

Lack of Integration in Software Systems for Health Practitioners in Nigeria: The Way Forward

Batya Oluwagbemi Oluwatolania^a and Achimugu Philip^b

Abstract

The healthcare industry is composed of primary, secondary and tertiary healthcare providers in Nigeria. Each provider needs to exchange information with other providers. Information Systems (IS) developed on different types of hardware and software platforms serve this need. Due to the heterogeneous and distributed nature of information and communicating technology (ICT) in the healthcare industry, sharing of the data has become an issue. There is an urgent need for the integration of these distributed IS. Several efforts have been made to achieve the integration, but traditional methods can only in part address integration problems. This paper presents a new approach to solving the critical healthcare systems integration problem. The premise is that any significant level of healthcare systems integration requires the development and use of a common data model.

Keywords: Information Systems, Enterprise Application Integration, Hardware, Software, ICT

Introduction

Health information systems (HIS) comprise the entire infrastructure, organization, workforce and components for the collection, processing, storage, transmission, display, dissemination and disposition of information in the healthcare industry. In many clinical and hospitals settings, HIS tend to consist of enormous silos of paper-based or electronic data that are fragmented or of poor quality, exposing systems to risk of infraction. Within organizations, information technology implementation decisions are often made at the departmental level, with each department choosing technologies and solutions based on its own needs and beliefs (Erasala et al., 2002). These applications are often not developed in a coordinated way but have evolved as a result of the latest technological innovation (Themistocleous et al., 2000).

In most of the cases, the programs are written in different computer languages, compiled on different platforms, run on different hardware and have different data structures, types and formats. They function independently and do not share their data. As a result, the IT infrastructure in such organizations consists of a number of autonomous and heterogeneous solutions, which cause integration problems. Following recent trends the healthcare sector has turned to the use of information technology to automate and improve business processes. As a result, in healthcare organizations there are numerous information systems, ranging from personal management to department-specific decision support systems (Hakkinen et al., 2003).

These information systems function independently and their interconnectivity and interoperability have continued to be a big issue, as in any healthcare organization it is essential to be able to retrieve information from disparate information systems. In healthcare organizations integration of disparate information systems has therefore been viewed as high priority, hence this study.

Health Care Delivery System in Nigeria

The Nigeria healthcare delivery system is implemented at the three tiers of government, Federal, State and local government. The Federal government is responsible for tertiary healthcare comprising of Teaching and Specialist hospitals, the State governments for secondary care which is essentially the general hospitals, and the local governments for Primary care level. (FMoH, 1998). The local communities are at the center of the Primary Health Care (PHC) system with several health-related services ranging from environmental services and traditional healthcare to the 'modern' healthcare delivery system. The Local government is in charge of coordinating the whole range of services and especially of operating the public-sector PHC facilities (health centers, health districts and health wards). At the ward level, village/neighbourhood development committees composed of local opinion leaders supervise the implementation of the health development plans.

^aDepartment of Computer & Information Science, Lead City University Ibadan.

^bDepartment of Computer & Information Science, Lead City University Ibadan.

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Nigeria has witnessed several efforts to improve the state of the national health information system in the last two decades. The Federal Ministry of Health (FMOH), at the early stages of Primary Health Care implementation in Nigeria, for example, initiated a Health Information System in 1987 (Oyegbite, 1992). The system included mechanisms for collecting data at household, community and facility levels. At the community level, home based cards were introduced and a pictorial method of health record was provided to community-based health workers such as volunteer health workers. At the local government level, specifically, the following were identified as important elements of the health information system: recording, monitoring, evaluation, and supervision. Alongside this initiative, a system for improving disease surveillance was also initiated in order to improve, among others, the reporting of diseases and facilitate prompt responses. While this system has the potential to generate the data set required for effective PHC, which, as identified by Iwunor (1992), include demographic data, health status data, health services data, and health resources data, the system was not able to achieve the desired objectives due to logistic and managerial problems. Despite the health information system put in place by the government, a number of different data collection instruments and parallel system was being operated by various development agencies in the country.

