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Organization Structural and Cultural Influences in Hospital Information Systems Integration

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ABSTRACT

Information systems (IS) integration has long been regarded as the result of various information technology (IT) related problems within the IS architecture and IT infrastructure. This study takes a new approach to examining the origins of IS integration problems from an organizational context perspective. Based on a 30-month longitudinal study at a 1,050 registered bed large teaching hospital, this paper shows that the complexity of organizational structural and cultural influence is a main factor that gives rise to hospital IS integration challenges. Theoretical and practical implications of this study are also discussed.

KEYWORDS: Hospital information systems, systems integration, organizational context, systems theory, systems architecture

INTRODUCTION

Organizational information systems (IS) have become increasingly important as the boundaries of traditional IS overlap as a result of leveraging information technology (IT) applications for efficiency, business processes redesign, and ultimately competitive advantage (King and Teo, 1997). As organizational strategies depend on specific underlying IS capabilities (Ross, 2003), IS development has become a strategic organizational issue as demonstrated by its increased rank among IS management issues during the 1990s (Brancheau, Janz, and Wetherbe, 1996; Niederman, Brancheau, and Wetherbe, 1991). Similarly, IS and IT have taken increasingly central roles within the health care industry (Raghupathi and Tan, 2002).

In contrast to its strategic importance, traditional IS development often took a functional bottom-up approach that yielded independent and disparate IS for separate functions (Madnick and Wang, 1988). The inability to share information across IS and between health care organizations was reported as a major impediment toward efficiency and cost-effectiveness (Grimson, Grimson, and Hasselbring, 2000). Herbold (2005) noted that organizational units operating autonomously created redundancies, hoarded IT resources, and complicated organizational IS efforts. As an alternative approach, integrated top-down IS development reinforced organizational strategies, information sharing, and synergy across organizational IS (Karimi, 1988; Ross, 2003; Zani, 1970).

In the context of IS development, the shaping of integrated IS architecture was influenced in many complex ways by organizational structure (Anand and Mendelson, 1997; Brown and Magill, 1994; Scheer, 1992). Hofstede (1984) described organizational culture as “the way things are done in business,” and IS architecture is a reflection of both organizational structure and organizational culture. For example, Andreu, Ricart, and Valor (1994) noted that IS development was influenced most during the evaluation or “weeding out” phase where IS alternatives and capabilities compete for limited organizational resources. Thus, the complexity of organizational structure and organizational culture pose additional challenges to IS integration.

Prior research has investigated IS integration challenges; however, prior approaches were based on technology and protocol (Bakker and Leguit, 1999; Chan, Cao, Chan, and Young, 2001), which yielded ad hoc solutions that failed to address all aspects of IS integration (Hasselbring, 2000). Rather than explore another ad hoc solution to IS integration, this paper

investigates the organization structural and cultural challenges to IS integration through a longitudinal study of a hospital information system and its corresponding IS development.

The organization of this paper is as follows. The next section reviews previous literature, addressing the impact of organizational structure and culture on IS development. A holistic approach for IS development is identified, thereby helping prescribe a priori prevention to their occurrence. Following the literature review, we present the methodology, results, and analysis of our longitudinal case study on the effects of organizational structure and culture in hospital IS integration. Implications and limitations of this study are discussed in the conclusion.

STRUCTURAL AND CULTURAL INFLUENCES

Holistic rather than reductionistic views are fundamental to systems theory and its use in describing IS within organizations (Checkland, 1999; Klir, 1972; Laszlo, 1996; Silver, Markus, and Beath, 1995). Churchman (1971) described a system as a set of interrelated elements (subsystems) oriented to accomplish a set of common goals. Andrew (1965) introduced the concept of a goal state system, where self-regulation with the environment through interactions, feedback, and responses maintained or achieved a stated goal. Ackoff (1967) reinforced embedding feedback loops within IS as a control measure (self-regulation) to avoid management misinformation. Through all of these concepts, holistic views of system strategy stated as common goals drove individual system functions.

