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The Adoption of Enterprise Application Integration in Healthcare Organisations: Methodological Perspective

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Abstract

The integration of various Information Systems (IS) applications based on heterogeneous systems has always remained problematic in healthcare organisations, with issues such as high operational cost, functionality problems and maintenance cited as significant barriers. As a result of such issues, healthcare organisations are struggling to find new means to increase their functional capabilities. As a result, many large and multi-national organisations are turning to Enterprise Application Integration (EAI) as a means of solving data and process integration problems. The adoption of EAI offers several significant benefits to various organizations, such as cost reduction, process integration, return on investment. Therefore, EAI may be regarded as an integration solution for healthcare organisations. However, there is limited empirical research reported on the adoption of EAI in healthcare. In attempting to explore EAI, the discussion on the adoption of EAI in healthcare organisations is presented. In doing so, the authors conceptualize and propose a model for the adoption of EAI through a comprehensive review of the normative literature in the areas of integration technologies, healthcare informatics and other associated sectors. In addition to that proposition is identified. This proposition will define the scope of the research and provide an in depth analysis of the factor (e.g. barriers). This paper also attempts to present the appropriate research methodology by describing and discussing the prevalent research methodologies in the domain of technology adoption.

Keywords

Healthcare, Integration, EAI, Adoption Model, Research Methodology

Introduction

In the last two decades, several integration efforts have been made to solve the problem of integration (Grimson *et al.*, 2000), with EAI emerging to overcome many of these problems. EAI software provides the infrastructure to rapidly connect and interface information between organisations internal and external applications. The advantages of this approach are that enterprises develop a flexible and sufficient IT infrastructure by integrating functionality from existing and new applications.

Khoubati *et al.*, (2003) proposed a conceptual model for the adoption of EAI in healthcare organizations, with this paper further refining and expanding the model. Initially the comparative analyses of various models that focus on the adoption of integration technologies are discussed, with common beneficiary factors from these adoption models being identified and discussed. These factors facilitate the development of EAI technology adoption model for healthcare organisations. The authors then analyze the factors that are related to EAI adoption in healthcare organisations. As a result, the authors combine these factors to develop a framework that focuses on EAI adoption in healthcare organisations. Finally the authors proposed the research methodology to empirically test the EAI adoption model for healthcare organisations.

Information Technology Adoption in Healthcare Organisations

Several developments associated with IT implementation have taken place in the healthcare industry, with IT playing an increasingly significant role in its delivery. Computerised Patient Record (CPR) systems, the adoption of the internet along with intranets and extranet, enterprise systems, integration approaches and remote diagnostics via telemedicine have experienced significant growth in recent years (Raghupathi and Josph, 2002). As a result, IT is extensively being used at the primary and secondary levels of healthcare units. This has resulting for healthcare information systems being increasingly

developed at primary and secondary healthcare levels. This situation has resulted into a large number of heterogeneous and mutually incompatible systems emerging (Ferrara, 1998).

However, the integration of such heterogeneous systems in the existing, multi architectural computing environment has been proved to be a complicated task and difficult to be accomplished (Zviran and Armoni, 1999). Thus, several integration approaches such as Electronic Data Interchange (EDI), Health Level 7, CEN/TC251, Synergy Extranet (SynEx), Synapses, etc) have been developed and deployed in healthcare organisations to address integration problems. These integration approaches have caused significant problems, such as high operational cost and functional problems. Healthcare organisations have realised this situation and now seeks better integration solution that result in cost effective solutions, better patient care and manageable integrated IT infrastructure. This might be achieved through EAI adoption.

Integration of Healthcare Systems with EAI

Healthcare was the one of the first sectors to adopted EAI. The reasons for that are:

- Healthcare organisations consist of a larger number of departments compared to others. Integrating this large number of departments using other technologies (e.g. middleware) can not always provide a manageable, maintainable integrated IT infrastructure.
- Healthcare organisations do not often have enough budgets for the IT department. The integration of these different information systems with other integration solutions has in the past proved costly hence, the need for EAI emerged.