Adoption of Information Technology in Healthcare Organizations in Nigeria

The healthcare industry is among the most information intensive business sectors in the world. Some theorists estimate that health workers spend between 35% and 60% of their time managing clinical data (Ebell, 1999). Every acute care hospital is capable of generating up to five terabytes of data per year, most of which is stored in numerous, widely scattered repositories. Using IT to manage the administration of intricate information resources promises significant rewards, such as improved practices and cost savings.

Several developments in IT implementation have taken place in healthcare organizations, with IT playing an increasingly significant role in its delivery. All these technological developments have been made in providing effectively functioning systems to healthcare organizations to improve healthcare services (Grimson, 2001). As a result, IT is now being extensively used at the primary, secondary and tertiary levels of healthcare units in Nigeria. This has resulted in healthcare information systems being increasingly developed at primary, secondary and tertiary healthcare levels. This situation has in turn resulted in a large number of heterogeneous and mutually incompatible systems emerging at these levels, hence the need for integration.

These modernization efforts in the healthcare sector have also resulted in the development of several new types of application at the primary, secondary, and tertiary healthcare levels. At the primary care level in Nigeria, it has been observed that the basic

foundation of healthcare providers comprises the General Practitioners (GPs) and primary healthcare centres, which provide basic healthcare services to the community. Initially, the demographic and clinical records of citizens are kept with the GPs, most of whom use IT applications such as MINPHIS (Made in Nigeria Primary Healthcare Information Systems) in their practices. The current use of IT at GP level has not grown significantly. Only about 4% of GPs are now using IT applications for the clinical purposes. Unsurprisingly, the sharing of patients' records among GPs and hospitals is a big issue. Nonetheless, the IT is being used extensively at secondary and tertiary healthcare level such as general and specialist hospitals, as well as teaching hospitals.

Integration of Healthcare Systems

The integration of healthcare software systems has remained one of the most prominent issues in healthcare software development. Changing work in healthcare, e.g. to support patient-centred care and regional healthcare networks, requires integrating health information systems and many workflows in the healthcare facilities involve more than one application. At the same time, the application architectures for the new systems in healthcare are evolving towards the use of web-enabled, distributed and component and service-based systems.

Many software products have been built and acquired from heterogeneous sources during a long period of time, and the systems have differences in implementation technologies and architectures. These legacy systems, the heterogeneous environment and an increasing pressure to introduce new software rapidly add even more pressure on the systems integration. Furthermore, there are many complementary and also overlapping technologies and standards available for integration.

Different types of integration requirements cannot be satisfied by one integration approach only. Selecting appropriate standards or approaches for each integration need is a complex task for the integration projects, and systems integration in healthcare facilities requires defining more specific processes for integration. Both health service providers who acquire the information systems and system providers and integrators need efficient methods, which are applicable in integrating new solutions to the existing systems in healthcare facilities.

In view of the above, we propose a process for specifying integration for multi-tier applications in the healthcare domain. This process will ensure that heterogeneous systems in the healthcare domain interoperate both from the technical to the functional point of view.

The Way Forward

The primary need with respect to legacy data is to be able to convert data from multiple mutually incompatible sources into a single, standardized patient-centric Electronic Health Records (EHR) for each patient that can then be longitudinally viewed and queried. This is what enables GP and specialist notes, diagnoses and plans to be integrated with laboratory results from multiple sources, patient notes, administrative data and so on, to provide a coherent record of the patient journey.

