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A Multi-method Study of Factors Associated with Hospital Information System Success in South Africa

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Abstract. A combination of interpretivist and positivist techniques was used to develop and refine a conceptual model of factors associated with computerised hospital information system (CHIS) success in South Africa. Data from three case studies of CHIS use in level 2 public sector hospitals were combined to develop a conceptual model containing seven factors associated with CHIS success at hospital level. This conceptual model formed the basis of a fourth case study which aimed to confirm and refine the initial conceptual model. In the third phase of the study, a survey of CHIS use was conducted in 30 hospitals across two South African provinces, each using one of three different CHISs. Relationships between hospital-level factors of the conceptual model and user assessment of CHIS success were examined. A revised conceptual model of CHIS use was developed on the basis of the survey results. The use of a multi-method approach made it possible to generalise results from the case studies to multiple CHIS implementations in two provinces.

Keywords. Hospital information system success, Information system (IS) success, multi-method approach, conceptual model.

1. Introduction

A conceptual model of computerised hospital information system (CHIS) use has been developed, based on relevant theoretical background and the results of case studies and a survey, to support decision-making about CHIS acquisition and implementation in South African level 1 and level 2 hospitals[2]. This model takes into account the context in which the CHISs are implemented (environments of limited or vulnerable resources such as skilled personnel and infrastructure; and CHISs of limited scope, i.e., admission/discharge/transfer (ADT) and billing). In this paper, the combined use of interpretivist and positivist approaches to test and refine the conceptual model is described.

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[2] A level 1 hospital is a facility at which a range of outpatient and inpatient services is offered, mostly within the scope of general medical practitioners. A level 2 hospital is a facility that provides care requiring the intervention of specialists as well as general medical practitioner services.

2. Methods

Two contrasting approaches (positivist and interpretivist) have typically been used in the analysis of the effects of the implementation of information systems in organisations. Much of the literature on information system (IS) success seems to reflect the positivist approach, in which attempts are made to demonstrate the validity of theories of IS success, or the need to modify such theories, based on empirical studies of comparatively large numbers of cases (for example, studies reviewed in [1]).

The theoretical work relating to health information system (HIS) success and failure identified to date has generally been based on an interpretivist approach, in which the aim is to deepen understanding of the social and other factors which contribute to the experience of implementing HISs in different environments. In this study, the aim is to develop an understanding of the relationships between an organisation (a level 1 or level 2 hospital), the people in that organisation, and the information system (the CHIS). The aim of some HIS studies has been to develop or extend theories which provide a framework in which to interpret results (for example, [2] and [3]). Other recent studies of factors influencing the success of HISs have taken the form of Delphi studies [4-5]. The interpretivist approach is appropriate to investigating CHIS success or failure because the highly complex nature of the environment being studied makes it difficult to predict outcomes of activities.

This study used the opportunity to combine positivist and interpretivist approaches by using in-depth case studies to identify and examine the factors which affect the success or failure of CHISs in the environment of level 1 and level 2 public sector hospitals (a largely interpretivist approach), in combination with a survey of a large number of these organisations in an attempt to explain similarities and differences in the experiences of CHIS implementation across the organisations (a largely positivist approach). The combination of interpretivist and positivist approaches has been advocated by authors such as [6-8]; so that the strengths of each approach can be combined to enrich the analysis of a particular domain. Westbrook *et al.* [9] are following a multi-method approach in a study of the implementation of a commercial CPOE system in an Australian hospital, describing the analysis of the effects of this implementation as a 'wicked' problem, requiring multiple methods of investigation to gain the best possible understanding of the process.

The broad framework for the methodological approach used in this study is a reflection of the complexity of the issues being addressed: the **socio-technical approach** to HIS studies (as in [9-11]) is based on the premise that the implementation of information systems, such as CHISs, results in a complex interaction between the organisation in which the CHIS is implemented and the CHIS itself; i.e., the social and technical aspects of the implementation. This approach is consistent with the intention in this study to examine the implementation of CHISs in the specific context of level 1 and level 2 public sector hospitals in a developing country, based on the premise that access to the resources required for CHIS implementation in these environments is limited and vulnerable. The socio-technical approach provides a mechanism for the incorporation of the context issues in the study design and analysis.

The CHISs in use in the study hospitals support mainly patient administrative functions (patient registration, ADT and billing). Most published HIS studies identified in this project refer to clinical information systems, such as computerised physician order entry (CPOE) systems. The lack of published studies of administrative CHISs could imply that the technical and organisational issues related to a CHIS

implementation like those at the study hospitals are relatively trivial. However, reports of studies in two South African provinces highlight the challenges experienced with the implementation of similar CHISs in those environments [12-13].