Published case studies in the area of EAI report a 50% cost reduction (Themistocleous *et al.*, 2000). Furthermore, EAI aims at integrating individual applications into a seamless whole, enabling business process, and data to speak to one another across applications (Johannesson and Perjons, 2001). Themistocleous, (2002) specifies that EAI can efficiently incorporate custom applications, packaged systems and e-business solutions into a flexible a manageable infrastructure.

Descriptions of the Models for the Adoption of Integration Technologies

Various models have been proposed in the literature (presented below) to provide an understanding of the principles behind the adoption of IT innovations. Based on a comprehensive literature review on the adoption of integration technologies, the authors have reviewed a variety of adoption models and have attempted to analyse the factors of these models that can support the adoption of integration technologies in healthcare organisations.

Table 1 provides the description and presentation of factors inherent in these models. The purpose of this analysis is to identify the common factors that are being used in all these integration technology adoption models. As a result, the authors have identified six common factors and categorised them into common terminology used in different models such as (a) Benefits, (b) IT infrastructure, (c) External pressures (d) Cost (e) Barriers and (f) Internal pressures.

Singletary and Watson (2003) proposed a theory of an IT integration infrastructure, in which the authors have presented the IT integration infrastructure model. This model has various factors such as integration constructs, perceived benefits, environment, motivation, integration decisions, IT infrastructure, costs and outcomes. While Singletary and Watson (2003) have not proposed the integration constructs as a factor for the model. Their explanation for this is that the relationships of this factor do not appear to bear directly on the primary purpose of integration theory. Singletary and Watson (2003) have describe the costs with the outcome of the IT integration infrastructure adoption. On the other hand the study of integration technology adoption models suggests that costs is the overall costs that is associated with the adoption of integration technologies in the organisations Therefore the factors such as perceived benefits, environment and IT infrastructure provides further support for considering the six common factors for the development of EAI adoption model for healthcare organisation.

Themistocleous (2002) listed two other important factors such as evaluation framework for the integration technologies and evaluation framework for the integration packages. These evaluation frameworks provide the support in the decision making process for the integration technologies, because there is market confusion regarding the adoption of EAI technologies and packages. Therefore, the authors consider these frameworks as factor for the adoption of EAI in healthcare.

Models	Description	Technology	Factors
Iacovou <i>et al.</i> , (1995)	This model discusses the adoption of EDI in Small and Medium Size (SMEs) organisations.	EDI	Perceived Benefits Organisational Readiness External Pressure
Kuan and Chau (2001)	This model provides the understanding for the adoption of EDI in small business organisations.	EDI	Technology Organisation Environment
Martinez and Redondo (2001)	The discussion of this adoption model for EDI is focused in retailing sector of Spanish firms.	EDI	Network Factors Intra-organisational Inter-organisational
Chwelos <i>et al.</i> , (2001)	The authors of this model have identified several factors that support the adoption of EDI	EDI	Competitive Pressures Industry Pressures Enacted trading partners press. Dependency on partners Financial Resources IT Sophistication Trading Partners Readiness
Heck and Ribbers (1999)	The authors of this model have focused the research on the adoption and impact of EDI in Dutch SME's.	EDI	Perceived Benefits Organisational Readiness External Pressure Availability of EDI Standards
Waarts <i>et al.</i> , (2002)	This model discusses the adoption of ERP in medium-sized companies in a variety of European countries.	ERP	Adopter Characteristics Perceived Innovation Char. Internal Environment Char. External Environment Char.
Bradford and Florin (2003)	In this model the authors have discuss the adoption of ERP in general organisational context.	ERP	Innovative Characteristics Organisational Char. Environmental Char.
Somers (2000)	In this model authors have identified several factors that support the adoption of ERP.	ERP	Contextual Factors Implementation Process Outcomes
Chen (2003)	This model identified various factors that discuss the adoption of web services in SMEs.	Web Services	Stakeholders Organisational Factors IT Standards Char
Themistocleous (2002)	This model identified various factors that influence the adoption of EAI in large organisations such as multinational organisations.	EAI	Benefits Barriers Costs Internal Pressures External Pressures IT Sophistication IT Infrastructure Support Evaluation Framework for the Integration Tech. and Packages.