We have adopted a collaborative process from Mykkänen et al., 2004 to produce integration specifications and approaches in Nigeria's health sector. In the tripartite collaboration, health service providers (health professionals and e.g. hospital IT departments), software vendors (also competitors), and a multidisciplinary research group (moderator) are involved in each identified integration domain. A specific process for the solution specification phase is also proposed. In this phase, existing applications, standards and new technologies, and the requirements and process improvement needs of the participants are considered. The aim is to produce solutions for several interoperability levels, including interface technology, functionality, data contents, semantics and application architecture. As a result, reusable specifications with distinct goals and audiences are produced on incremental documentation levels: requirements, platform-independent and technology-specific interfaces.

The specifications are evaluated and harmonized collaboratively, and implemented in pilot projects in existing application products. The integration process incorporates features from different integration models, including understanding and description of the processes in health environment and specification of information contents, application services and user interaction in the solutions.

When considering the integration of software systems, the following must be taken into cognizance:

- a. User and access management,
- b. Patient and clinical information access,
- c. Code sets and organizational structures,
- d. Billing interfaces, and
- e. Electronic patient record (EPR) archive interface.

With Service Oriented Architecture (SOA), healthcare information systems can interoperate. The SOA is an approach gaining support in several industries and is based on the view that organizational solutions can be modeled as federations of services connected by well-specified contracts that define their service interfaces. Many organizations now express their solutions in terms of services and their interconnections.

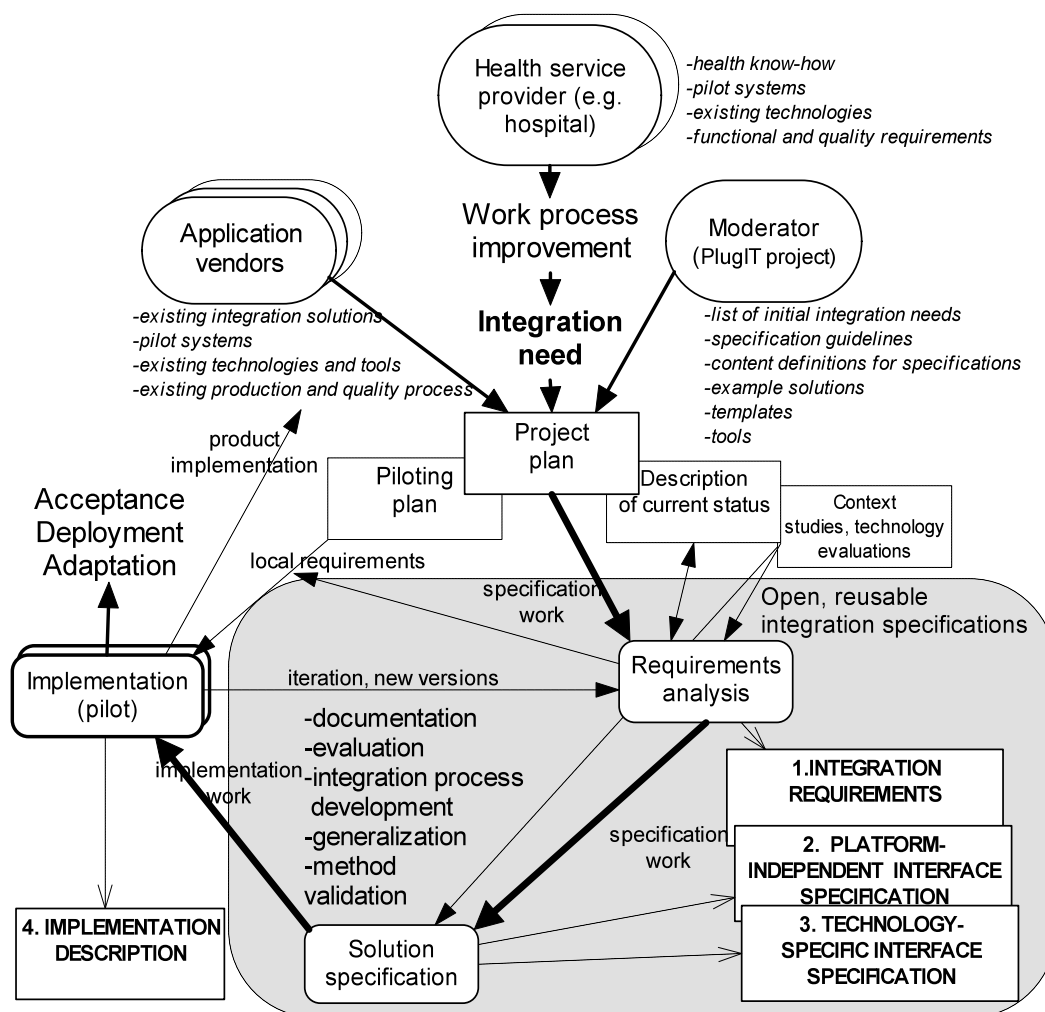
A number of important technologies have been defined to support an SOA approach, wherein services are distributed across multiple machines and connected over the extranet or an intranet. For example, Web services approaches operationally enable an SOA (Kreger, 2003). These depend

