

The Diffusion and Implementation of Information System for Hospital Innovations in Korea: Qualitative Method Base

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Abstract

This paper explores the diffusion of digitalization for health care organization in Korea, tracing the development of internet applications, and their impacts on important organizational aspects of health care delivery and the health care system.

We classify the organizational innovations by modifying Henderson and Clark model of technology innovation. Most hospitals in Korea belong to Type I, and 10% of hospitals are Type II. Type II innovation is characterized as making new components and new medical services through combining among the existing computerized factors like EMR, PACS, and OCS to improve efficiency. We have also discussed the role of the internet in encouraging the formation of various networks (Type III & IV innovations) among the health care providers. Anecdotal evidence suggests that the adoption of common HIS platform using ASP was a major driving force for this change. The loosely coupled structure (architecture) is regarded as a real innovation in the Korean health care sector.

The Korean health care sector has been focusing on reducing its management cost rather than creating a new business model because their idea is based on the Fordism due to the low national health insurance reimburse rate and the strong government interventions in the health care sector.

Key word : Digitalization, Henderson & Clark Model, Innovation, Diffusion, Implementation

I. Introduction

1. Conceptual Classification of Technology Innovations

In the management information system literature, Henderson and Clark (1990) model is well recognized in classifying the technology innovations. In the model, they conceptualize a new technology as composed of component knowledge and architecture knowledge. Component refers to function that provides services and architecture refers to structure that coordinates functions. By using these dimensions, they classified the technological innovations into two by two matrix. In the matrix, they categorized the types of technology innovation into the gradual

innovation, component (modular) innovation, architecture innovation and progressive innovation (See table 1).

Table 1. Henderson and Clark's Model of Technology Innovation

	Architecture Knowledge Reinforce	Architecture Knowledge Change
Component Knowledge Reinforce	Gradual Innovation	Architecture Innovation
Component Knowledge Change	Component Innovation (Modular Innovation)	Progressive Innovation

2. Modification of Henderson and Clark Model for Organizational Innovation

The introduction of internet and related technologies into the health care field generates many changes in the hospital services and organizational structure. To explain the organizational innovations related to the internet technology, we modify the Henderson and Clark Model. In our model, the component can be referred to medical service lines provided by a hospital and architecture can be referred to hospital organizational structure (Table 2).

The organizational component reinforcement is achieved by computerizing the administrative and supportive functions to reduce cost without introducing a new organizational component. In contrast, an organizational component change means introducing additional components or the replacement of old components. Therefore, organizational component change includes a new service introduction into a hospital, and replacement of the hospital clinical service portfolios.

Table 2. Type of organizational Innovation through Digitalization

	Tightly coupled organization architecture	Modular Organizational Architecture
Existing Organizational Component	Type I tightly coupled organizational architecture +reinforcement of existing	Type III Introduction of modular organization architecture (loosely coupled organizational architecture) + reinforcement existing

	component	component(existing services)
New Organizational Component Introduction	Type II tightly coupled organizational architecture + introduction of new component; new services	Type IV Introduction of modular organization architecture (loosely coupled organizational architecture) + Introduction of new organization components(new services)

Organizational architecture reinforcement means tightening (strongly centralized) an organizational structure which is a similar idea as "tightly coupled system". In contrast, an organization architecture change is developing a new organizational structure for an organizational innovation. With the change in the organizational architecture, the organization is transformed to a modular architecture which is similar to "loosely coupled system" in the organization theory literature (Thomson, 1967; Schilling, 2000). In the modular architecture, each subsystem has its own distinctive features that are simultaneously coordinated in the modular system. Loosely coupled system can be called "network organization" (Miles & Snow, 1986), "network forms of organization" (Powell, 1990), and "inter-firm network" (Uzzi, 1996).

It is easier to transform the modular system (architecture) with maintaining the organizational knowledge and ability than a tightly coupled organization. In this sense, the modular system can be more responsive to rapid environmental changes. Generally, when a tightly coupled organization faces environmental changes, they predict changes in the future, and then develop, make, and sell service under the prediction (make and sell; provider centered concept). Contrarily, the modular organizations first of all, recognize environmental changes and then they coordinate their capability and activities to fit into environment (sense and respond; customer centered concept) (Sanchez, 1996, 1999).