3. Results and Discussion

The interpretivist component of the current project provided the opportunity to examine the use of a specific CHIS through case studies in three hospitals (the pilot case studies) in order to improve understanding of factors which influence the potential for CHIS success or failure. Once factors had been identified, they were incorporated in the initial conceptual model of CHIS use. This initial conceptual model then provided the framework for the subsequent (fourth) case study. All case study hospitals used the same CHIS. Based on the findings from the fourth case study, and additional insights from the literature and from interviews with HIS experts, the conceptual model was revised to develop an 'extended conceptual model of CHIS use', following the structured case study approach described by Plummer [14].

The aim of the survey component of the study was to validate the extended conceptual model by conducting a survey of CHIS use in level 1 and level 2 hospitals in two South African provinces, each using one of three different CHISs. Survey respondents were asked questions designed to confirm (or not) the factors affecting CHIS success, and the relationships between them. This positivist approach was supplemented by a small interpretivist component, since respondents were also asked a few open-ended questions designed to obtain information on additional factors which could affect CHIS success in the study environments.

The final version of the conceptual model of CHIS use for this project, the revised conceptual model of CHIS use, was developed based on the results of the survey. The following seven hospital-level factors were identified as being associated with CHIS success: Knowledge and understanding of CHIS; Appropriateness of CHIS design; CHIS performance; Resource availability and allocation; Perception of usefulness; Management commitment to success; and Effective use of CHIS and/or outputs. The survey results and the revised conceptual model are described in [15].

The case studies and discussions with expert informants yielded mainly qualitative data about opinions of the CHISs in use in the study environments. The survey was designed to collect quantitative data, based as far as possible on a 5-point scale to order opinions, and thus facilitate statistical analysis. The design of the questionnaires also made provision for recording qualitative data, both through open-ended questions and by making provision for respondents to record comments.

3.1. Case Studies

The use of case studies in examining HIS implementations is well established (for example, as reported in [10]; [13]; [16-17]). In practice, the pilot case studies and the fourth case study resulted in the identification of factors associated with (effective) CHIS use, rather than the more general concept of CHIS success. In keeping with the practice for qualitative research, cases were chosen in order to ensure representativeness of a particular class of cases , rather than on the basis of statistical sampling [18]. The description of the relationship between the identified factors was formalised in the development and refinement of an initial conceptual model of CHIS

use. The fourth case study differed from the pilot case studies in that it was aimed at investigating the applicability of the initial conceptual model of CHIS use while also clarifying information gained in the pilot case studies, resulting in the extended conceptual model.

Yin [19] has made recommendations for enhancing the quality of case studies in health services research. Among the issues identified as being associated with high quality case studies is that they 'should contain some operational framework' even if they are exploratory [19, p1215]. For the pilot case studies in this CHIS success study, the framework was provided by the interview framework which was used in all the case studies, and the key IS success models identified by that stage ([1], [20-21]). The initial conceptual model of CHIS use and the same interview framework (as used in the pilot case studies) provided the operational framework for the fourth case study.

3.2. Survey

The survey provided data on the CHIS implementations in 30 hospitals. There was no evidence from the available literature that other surveys of similar scope had been conducted either in South Africa or elsewhere, although there have been reports on surveys of the status of clinical information technology in hospitals in Canada and the US [22-23].

While the primary aim of the survey was not to obtain information about the CHIS itself in each hospital, questions were included about the functioning of the CHIS, relating to the factor 'CHIS performance' in the conceptual model of CHIS use. The survey was also designed to confirm whether the factors included in the conceptual model of CHIS use do apply in a wider set of hospitals, and to find out whether the relationships described in the conceptual model could be identified from the survey data. Several hypotheses related to the factors in the conceptual model were defined for investigation through the survey.

The analysis of the survey data showed that the factors of the conceptual model are associated with CHIS success, and confirmed the relationships between factors of the model in varying degrees.

4. Conclusion

The results of the study of factors associated with CHIS success in South African level 1 and level 2 hospitals have been reported in more detail elsewhere [15], [24]. The use of a multi-method approach made it possible to generalise results obtained from the case studies in four level 2 hospitals in the same province using the same CHIS to level 1 and level 2 hospitals in two provinces, using three CHISs. This approach has the potential to support further generalisation of the results of this study.

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