler, 1982; Braa, 1995). The user views expressed by the nursing staff need to be considered by management. There are major problems with the EDHIS but high level management continue to ignore the users. Management ignores the opinions of the managers of the emergency department. The head doctor of the department states "*This is probably the most user-friendly system available and it is still no good*" (Clark, 1999). Participatory design or User-centred Design of information systems within health care organisations may have a positive impact in meeting the user requirements.

Conclusion

In an exploratory investigation of the quality literature the following viewpoints emerged: *product, use, process and organisation*. The *product* view focuses on the technical aspects of producing a quality product. The *use* view represents the user's point of view towards the use of information systems. Quality standards are used in the *process* view to develop systems. The *process* view is closely related to the *product* view because of the focus on producing a quality product through processes. The *organisation* view encompasses the whole organisation in quest to achieve holistic quality. This paper suggests the *use* point of view is most applicable to HIS.

The main findings revealed that poor quality information systems were a result of inadequate training and users rejecting information systems due to the strong beliefs and values of health care professionals. The strongest consequence of the poor information system was the data inaccuracy. A government body for decision making use the data extracted from the EDHIS. Finally, when the EDHIS was implemented, no part of the budget for the emergency department allocated finance to the maintenance of the information system.

The results of the research could be very useful to health care organisations to optimize the current system implementation process. Important issues have been raised as to why the users of systems reject and/or accept the introduction of information systems into health care organisations. The perceptions of the main stakeholders of an emergency department have been explored in order to discover the difference between the quality expectations of the users involved to the actual outcomes. There is a lack of literature about quality particularly focusing on quality applied to information systems within health care organisation, as opposed to other aspects within this domain. Research is missing from contemporary information systems research about information systems quality in health care; it is a topical area of increasing importance.

Due to the exploratory nature of this paper, the relevant issues of data quality and organisational culture were excluded from the scope and could be addressed in future research projects.

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