Schilling (2000) clarified the relationship between organizational components and organizational architecture. When there is a strong relation among organizational components (services), the system modularity reduces. Contrarily, when there is a weak relation among organizational components, or when an organizational input and an organizational output are heterogeneous, the value of modular system increases.

II. Classification of Organizational Innovation in the Korean Health Care Sector

By using the modified model, we classify the organizational innovations occurred in the Korean health care sectors;

1. Organizational Innovation Type I : (tightly coupled organizational architecture +reinforcement of existing component)

1) Description

In type I innovation, a healthcare organization maintains a tightly coupled architecture and the reinforcement of pre-existing organizational components

(services) simultaneously. This type is characterized by the use of automation process into the existing product line, web based promotion or administrative automation through the introduction of Electronic Data Interchange (EDI), and Electronic Medical Record (EMR). At most, some part of organizational process is modified but the process is still operated off-line to improve efficiency.

2) Cases of Innovation Type I

Major characteristics of the hospitals with innovation type I are the application of digitalizing the process of medical services. In Korea, many large size hospitals started to apply the information system (IS) into the administration department in 1990s. Hospitals' IS includes patient management system (PMS), order communication system (OCS), laboratory information system (LIS), picture archiving and communication system (PACS), electronic medical record (EMR) and electronic data interchange (EDI). The purpose of applying computerized system in hospitals is to reduce operating and administrative cost. The change from paper based medical record system to EMR has considerable effects on the hospital routines. Especially, EMR is a major driving factor to activate the health insurance claims through EDI, and also reinforces the management function to control service, to predict medical utilization, and to control inventory.

Due to the change in medical law in April 2003 FY, the number of hospitals applying EMR is increasing. With this trend, small size hospitals and clinics also started to introduce the computerized system using application service provider (ASP). The emersion of an ASP makes a new possibility for diffusion of EMR and EDI without incurring significant investment cost and for the new organizational structural change from tightly coupled to loosely coupled organizations. Hospitals didn't need to have their own IT department and could access appropriate IT services through the contract with an ASP. Therefore, ASPs can easily access to hospital IT service market and provide hospitals with the various software and network products relating internet.

Nowadays, 60% of Korean hospitals have PACS and EMR system, and the proportion of EDI among total health insurance claims is 96%. The Korean hospitals showed a very high diffusion rate of information system such as order communication system (OCS), hospital information system (HIS) and PACS (See Table 3). Generally, the market penetration rate of PACS is still increasing. When hospitals apply PACS in their system, they can save on the average 2 million dollars per year. There are four major ASPs in the Korean hospital field. They provide hospitals with various IT systems using their core competencies. As shown in Table 3, 98% of hospitals have computerized administrative systems. However, they have not yet integrated system components. For example, only 10% hospitals have a full scale HIS system that combined EMR and PACS (See Table 4). In summary, the Korean hospitals showed a significant gap in digitalization between the administrative system and clinical system.

Table 3. Trend in the Diffusion of Information

Technologies and ASP Contracts

	Penetration Rate	ASP Contract
EDI	96% of health insurance claims	Most of clinics and small size hospitals use ASP
EMR	60% of nation-wide hospitals: 10% of hospitals (large size hospital) use full EMR system, 50% of hospital use only Electronic Chart system.	ASPs cover Electronic Chart for small and medium size hospitals, and Full EMR is operated by large size hospitals directly
PACS	60% of nation-wide hospitals	Only 10% hospitals have integrated system with EMR. The rest have PACS system only
OCS	36%	Hospitals use their systems not internet based.
Administrative Systems	98%	No contract with ASP

Table 4. Service Contents by Major ASPs

	Home Page Address	Contents
UB CARE	www.medidas.co.kr	Remote treatment consulting
E-HEALTH CONSULT	www.ehealth24.com	Remote chart service, laboratory result checking, remote treatment consulting
MEDICAL SOFT	www.medicalsoft.co.kr	Electronic prescription (in hospital), doctor appointment programming
BIT COMPUTER*	www.bit.co.kr	Image EMR, patient management system, doctor appointment

* Bit computer occupied 80% of market integrated EMR and PACS system

2. Organizational Innovation Type II : (tightly coupled organizational architecture + introduction of new components: new services)

1) Description

The organizations with type II innovation maintain a tightly coupled architecture but introduce a new process or service through digitalization. Also, a new organizational routine (basic function) can be devised by using a strong information technology. In this type, an organization tries to extend to a new service area like a new purchasing, selling, inventory system, new customer management and adding to the existing organizational routine using internet related technologies. There can be a conflict between the existing components (services) and new components (services). By innovating the organizational routine, an organization can achieve efficiency and quality at the same time.