Table 1: Description of the Integration Technologies Models

Identification of other Factors

In addition to the factors identified in previous section the authors have attempt to review the literature in health informatics area, by which several other factors have been identified. These factors can be considered to the development of EAI adoption model. These factors are listed in Table 2.

No	Factors
1	Telemedicine
2	Patients Data Security
3	Return on Investment
4	Medical Decision Support
5	Patients Satisfaction
6	Physician-Patient Relationship
7	Cash Flow

Table 2: Factors for the Development of EAI Adoption Model for Healthcare Organisations

Conceptual Model for EAI Adoption in Healthcare Organisations

General results from the past research indicate that several factors influences the organizational adoption of an IS innovation. Therefore, the author has analyzed the factors identified from the integration technology adoption models, and the factors listed in Table 2 To provide better understanding of these factors, the authors has categories these factors into five categories: (a) organisational factors, (b) technical factors, (c) environmental factors, (d) financial factors and (e) social factors. A description of all these factors is listed according to the broad categories in Table 3, 4, 5, 6 and 7 respectively, with Figure 3 illustrating the conceptual model for the EAI adoption in healthcare organisations.

Organisational Factors

Factors	Description
Benefits	Themistocleous (2002) extended the benefits to cover: (a) operational (b) technical (c) strategic and (d) managerial, which refers to the degree to which EAI adoption is providing to the organisations. In the context to the healthcare organisation the author has extended these benefits to cover organisational, technical, financial, risks and errors, communication and collaboration, quality of care, performance and reputation. Therefore, when healthcare organisations decision makers understand these benefits, this tends to facilitate the adoption of EAI in healthcare. The scope of benefits is further discussed in next section.
Barriers	EAI clearly presents barriers with organisations needing to consider these barriers before proceeding to EAI adoption. Healthcare organisations have similar barriers such as operational, tactical and strategic. The adoption of technologies like ERP has caused many problems to the organisations such as bankruptcy, as they did not consider the impact of these technologies in the organisations before adopting them (Davenport, 1998).

Table 3: Organisational Factors of the Proposed Model for EAI Adoption in Healthcare organisations

TECHNICAL FACTORS

Factors	Description
IT Infrastructure	The non-integrated nature of IT infrastructure causes numerous problems to organisations, which need to unify their information systems and fully automate their business processes. This influenced the decision regarding EAI adoption in healthcare organisations, to provide the better patient care services, improve decisions making process etc. Grimson <i>et al.</i> , (2000) also reported the exiting IT infrastructure in healthcare organisations as a main obstacle in providing better healthcare services. The existing IT infrastructure is a factor that effects the introduction of EAI in healthcare.
Framework for Evaluating Integration Technologies and packages.	The integration marketplace is extremely complex with a diversity of EAI products and technologies solving different types of problems. Themistocleous (2002) proposed two framework for evaluating these technologies and packages. This can be used as a decision-making tool to support the adoption of integration technologies in healthcare organisations.
Telemedicine	Telemedicine involves the use of modern telecommunication technology to deliver healthcare services to remote patients and to allow information exchange between physicians and specialists. However, the non-integrated natures of many healthcare applications do not allow fully uses and take the advantage of telemedicine. Therefore, the author has considered this as factor for EAI adoption.
Security and Confidentiality of Patients' Data	Huston (2001) states that security and confidentiality of patients' data has always been important. In an open and distributed processing environment, accesses control and authentication mechanism have very important role in healthcare organisations (Rindfleisch, 1997). As patients' data may contain some of the most sensitive information such as the emotional problems, psychiatric care, sexual behaviors. Access to such information must be controlled because disclosure to irrelevant users can harm the patients' privacy. Thus, there is a need for a technology that provides the best security approaches to the healthcare organisation.
Medical Decision Support	Healthcare organisation needs to improve decision-making process for the patient treatment in real time. This can be achieved by integrated IT infrastructure. Medical decision support requires the higher level of integration for exchanging and sharing of patients information between various decision support applications, to generate warnings, provide diagnostics suggestions, offer treatment advice (Ginneken, 2002).