IS are physical systems and IS nest within the organization as subsystems to form a composite architecture. IS architecture is the road map for IS development where sub-components receive perspective, specific functionality, structural relationships, and defined dynamic interactions (Nunamaker, Chen, and Purdin, 1991). With respect to IS development and IS architecture, integration is a realization of Belady's and Lehman's 1st and 2nd laws of program evolution dynamics, where IS integration is an attempt toward IS renovation (van Duersen, 1999). Unfortunately, many organizations that venture into IS integration projects have inherited IS architecture, which lacked the subsystem integration necessary to share data due to prior shortfalls in the self-regulation of organizational strategy among functional groups.

Without the self-regulation of organizational strategic goals, IS could be vulnerable to organizational structural and cultural influences (Sillince and Mouakket, 1997). Huber (1981) observed that organizational decision-making was political in nature and would impact both IS use and IS development. Kim and Michelman (1990) found that integrating disparate IS often cut across political boundaries, where IS were valued resources, and whose redistribution through integration affected group interests, manipulated organizational structure, and altered the distribution of organizational power (Burkhardt and Brass, 1990; Keen, 1981; Robey and Boudreau, 1999).

A closer look at political influence during IS development showed that champions, facilitators, and users could manipulate the outcome (Barki and Hartwick, 1994; Beath, 1991; Cavaye and Christiansen, 1996; Griffith, Fuller, and Northcraft, 1998; Howell and Higgins, 1990). Political considerations have also obscured technical and economic considerations during IS development (Weill and Olson, 1989), where rational choices were passed over for the seemingly irrational (Lederer, Mirani, Boon, Pollard, Prasad, and Ramamurthy, 1990). IS development should be considered both political and rational, where political behaviors defined the context against which rational or irrational behaviors were measured (Franz and Robey, 1984; Robey and Markus, 1984). Simon (1957) distinguished between rational and irrational decisions where people, especially in political environments, tended to make "satisficing" decisions rather than irrational decisions according to the bounded rationality of the decision context. To maintain a holistic organizational perspective, Kim and Michelman (1990) suggested that an informed top management arbitrate political issues surrounding IS integration.

Organization cultural influences also affect IS development. An IT department has relatively little influence when compared to other functional groups within the organization (Lucas, 1984; Lucas and Palley, 1987). Institutions external to the organization were also observed to exert cultural influence on IS use and IS development (King, Gurbaxani, Kraemer, McFarlane, Raman, and Yap, 1994), where IS customer power determined IS supplier dependence (Hart and Saunders, 1998).

Influence could redefine or reinforce IS architecture, development, and use (Jasperson, Carte, Saunders, Butler, and Zheng, 2002); hence, the organizational IT function must be cognizant and aware of its affect. Given these structural and cultural influences, an IS integration effort could become an organizational power struggle over supporting group objectives versus organizational strategy. With adherence to strategic goals, an IS integration effort could also drive change through organizational power structures and processes to support organizational strategy.

RESEARCH METHOD

Given that the objective of this study was to investigate organization structural and cultural influences in hospital IS integration, we took an in-depth case research approach to conduct this study. Case research is considered to be particularly appropriate (Eisenhardt, 1989; Yin, 2003). An advantage of the positivist approach (Weber, 2004) to case research allowed concentrating on hospital IS integration in a natural setting to analyze the associated qualitative problems and environmental complexity.

We selected a large teaching hospital (Hospital-A) that possessed 1,050 beds in China as the research site, which allowed us to more fully investigate the research questions and to collect longitudinal data. This study started in January 2002 and concluded in June 2004. During the 30-month study, we conducted field research and gathered data from multiple sources including interviews, field surveys, site observations, field notes, archival records, and documents reviews.

RESULTS

Figure-1 depicts Hospital-A’s IS architecture as of January 2002. There were four main IS in Hospital-A: (1) a large-scale hospital management IS (HMIS), which included five modules: outpatient, inpatient, pharmacy, material and medical device management (abbreviated as material module), along with finance and accounting management (abbreviated as finance module) modules; (2) a lab IS (LIS); (3) a patient record statistics (PRS) IS; and (4) a telemedicine IS. The latter two IS were standalone.