2) Cases of Innovation Type II

In this type of innovation, a hospital routine is replaced by introducing new components, and some new service lines are introduced by hospitals or related ventures. Two major examples are medial portal web sites and telemedicine.

In 2003, we could search about 1000 health care related websites using top five search engines. Among them, 190 sites are not providing services and we investigated the 810 sites in details. The services provided by the medical sites include the provision of basic medical information, online Q&A, information on medical institutions, professional knowledge on specific diseases for medical doctors, the health statistics, and medical shopping malls. During the internet boom, entrepreneurial ventures were leaders in the field of medical portal business. For example, the Pageone company (www.hidoc.co.kr) contracted with 650 famous clinicians and professors in the Korean medical field and launched contents provider business in 1999. The company is still in business but most clinicians do not renew the contract with the company. Another site called Kyunkangsaem meaning the fountain of health (www.healthkorea.net) had 4500 clinics and 5000 pharmacy members once. Recently, the company was acquired by the Pageone. After the internet boom, the major players in the medical portal business were changed to the academic medical centers in Korea. For example, the Seoul National University Hospital employed the McKinsey & co. to establish long-term strategies for e-health business. This trend is confirmed by the related statistics. In 1999, only 38% of general hospitals owned their medial portals, which increased to 74.6% in 2002 (Korean Hospitals Association 2003).

Through these sites, customers search the medical information and supplement their lack of medical information. Medical portals seem to affect the traditional doctor-patient relationship in Korea. Until recently, physicians have enjoyed an autocratic status over their patients based on the information asymmetry and the shortage of doctors. Patients are no longer ignorant about their diseases. Many patient satisfaction surveys (KHU 2002, SNU 2002) report that reasons for patient complaints changed from the facility and unkindness to the lack of professional attitude and the inability to answer disease specific questions. Since a physician in Korea treats more than 100 patients per day, a physician cannot squeeze his/her time to answer patients' questions in details. Many physicians are, therefore, using web-mail, internet homepage Q&A section or SMS (short message service) to answer their patients' questions online.

While most of the sites are used to complement off-line services of clinics and hospitals, some innovative entrepreneurs are adding new components based on the internet platform. For example, a teaching hospital provides a SMS (short message service) that sends warning signals to chronic patients' mobile phones and makes the appointments for consultations when home health test results are automatically reported to the hospital over the threshold. After the change in medical law for RT and EMR, many remote treatment (RT) system-telemedicine-

companies started to prepare to access this market. Currently, six companies are already in this market. In summary, the medical portals are supplementing the offline medical services rather than substituting them. The role of medical portals seemed to be modified by the increase in the proportion of hospitals that own e-health business.

LG CNS developed RT system using PACS and EMR with Aju University Medical Center. With this RT system Aju University Medical Center made new integrated delivery system relating affiliated hospitals. DigitalMed system developed patient RT system for overweight students. This company has a remote screening and treatment system for employees. Hicare company provides patients with a remote screening applicant to check their health status and to cumulates in the electronic charts that are accessible through the web. It is possible for patients to receive their health status information and to consult for treatment through their mobile phone with IMT 2000 (International Mobile Telecommunication 2000) feature . Bit computer contracted with the Sybercare in the U.S. and is planning to provide the remote health maintenance services for the corporate employees in 2004.

However, the prediction of remote treatment business is not optimistic because it is necessary to change the current medical law for the health insurance reimbursement and malpractice. Therefore, most companies are focusing on the remote screening business.

3. Organizational Innovation Type III : Introduction of modular organization architecture (loosely coupled organizational architecture) + reinforcement existing component(existing services)

1) Description

This type III innovation makes changes from a tightly coupled organizational architecture to a nearly decomposable or loosely coupled modular system. It means that the innovation changes its method to combine organizational components and, thereby, creates a new organizational structure. However, an organization still maintains the existing components or services.

4. Organizational Innovation Type IV : Introduction of modular organization architecture (loosely coupled organizational architecture) + Introduction of new organization components(new services)

1) Description

Type IV innovation achieves innovations in both component and architecture, simultaneously. Reaching this stage, an organization completes the e-transformation.

