Chapter 2.10
Integrated Digital Health Systems Design:
A Service–Oriented Soft Systems Methodology

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ABSTRACT

The application of information technology in healthcare has focused primarily on the implementation of specific systems such as electronic health records (EHRs) and clinical decision support systems (CDSSs), mainly for intra-enterprise use. However, for the integrated health system (IHS) to function effectively in a complex inter-enterprise healthcare delivery environment, designers must focus on approaches such as soft systems methodology (SSM) to enable the design of robust integrated digital health systems (IDHSs). A service-oriented architecture (SOA) offers a flexible framework for IDHSs to become de-centralized, fully functional and modular systems with interoperability. This article identifies the design issues in IDHS and explores the potential of an SSM methodology-based SOA for the development of interoperable IDHSs. In the process we compare and contrast the functionalist socio-technical approach to the interpretive SSM. We also describe a prototype SOA application for an IDHS setting and discuss challenges in the application of SOA to healthcare.

INTRODUCTION

The delivery of healthcare services in the United States is a complex, fragmented, and disconnected process, and in 2006, cost almost $2.1 trillion, or 16% of the GDP (Melvin, 2008). Studies published by the Institute of Medicine indicate that the disconnectedness, disorganization and inaccessibility of clinical information adversely affect healthcare quality and compromise patient safety (Institute of Medicine, 2003). In addition, long-standing problems with medical errors as well as inefficiencies increase the costs of healthcare delivery.

The potential of health information technology (HIT) in public and private integrated health systems (IHS) already has been established, and yet implementation of HIT applications has been haphazard. Missing is the necessary planning and attention to the long-term viability of such applications as electronic health records (EHRs), clinical decision support systems (CDSSs), regional health information networks (RHINs), and the national health information network (NHIN). Large-scale implementations, absent consideration of significant design issues such as interoperability and compliance with standards (Chaudhry et al., 2006; Himmelstein and Woolhandler, 2005), can result in the failure of the applications. Note, for example, reports that the U.K. National Health Services program to create a nationwide e-health records system is in trouble, the cost having escalated from 2.6B pounds to at least 13B pounds today (Charette, 2006). So while the call for information technology in healthcare is a positive trend, the need has led to the ad hoc creation of stopgap applications that never will be able to "speak" with other systems that come along.

Newer approaches to design are needed to produce viable IDHSs. A soft system methodology, for example, combined with a decentralized and distributed architecture such as a service-oriented architecture (SOA) offers viability. In this exploratory research, we discuss the application of soft systems methodology (SSM) to the design of IDHSs to support RHINS and the NHIN. The SSM methodology is mapped to the SOA approach (Nadkarni and Miller, 2007) to developing distributed, loosely coupled, interoperable IDHSs. The rest of the article is organized as follows: First, we identify design issues in IDHSs, focusing primarily on interoperability. Then, we discuss the potential of the SOA for IDHS design. Third, we compare and contrast the socio-technical approach to SSM in the context of IDHS-SOA design. Fourth, we apply the SSM to the design process, map the outcomes of the SSM to an SOA framework, and illustrate each stage of the SSM

with examples. We also describe a prototype application for an IDHS setting. Fifth, we discuss the challenges in implementing SOA-based IDHSs. And finally, we offer our conclusions and future directions for research.

DESIGN ISSUES IN IDHS

Typically, IDHSs support large integrated health systems that feed into RHINs. For example, the Partners Healthcare Systems—a federation of hospitals in the Boston metropolitan area made up of several hospitals, clinics and laboratories —is a large integrated delivery network. The network uses a combination of centrally or locally managed information system resources. In Indiana, the Regenstrief Institute created the Indianapolis Network for Patient Care (INPC) in 1995 with the goal of improving the medical care of patients. The network is an operational community-wide electronic medical record system that includes an active surveillance component built around real-time electronic laboratory reporting. The Santa Barbara County Care Data Exchange is another pilot example of the trend towards operational health information networks (Overhage et al., 2005). Other examples of integrated health systems include the Taconic IPA (independent practice association) in New York, which uses its physician base as a core for a comprehensive, practice-oriented health information infrastructure that includes clinical information systems and secure networks (Frisse, 2005). Hospitals, clinical laboratories, health plans, and pharmacies subscribe to its network to communicate more effectively with practitioners. IPAs in Colorado, Oregon, and other states are adopting similar models (Frisse, 2005). The Mid-South eHealth Alliance is one more example of a regional comprehensive health information initiative for three counties in Southwest Tennessee.

At the national level, the Department of Health and Human Services released a Strategic

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