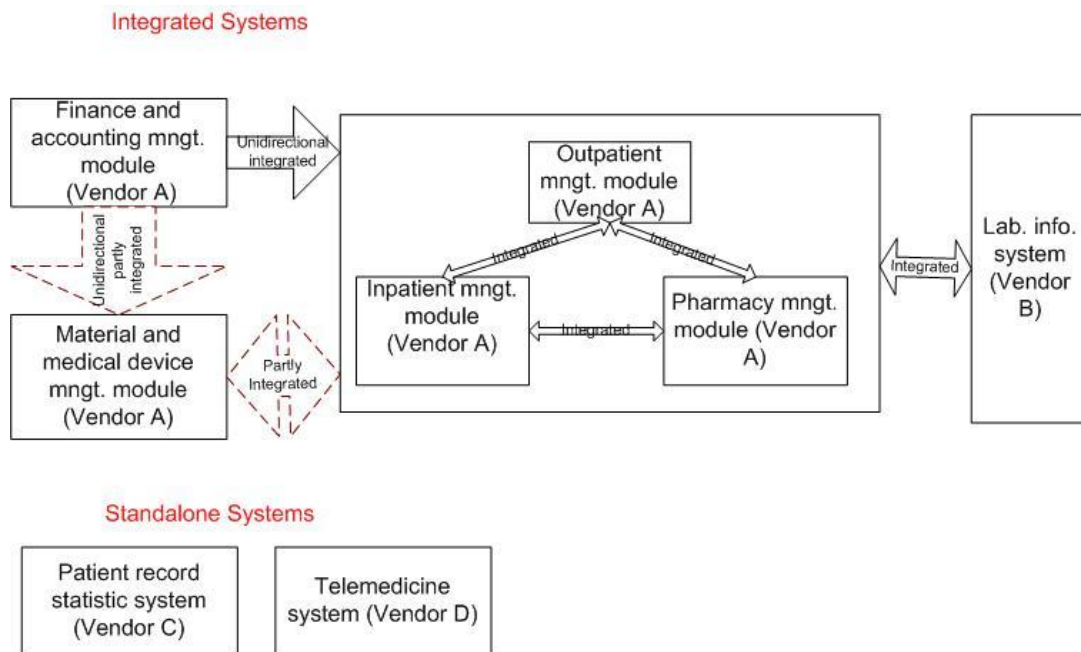


Figure-1: Hospital-A’s IS Architecture (January 2002)

Early in 1999 Hospital-A implemented outpatient, inpatient, and pharmacy (OIP) modules from Vendor-A, with the same vendor’s finance module added to the large scale HMIS later in 1999. Because sensitive information resided in the finance module, the interaction between OIP modules and the finance module was unidirectional. Only access from the finance module to the OIP modules was allowed. The material module from the same vendor was implemented, yet interactions among the material, OIP, and finance modules were limited because the material module’s “Save” function lacked the proper integration design to update the other modules. Particular data generated by the material module could not be electronically transferred, with the manual data entry of printed data sheets used as a workaround. The LIS from Vendor-B was installed in 2000, with the integration between OIP modules and LIS achieved by sharing database tables.

The PRS system was a standalone system. As the manager of the patient record department explained, “There is no way to connect our system to the other IS simply because of two reasons. First, our system was developed using Data-Tree M (DTM) technology, a very old technology used by the American military’s Fileman system. All other IS in our hospital are based on Microsoft’s Windows technology, and are incompatible. Second, our hospital lacks electronic medical record (EMR) capability and comprehensive electronic patient information availability. We do not have the electronic information sources that our PRS needs.”

Hospital-A’s telemedicine IS was only occasionally used for medical research and teaching purposes. Hospital-A’s IT department manager said, “This system (telemedicine) is one part of national Golden Health Medical Network (a sole satellite network owned by the government). The telemedicine IS is separate from our daily medical services and does not generate any economic profit. Instead of being managed by IT professionals in our hospital, it is managed by our Medical Affairs Department. We do not have any plans to integrate it to our large scale HMIS in the near future.”

Hospital-A’s IS Development over the Next 30 Months

A new president, a nationally well-known medical expert, replaced hospital-A’s president of six years in 2002. The new president assigned the director of the president’s office to manage the hospital’s IS development. Hospital-A’s IT department manager, who formerly reported directly to the president, started working with the director of the president’s office. After several communications, they both realized the necessity of sharing information among all departments for future hospital IS development. Both noticed that IS integration was an obstacle to hospital IS development; however, over the 30-month study Hospital-A installed three new IS that created more integration challenges.