Table 4: Technical Factors of the Proposed Model for EAI Adoption in Healthcare Organisations

Environmental Factors

Factors	Description
Internal Pressures	This factor represents the several pressures such as technical and managerial. Healthcare organisations have various drivers such as huge cost pressures, healthcare quality, medical errors, data security and privacy that motivate the adoption of new technologies These initiate the adoption of EAI in the organisation.
External Pressures	In healthcare organisations there are several stakeholders such as patients', suppliers, insurance service providers and government departments that collaborate with the organisation. They always expect better collaboration with organisations. Also patients always demand for better services such as appointment, correct record keeping, proper care, availability of data where ever is required and data security. Therefore, this factor can be considered for the development of EAI model as an external pressure.

Table 5: Environmental Factors of the Proposed Model for EAI Adoption in Healthcare Organisations

FINANCIAL FACTORS

Factors	Description
Costs	Many organisations conduct a cost benefit analysis before taking any important decision regarding the adoption of technologies. Cost is a significant parameter that influences the adoption of EAI in healthcare organisations. A significant benefit of application integration is the reduction of overall integration costs (Puschmann and Alt, 2001). Therefore, the author has considered the costs as an important factor for EAI adoption. Themistocleous (2002) has classified the EAI cost based on costs classification proposed by Irani and Love (2001) such as direct and indirect (e.g. human and organisation) costs.
Return On Investment	Return on investment is important in healthcare organisations. As the IT budgets of the healthcare organisations are lower comparing to other organisations. As a result, they do not want to invest more in technology, without significant ROI. Therefore, the author has considered this as a factor for the adoption of EAI in healthcare organisations.
Cash Flow	Healthcare organisations are facing severe financial constraints as well as proposed changes in their financial reporting. It is well suggested that analysts should pay closer attention to healthcare organisations financial performance such as (equity in relationship to total assets, net income, working capital flow) (Chu et al., 1991). A cash flow statement is used to highlight these activities. To monitor such activities involves keeping costs down, controlling payments, and ensuring the customers payments promptly (Clegg, 1991). Thus, that will increase the value of the organisation. Therefore, the author considers this as an important factor for healthcare organisation.

Table 6: Financial Factors of the Proposed Model for EAI Adoption in Healthcare Organisations

Social Factors

Factors	Description
Physician Patient Relationships	The complete integrated computerised patients’ clinical and biological information has become a good resource for the further development in the related diseases. As a result, this has attracted the researchers, and has opened totally new dimensions of research for them. But this all depend upon the willingness of patients that at what level they are allowing the organisation to use their data. If the patients and physicians have got better relationships and if these relationships are based on mutual understandings, trust, needs and expectation, due to this physicians can be able to motivate the patient to use their data for research purpose. Therefore, the author has considered as social factor for integrated healthcare organisation.
Patients Satisfaction	Patient satisfaction stands to play an increasingly important role in the growing push towards accountability among healthcare providers. Thus, Patient satisfaction has become a significant issue for healthcare providers. It is not just a matter of people feeling good about the care they have received. The non-integrated IT infrastructure in healthcare organisations has caused the problem in providing the highest quality medical care and to achieve the higher patients ratification.