on inter-service communication protocols, such as the Simple Object Access Protocol (SOAP). The Web services interfaces are expressed in Web Services Description Language (WSDL) and registered in public directories. These can be searched in UDDI (Universal Description Discovery and Integration) repositories. The information in the exchanged documents are defined in XML (Extensible Markup Language) and described in standard schemas. The loose coupling of independent service providers scattered across the participants may be implemented by using a range of different technology options. Therefore it is platform-independent, a key to open standards and interoperability (Brown et al., 2005).

The following are characteristics for services related to their nature and applicability:

- a. *Granularity*: The operations on services are frequently implemented to encompass more functionality and levels of service. This enables scalability from small to more complex, distributed applications.
- b. *Interface-based definition*: Interfaces are implemented at several levels so multiple services can implement a common interface and a service can implement multiple interfaces.
- c. *Discoverability*: A key feature, services need to be found both at design run time and by unique identification.
- d. *Single-instance type*: Each service is single and always running instances that a number of consumers (users) can access. This feature typifies reusability of the service.
- e. *Loosely coupled nature*: The SOA is a loosely coupled architecture because it strictly separates the interface from the implementation. Further, the discovery of services at run time reduces the dependency between service consumers and providers. Services are connected to other services and consumers (users) via standard methods such as XML document exchanges.

Figure 1
Integration
Specification Process



Source: Mykkänen et al., 2004

Conclusion

The rapid advance of IT in health settings has accentuated the importance of addressing the shortcomings of current HIS integration practices. In recent times, health services often have difficulty in complying with the elements of robust integration frameworks. This matter is made worse by the regulatory gap between implementing new and emerging ICT, and managing the security risk the latter represents. Other problems include poor data quality and fragmentation, budgetary constraints, irreconcilable systems architecture, a history of incompatible data standards, confusing privacy jurisdictions and a lack of access to proven evaluation results. This paper argues that it is of crucial importance that technology innovation in health is associated with the development of generalisable operational paradigms for establishing secure HIS through integration. Mainly illustrated by examples from Nigeria, it synthesizes the literature about HIS integration as a means of providing a foundation for constructing methodical frameworks for use across the sector. The paper also charts the evolution of Nigeria healthcare delivery trends over recent decades. The work concludes by outlining a current effort that explores useful ways

of developing tools for health services integration which incorporate standards and legal frameworks.

Ongoing ICT innovations are poised to change the clinician-patient relationship forever and governments are increasingly looking to provide health services, such as national EHR databases, via the Internet. Addressing the factors that contribute to a lack of integration in HIS is not simply of abstract interest, but of practical and immediate relevance. Clearly, ongoing research is required to evaluate innovative technology implementations and practices to limit threats in HIS security environments which discourage integration because of secrecy of data shared amongst practitioners and thus enhance the quality of care and efficiency outcomes to be gained from using ICT in healthcare settings.

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