A new finance system

In 2002, China’s Ministry of Health (MOH) requested all affiliated hospitals to conform to content and format changes for hospital annual reports. This dramatic change posed a challenge to Hospital-A, since its finance module was developed to accommodate the old policies. Hospital-A’s finance department had difficulty in generating the 2002 annual report, with most of the MOH compliance reporting performed manually. As an effort to reduce the manual MOH reporting, the finance department manager made a proposal directly to the hospital president for a new IS that was produced by a leading finance software vendor in China (Vendor-E) as a replacement for the current finance module.

Fearing the new finance IS would be incompatible with the existing HMIS, the IT department manager discussed with the finance manager about the possibility of modifying the current finance module instead of switching to another vendor’s product. The finance manager was reluctant to participate in a painful modification process, was uncertain about the modification end-results, and from the finance department’s standpoint preferred to buy a totally new system. Due to the high position afforded the finance manager in Hospital-A’s organizational hierarchy and the good relationship with the hospital president; the finance manager’s proposal was easily approved. The new finance IS was installed in early 2003.

A multimedia system

After China opened its healthcare market in the bid for entering the World Trade Organization (WTO), competition from private and foreign invested hospitals emerged as a posing threat to China’s public hospitals. To attract patients in 2003, Hospital-A’s top managers decided to use computers for marketing purposes. After three rounds of internal management (including top and middle managers) team discussion, Hospital-A purchased a multimedia IS from Vendor-G. The IS consisted of computers (information kiosks) that were put at the hospital entrance (to provide general hospital information and information about outpatient, laboratory testing, and inpatient service procedures) and different clinical departments (to present clinical department information with common diseases’ prevention and treatments). The multimedia IS presented information in the format of text, graphics, audio, and video. Hospital-A provided all the content information to Vendor-G, as Vendor-G created the multimedia files and customized the IS for Hospital-A. The content residing in the IS was fixed, lacking update capability or access to any of Hospital-A’s databases.

A human resources management system

Hospital-A is an affiliated teaching hospital of a major university in China (University-A). University-A and one of its affiliated teaching hospitals (Hospital-B) adopted a vendor’s (Vendor-F) human resources (HR) management system (HRMS). Being told the benefits of the HRMS by University-A’s and Hospital-B’s HR managers, Hospital-A’s HR manager suggested to purchase the same HRMS in a management meeting.

Since the adoption of Vendor-E's finance IS, Hospital-A's IT manager had been troubled with problems of integrating data between the finance IS and the hospital's large scale HMIS. Hence, when the IT manager heard the HR manager's proposal, he cautioned other managers about the integration issue. He then consulted Vendor-F to check the possibility of partially sharing database tables between Vendor-F's HRMS and the large scale HMIS. Privacy and security concerns prevented opening all HR information to the large scale HMIS. The proposed HRMS only allowed total data sharing and would not allow partial database access. Hence, Hospital-A's IT manager asserted the following in a management meeting, "This means that Vendor-F's HRMS can not integrate with our large scale HMIS. We are going to have another standalone system." Regardless of the IT manager's IS integration concerns, the HR manager insisted on purchasing Vendor-F's HRMS. Hospital-A eventually bought the system in spite of the IT manager's warning.

Hospital-A' IS Architecture in June 2004

Figure-2 described Hospital-A's IS architecture as of June 2004. There were seven main IS: (1) a large scale HMIS, which included four modules: outpatient, inpatient, pharmacy, and material/medical device management; (2) a laboratory IS (LIS, a newer version with more management functions was added in late 2002); (3) a patient record statistics (PRS) IS; (4) a telemedicine IS; (5) a finance and accounting management (abbreviated as finance) IS; (6) a HRMS, and (7) a multimedia IS. The latter five IS were standalone systems. Our study did observe that the integration between the material module and the OIP modules were largely improved.