Table 7: Social Factors of the Proposed Model for EAI Adoption in Healthcare Organisations

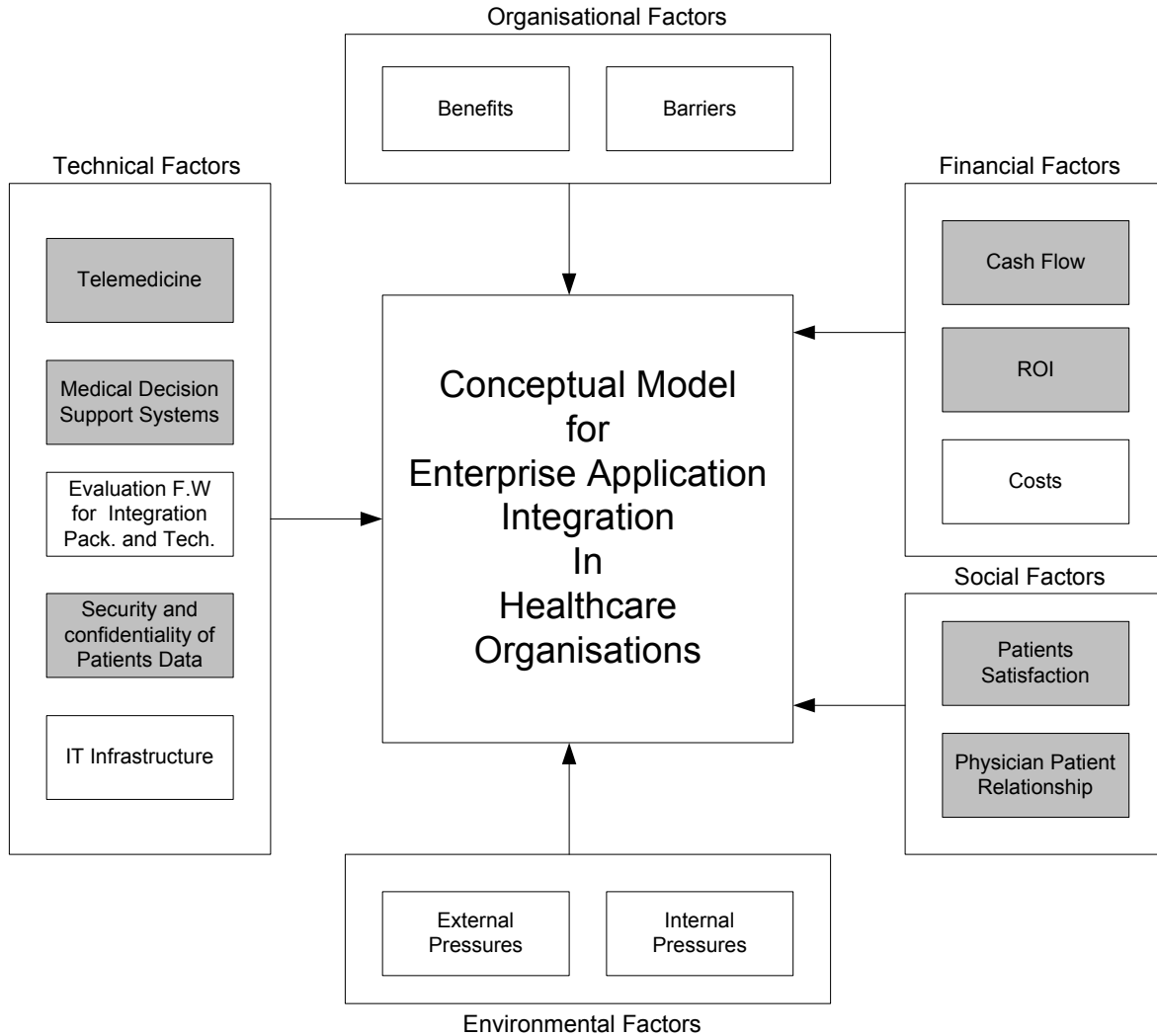


Figure 2. EAI Adoption Model for Healthcare Organisations

In the model various factors have been identified, which are influencing the adoption of EAI in healthcare organisation. During the imperial test of the model, the authors also attempted to further expand this research by doing an in-depth study of a factors (e.g. barriers). In doing so, the authors expect that this will help in solving the several issues regarding EAI adoption in healthcare organisations. Therefore in the next section the authors have attempted to focus on the in-depth study of barriers associated with the adoption of IT in healthcare organisation. This will help in getting the understanding of barriers of EAI adoption in healthcare organisation