2) Cases of Innovation Type III and IV

A typical example of the loosely coupled structure is strategic alliance. When a hospital wants to enter into the new medical service market using the internet based technology, the hospital can affiliate with an exiting ASP or can establish a new IT company investing jointly with an ASP, other hospital, or other firms. The new IT company is perfectly controlled or owned by neither the hospital or other investors. However, the IT company still belong the modular system led by the hospital. It can make contracts with several modular systems. This

strategy is used to reduce investment burden and diversify risk from the investment. This architecture type can easily separate and combine organizational divisions and service portfolios depending on the environmental changes, market demand and internal decision. As shown in Table 5, portals such as MD House and HiDoc do not have any relationship with the modular system. In this context, they belong to the Type II innovation. But most other portals were involved in developing the modular architecture systems and new business models.

The loosely coupled structure is not familiar in the Korean business world because the business founder wants to have an entire governance over the system. The hospitals are not exceptions. Hence, the loosely coupled structure (architecture) is regarded as the real innovation in the Korean health care sector. In addition to the strategic alliance, large hospitals spin off e-health ventures to provide the remote treatment or electronic commerce. Also, e-health companies are integrating online consultation, contents provision, remote treatment and B2C commerce.

Table 5. Description of Medical Portals

Companies	Characteristics	Major Operation
Health Korea	Health Screening through questions, Consulting and Medical History Service, Health Food Service	Internet using PC, TV, PCS
Care Camp	Service for health and hospital information, B2B exchanging for drug store, Health food shopping Mall	B2B, B2C, Financing support for clinic opening
Dr Crezio	Consulting to Doctors, TV program development	Appointment service
Hi Doc	Specialty services consulting, Health New, Consulting with hospitals	
Med City	Information for disease, and alternative medicine	
Doctor	Medical consulting for patients, information for specialty clinics and hospitals	Home page and advertisement.
Doctor Korea	Consulting through internet, Medical information, attending doctor consulting, prescription appointment, medicine delivery	Affiliating to pharmaceutical company
MD House	Portal service for medical information, clinic financial support, medical supply Shopping mall	
OK Medi	Portal service for oriental medicine, internet broadcasting	Internet health screening

It is still unclear that how Type III and IV innovations will develop in the Korean health care sector in the future. However, three cases deserve attention (Song, 2002). Samsung Medical Center led the modular system that involve the medical portal, supply management, insurance and home care. The 365 homecare currently provides the remote care. It is planning to provide the ambulance services to move its patients to a hospitals when it attracts 800,000 customers for the company membership. The leading medical venture Madison integrated various aspects of e-health and formed the Madison Federation. The Federation has the most extensive business scope including PACS (picture archiving and communication system) production, life insurance, and hospitals networks. However, the Federation was dissolved after the bankruptcy of the Madison in 2001. Some divisions of the Federation were closed and the others were merged by business groups or pharmaceutical companies. Cha hospital, which has specialized care for OB&GYN, had the portal web services for female specialty care. Cha hospital is developing a business system that links food and alternative medicine for females, and it has all total solution for females integrating on and offline services.

III. Conclusion

In Korea, the diffusion of broadband internet and related information technologies seem to have a limited influence on the innovations of business model, organizational form and structure in the health care sector.

We classify the organizational innovations by modifying Henderson and Clark model of technology innovation. Most hospitals in Korea belong to Type I, and 10% of hospitals are Type II. Type II innovation is characterized as making new components and new medical services through combining among the existing computerized factors like EMR, PACS, and OCS to improve efficiency. We have also discussed the role of the internet in encouraging the formation of various networks (Type III & IV innovations) among the health care providers. Anecdotal evidence suggests that the adoption of common HIS platform using ASP was a major driving force for this change. The loosely coupled structure (architecture) is regarded as a real innovation in the Korean health care sector. In addition to strategic alliance, the spin-off, virtual physician network and total medical solutions portals deserve attention. These changes had impacts on the organizational structures of health care providers and the competition among them.

Since the internet boom, the Korean health care sector has been focusing on reducing its management cost rather than creating a new business model because their idea is based on the Fordism due to the low national health insurance reimburse rate and the strong government interventions in the health care sector. In this light, the internet- related innovations have yet complemented the offline medical services. To supplement our study on organizational innovations, future studies on business culture and medical law making mechanisms of Korea are called for.

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