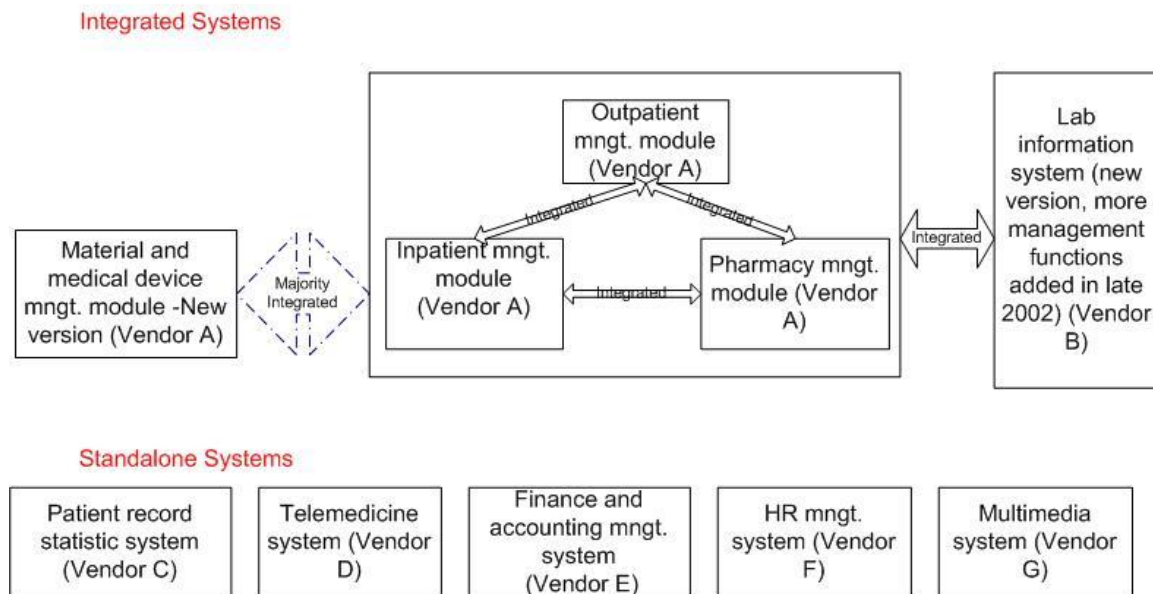


Figure-2: Hospital-A's IS Architecture (June 2004)

ANALYSIS AND DISCUSSION

Although the president's designee and the IT manager initially acknowledged the necessity of IS integration, a comparison between figures-1 and figure-2 revealed that IS integration worsened during the 30-month study. Top management failed to acquire IT expertise at their level that would have allowed an organizational IT perspective during IS development decisions. Functional groups chose to seek out IT solutions rather than collaborate with the IT department for solutions. Hospital-A's IT department perceived their lesser organizational influence as compared to other functional departments, and IT management acknowledged their inadequate influence to escalate the IS integration issue onto an uninformed top management for arbitration. Without an awareness to the strategic importance of IS integration, top management failed to establish an integrated IS architecture as an organizational goal to drive its IS development.

Hospital-A's IS development over the 30-month study lacked holistic goals, with communications and feedback between organizational functions lacking sufficient self-regulation to adjust the new or existing disparate IS. The absence of over-all common organizational goals to direct Hospital-A's IS development yielded sub-optimal IS architecture based on departmental objectives. The following sections offer plausible explanations for Hospital-A's IS architecture at the end of our study.

Organizational Structure and Culture

Our study found that Hospital-A's organizational structure was hierarchical and organized by specialized function, similar to Churchman's description of a system. Three vice presidents were respectively in charge of the hospital's three core functions: medical treatment, teaching, and research. A fourth vice president was in charge of logistics. As in most hierarchical organizations (Galbraith, 1977), the various functions lacked effective communication that resulted in poor self-regulation of organizational goals.

Harper and Utley (2001) noted the importance of identifying organization cultural attributes that would slow or halt IT development, implementation, and success. Hospital-A's organizational culture observed during our study exhibited hierarchical and compartmentalized characteristics based on control and power, which Wallach (1983) classified stereotypically as bureaucratic. Hospital-A had a centralized IT department that supported all core functions, yet lacked a chief information officer (CIO) on top management's level to advise on Hospital-A's IS development. Herbold (2005) noted that a CIO position could intercede with top management to prevent other influences from manipulating IT issues within such a power-oriented organization.

Impact of Structural and Cultural Influences

Hospital-A's IT governance was changed when the new president delegated the responsibility for hospital IS development to an individual who lacked IT knowledge and expertise. The authority of the IT manager may have previously been limited, but the change in governance consequently weakened the influence of the IT department. Its advice and expertise were not valued as illustrated by the finance manager and the HR manager proposing new IS and neglecting to consult the IT department for input prior to their proposals. In contrast, the finance and HR managers controlled Hospital-A's two most important resources of money and labor. In addition, the finance manager used a personal relationship with the president as influence. Top management lacked an expert IT presence; hence, both the finance and HR departments acknowledged and exploited the weaker IT departmental influence.