Proposition

Healthcare organisations have experienced different barriers for the adoption of IT such as (security and confidentiality issues and inadequate revenues). There are number of barriers experienced with the adoption of EAI. Themistocouls (2002) has identified several barriers for EAI adoption such as (organisational, technical, operational).In addition to that the author has extended the scope of the barriers according to the healthcare organisations context (see Figure 3). This classification can provide support to overcome these barriers. Therefore, healthcare organisations need to undertake a rigorous evaluation process before implementing EAI if they are to achieve improvements in their performance.

Proposition #1 *In order to avoid failure, healthcare organisations requires a holistic view of EAI adoption barriers.*

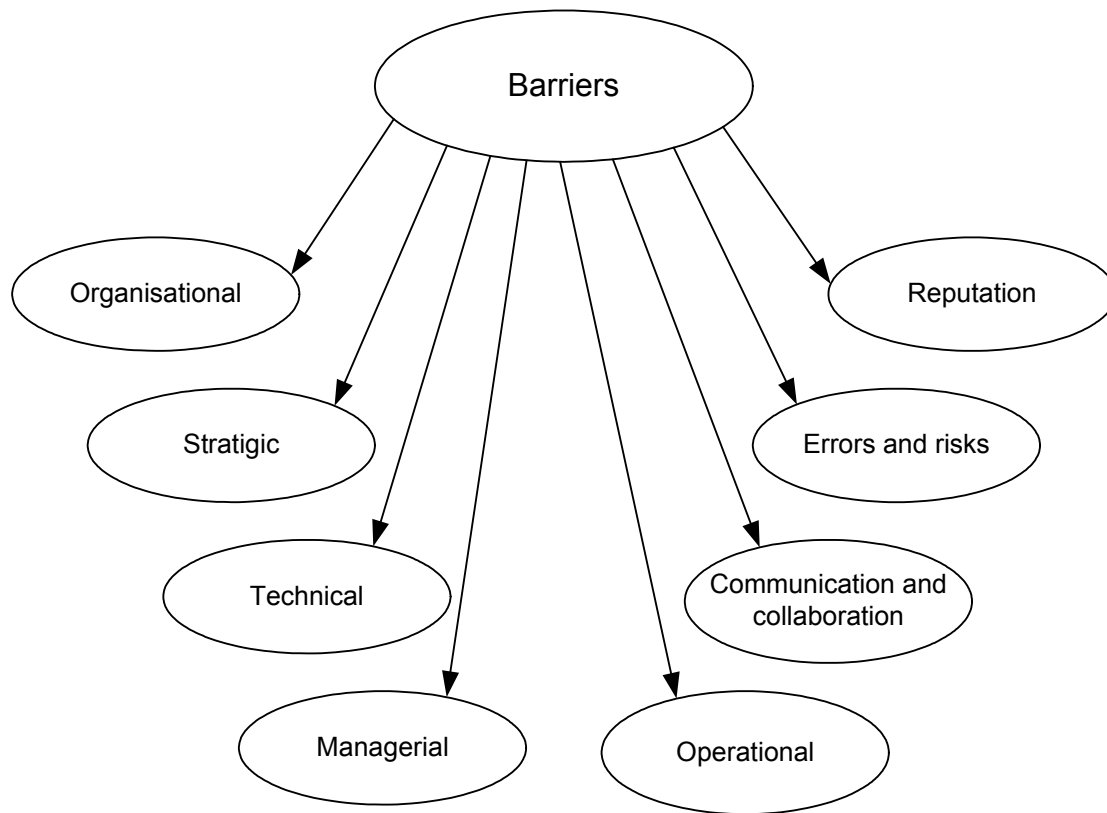


Figure: 3. Classifications of EAI Adoption Barriers for Healthcare Organisation

Proposed Research Methodology

Myers and Avison (2002) states that all researches are based on some underlying assumptions about what constitutes valid research and which research methods are appropriate. Furthermore, he stated that the most pertinent philosophical assumptions are those that relate to the underlying epistemology, which guides the research. There are several philosophical approaches are available for information system research such as positivist, interpretive and critical.

