Investigating TOE Factors Affecting the Adoption of a Cloud-Based EMR System in the Free-State, South Africa

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Abstract. Paper based medical records face many challenges such as inability of real-time access to patient data, exchange and share medical data, and monitor a patients' health progress. This negatively affects the ability to improve a patients' health and carry out medical research. Adopting electronic medical records (EMR) may help address some issues faced with paper records. However, standalone EMR systems may not fully mitigate some issues with paper records due to lack of real-time access to patient data. Cloud Computing presents cost-effective ways of integrating EMR systems together for different health institutions to share selected patient data. However, the extent to which South African health facilities are ready to adopt cloud based EMR, and the nature of patient data that can be shared on the cloud remains unclear. This study investigates the viability of a cloud based EMR for health institutions in the Free State province of South Africa.

Keywords: Adoption · Cloud-Based · Cloud computing · EMR · HealthCare · TOE framework

1 Introduction

Majority of health institutions (especially those in developing countries) still use paper-based medical records [1]. Paper-based medical records face many challenges, including the inability to get real time access to patient data when needed, inability to exchange and share medical data among health institutions, difficulties in compiling accurate medical reports, and in monitoring patient health progress [2]. In addition, paper-based medical records are often difficult to use for medical research and problematic when used for clinical studies [2]. In a recent study [3], it was found that inadequate record keeping is a major obstacle in doing archival research in a rural community in South Africa. Adopting new technologies, such as an Electronic Medical Record (EMR) system, may address some of the challenges facing paper-based records [4]. Although EMRs may help resolve some of the problems with paper-based medical records, if the EMR systems are not linked or integrated, the problem of real-time accessibility and exchange of patient data remains unresolved.

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The emerging cloud-computing model, which leverages the Internet to allow the sharing of IT resources as online services, may offer a cost effective solution of integrating diverse EMR systems. Cloud computing is a model that offers ubiquitous access to the network in a convenient way with minimal management effort [5]. Furthermore, most managers and experts believe that cloud computing may improve health care services and benefit medical research and reduce costs associated with setting up a shared EMR infrastructure [6]. Integrating EMR systems with the cloud enables the sharing and exchange of selected medical data among the different healthcare facilities [7]. Despite the benefits of using cloud computing such as lower costs, faster rollout and anytime, anywhere access, implementing a cloud-based EMR platform faces several challenges, and key among them is data security risks. Adopting cloud-based EMR, innovative as it is, requires thorough evaluation before deciding whether it is viable, and if viable what patient data to move to the cloud and what security provisions to put in place [6]. The path to cloud-based EMR is likely to differ from one country (or even one region) to the other based on the prevailing regulatory framework and state of readiness.

The purpose of this study is twofold. First, assess the current state of use of EMR systems within the Free State (FS) province of South Africa (RSA). Secondly, determine the extent to which health facilities (both public and private) are ready to embrace cloud-based EMR in which selected patient data is made shareable among participating institutions. In determining this, a set of factors that influences or impedes the adoption of cloud-based EMR will be evaluated. The study will be anchored on the Technology-Organization-Environment (TOE) framework, an organizational level framework that describes key elements which influences a firms' decision to adopt an innovation [8–11]. The key deliverable of this study is a framework that can guide the adoption of a cloud-based EMR system for the Free State province.

The study will target public and private clinics and hospitals drawn from the Free-State province of South Africa. The results obtained from this study will be used to propose a model for adopting cloud based EMR in the Free State province.

2 Literature Review

2.1 Cloud Computing and Cloud EMR

The National Institute of Standards and Technology (NIST) defines cloud computing as "*a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction*" [5]. The cloud can help break the barriers to the adoption of EMR in resource-poor areas, removing the need for building a local infrastructure (which includes including a server, network, security, maintenance and power supply) for each clinic, and having only one server used to cater for all the clinics [12]. Integrating EMR with the Internet provides flexibility in terms of *"transferability of information, greater communication among doctors, and improvement in quality of care"* [13]. Getting the right information at the right time when it is needed saves lives [14]. Due to its improved accessibility, storing medical data in the cloud enables

physicians and medical staff to collaborate with each other for medical research in order to improve and offer better quality healthcare services to people [15, 16]. Cloud-based medical record systems are much better, faster and easier to access than traditional sever-based storage systems, are more cost-effective, more scalable and results in increased productivity [17]. However, adopting a cloud-based EMR requires careful consideration in the face of challenges such as security fears, complexity of integration among other issues.