Individual departmental political considerations over-shadowed the technical and economic considerations associated with each new IS. The finance manager exploited structural and cultural influences to forego a complex and unknown IS integration project in favor of a known IS that delivered departmental objectives. Hospital-A's internal management team used their structural influence to micro-manage the organizational marketing effort rather than charter the IT department to provide integrated solution alternatives. HR exploited their structural and cultural influences from managing a limited resource (labor) to obtain a HRMS that reportedly supported their proposed departmental objectives according to unconfirmed information from other institutional influences.

Institutional influence from China's MOH, University-A, and Hospital-B drove departmental needs for new IS development without diligent organizational cross-functional discussion (interaction) over their impact to Hospital-A's IS architecture. Inadequate communications (stimulus/interaction) and discussions (feedback) from Hospital-A's functional departments yielded inadequate responses from middle and top management, and top management lacked control measures to counter any misinformation. During the 30-month study, Hospital-A was not functioning as an integrated system having common goals and its disparate nature was reflected in its IS architecture.

Management demonstrated bounded rationality in IS development decisions, which yielded deteriorating IS integration. Despite solid medical expertise, top management failed to discern the long-term consequences associated with the new IS and responded to short-term demands for productivity and organizational politics. The finance and HR managers insisted on their favored IS, regardless of their impact to Hospital-A's IS architecture. Hence, top management's decisions were "satisficing" from their perspective, the finance and HR managers' decisions were "satisficing" for their functional departments, and all decisions were seemingly irrational from the IT department's perspective.

The increased integration between the material and OIP modules stood out among IS development activities during our 30-month study. One vice-president (medical treatment) managed the OIP modules, while another vice-president (logistics) managed the material module. Vendor-A, developer of the original HMIS, was responsible for the module's architecture and recognized the need for their integration to be effective. A newer version of the material module had improved its integration among the other OIP modules.

Although Hospital-A's IS investments were all approved by top management, top management lacked IT expertise and an IS architecture advocate to fully analyze the impact of proposed IS development from an organizational perspective. Through all Hospital-A's IS development decisions during our 30-month study, top management was uninformed as to the impact departmental-driven IS development would have on Hospital-A's IS architecture and the long-term consequences of their

decisions. Without the enforcement of strategic IS development goals, the IT department and the entire organizational IS architecture was subject to Hospital-A's structural and cultural influences.

CONCLUSIONS

As IS integration is a challenge to any organization, organizational power manifested through structural and cultural influences can alter the IS development process that inevitably influences IS integration and IS architecture. Traditionally the IT function does not have the structural or cultural influence attributed to other organizational functions that claim ownership of functional data and information. A high-level CIO position within the organization could provide the influence to achieve the required equilibrium. The organizational IT function, lead by the CIO, must take stewardship for IS architecture that spans the organization, housing functional data and information used to meet organizational objectives. The IT function has to exert its limited influence toward maintaining an integrated IS architecture as an organizational directive and escalate IS development issues and their consequences to top management for arbitration. The CIO position within the organization must develop a trusted relationship with top management to succeed in this responsibility.

The organization is a political arena. With limited organizational influence, the IT unit with the CIO must educate management on the necessity of an integrated IS architecture to avoid bounded rationality during IS development. IT influence through communication and education as organizational interaction can stimulate self-regulation and prepare top management for informed arbitration. The case study of Hospital-A illustrated the consequences of inadequate IT functional interaction within an organization lacking strategic IS development goals.

Our case study contributed to IT literature through investigating organization structural and cultural influences in hospital IS integration, with a prescribed a priori prevention to their occurrence. This study was limited to a single case, where future research should broaden the focus to address this issue along with others that the authors may have inadvertently overlooked. The case examples presented in this study can serve as momentum for hospital IS integration comprehension and extension, while the results should be viewed as exploratory and in need of further confirmation. Researchers could choose to further or expand the investigation; while practitioners could apply the findings to minimize structural and cultural influence during hospital IS integration efforts.

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