Justifying the Interpretivism Approach

The authors consider Interpretivism as more appropriate research for studying the adoption of EAI in healthcare organisations. The reasons for this is because, Interpretivism stance allows concepts (constructs) to emerge from field data rather than entering the field with pre-conceived theories (Miles and Huberman, 1994). The factors such as technical, organisational and financial discussed earlier that influence the adoption of EAI in healthcare organisation could not be separated. Thus the authors need to understand the process of adoption and the factors that influences the adoption.

Justifying the Qualitative Research

In information systems research, there has been a general shift away from technological to managerial and organisational issues. The research presented in this paper focuses on the factors that influence the decisions of human beings (e.g. Managers and Physicians) when adopting and evaluating EAI solution in healthcare organisations. Thus, the Qualitative research methods are designed to help researchers understand people and the social and cultural context within which they live (Benbast et al., 1987). Therefore the authors believe that the qualitative methods will be the appropriate method for studying EAI phenomenon in healthcare organisations.

Justifying the Case Study Research

A case study examines a phenomenon in its natural setting, employing multiple methods of data collection to gather information from one or a few entities (e.g. people, groups, or organisations) (Benbast *et al.*, 1987). Yen (1994) define that case study relies on multiple sources of evidences, with data needing to converge in a triangulation fashion. The case study can be a single-case or multiple cases. Multiple case designs allow for cross-case analysis and the extension of theory. Multiple cases yield more general research results (Benbast *et al.*, 1987) . In addition to that Yen (1994) suggests that there are different types of case study such as exploratory, descriptive and explanatory depending on whether they are used to answer what, how and why research questions respectively. This discussion provides the justification for using the case study classified as exploratory. This reason for this is that the research focuses more on questions such as:

- What are the factors influencing EAI adoption in healthcare?
- Why do healthcare organisations adopt application integration solutions?
- What are the barriers of EAI adoption in healthcare organisations?

Justifying the Data Collection Methods

Multiple data collections methods are typically employed in case research studies. Ideally, evidence from two or more sources of evidence that work well in case research such as (a) Documentation (b) Archival records (c) Interviews (d) Physical artifacts Yen (1994). For this study basic data collection will be used structured interviews form as well by taking the additional notes during the interview. All observations will be recorded on paper and the organisations documents will be examined. This will provide the better support for understanding the phenomenon of EAI adoption and evaluation in healthcare organisations.

Justifying the Data Analysis Methods

Data analysis is the most difficult phase in case study research. A difficulty in the use of case study qualitative data is that the methods of analysis are often not well formulated (Miles and Huberman, 1994). Once data have been collected, there are many ways to analysis the qualitative data that have been collected, but it is non-mathematical in nature. Therefore, they can be represented within-case tables, flowcharts and diagrams.

On the basis of above discussion the authors believe that research methodology appropriate for studying the phenomena of EAI adoption in healthcare organisations would be qualitative multiple case studies, which will be followed by type exploratory method.

Conclusions

The authors have identified a gap in the literature dealing with the absence of theoretical models for EAI adoption in healthcare, which ascertains identifies benefits, barriers and costs, associated with EAI adoption in healthcare. Therefore, the authors proposed a model for EAI adoption in healthcare organisations. In particular, the paper includes a description of steps taken to insure the high quality research design. In future research the proposition will be test imperially to explore the impact of EAI adoption barriers in healthcare organisations. Further it will support in developing an understanding for EAI adoption in healthcare organisations. Furthermore, this leads for an empirical validation for future research. The proposed model can provide the support to the decision makers while thinking to adopt EAI in healthcare organisation. Additionally, researchers to analyse and understand the adoption process of EAI can use it.

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