2.2 TOE Framework

The TOE framework is an organizational level theory that explains the elements which influences a firms' decision on the adoption of an innovation [18]. These elements are the technological context, organizational context and environmental context [8, 10]. Technological context considers both the existing technologies and technologies that can be purchased or added to the existing ones for improvement of the firm. Organizational context refers to the organization's resources, which includes how the employees are structured, communication methods, the size/scope of the firm and managerial structures. Environmental context refers to the structure of the industry, consisting of government, community, competitors and the availability of service provider or suppliers [8, 9, 11]. The figure below illustrates the TOE framework developed by Tornatzky and Fleischer [18] (Fig. 1).

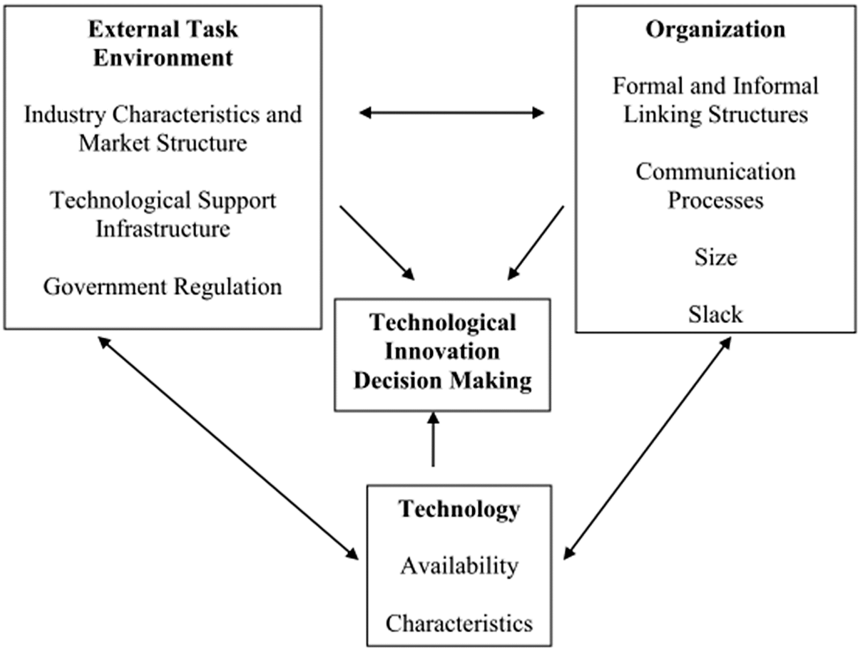

Fig. 1. Technology-Organization-Environment (TOE) framework.

Since we consider cloud EMR as an innovative approach that is not yet widely deployed, employing the TOE framework allows us to consider the most relevant factors when assessing its adoption. The use of the TOE framework is widely supported and has been utilized in existing literature which addressed the adoption of innovative technologies and models [19–21]. The table below presents a summary of some studies that relied on the TOE framework (Table 1).

Table 1. TOE studies on cloud computing adoption.

Preliminary studies on TOE framework			
Source/Study	Technological factors	Organizational factors	Environmental factors
Assessing a new IT service model, cloud computing [19]	• Perceived benefits • Perceived barriers	• Organizational learning capacity • Organizational IT capability	• Competitive pressure • Expectation of network dominance
TOE drivers for cloud transformation: direct or trust-mediated? [20]	• Reliability • Information security	• Size • International scope • IT competence • Entrepreneurship	• Institutional pressure • Structure assurance • Vendor scarcity
Cloud computing adoption by firms [21]	• Technology readiness	• Global scope • Top Management support • Firm size	• Competitive pressure • Regulatory support

3 Research Methodology

The study's objective is to assess the current systems used for recording and storing patient medical data and identify factors influencing the adoption of a cloud EMR system using the TOE framework. For this purpose, data will be collected via questionnaires and follow-up interviews. The study's population will be health care facilities in Free-State whereby a sample population will include medical doctors, nurses, administrators, etc. from (not all but few) public and private health facilities. Beforehand, a pilot study will be carried out in Bloemfontein to test the effectiveness of the questionnaire. Thereafter the questionnaire will be distributed via SurveyMonkey to the sample population, and follow-up interviews will be conducted.

The data collected from the questionnaire and interview will be analyzed, and the results will be used to propose a framework for adopting a cloud-based EMR system.

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