TOWARD A BUSINESS MODEL FOR E-HEALTH SERVICES: NTUH AS AN EXAMPLE

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ABSTRACT

This study synthesizes the extant literature regarding business models and service theories to develop a business model in the service context that can support e-health services to maintain sustainable operations. The proposed business model was applied to National Taiwan University Hospital (NTUH), one of the leading and largest hospitals in Taiwan, for the successful deployment of e-health services. Besides applying the business model approach to NTUH e-health services, this study contributes to establishing a business model for services and providing new prospects for domestic and worldwide e-health services.

INTRODUCTION

Enabled by the advancement of information and communication technologies (ICT), electronic health (e-health) has achieved universal coverage and improved the healthcare quality [16]. It has also improved service delivery and communication among healthcare institutions, healthcare community, and end-users, resulting in better quality of patient care, increased access to providers, and the reduction of unnecessary costs. Taiwan is among one of the developing countries that are progressively developing pilot projects to support the sustainable operation of e-health services. Challenges exist, however, including the complex industry network of service providers, platform developers and device providers, law regulations, operating fees, and the delegation of responsibility among stakeholders. Furthermore, most of the pilot projects strongly rely on government grants, lacking a clear vision of commercial operation.

A business model refers to the method by which an organization achieves profitability and creates a sustainable competitive advantage over time, through an interrelated set of decision variables in the areas of venture strategy, configuration, markets and economics. Although business models provide solutions to the challenges that are inherent in the deployment of e-health innovations [2] [5], few studies have focused on this area. Moreover, the business model approach builds upon the value chain concept of Porter [18], which focuses on a set of logistics, activities, and operations. The focus on production activities do not seem to suit healthcare institutions that specialize in e-health services through back-end support and front-end delivery processes. To address these limitations, a service-oriented business model is in need for e-health services.

The National Taiwan University Hospital (NTUH) is one of the national medical centers in Taiwan that concentrates on healthcare, teaching, research, and service. Being a leader in the healthcare area, NTUH also develops new prospects for ICT and innovative e-health services. Nevertheless, NTUH also faces the above challenges and needs to define its own business model for e-health to ensure its long-term sustainability in e-health services. Using this leading medical center as a case, the aim of this study is to propose a sustainable business model for NTUH's e-health services and provide a better prospect for healthcare institutions in general. The key objectives are: (1) to propose a business model in the service context, (2) to develop a successful business model for NTUH's e-health services, and (3) to extend the business model approach to e-health institutions.

LITERATURE REVIEW

The Business Model Concept

The business model can be described as a method by which a firm can determine a successful strategy. Stewart and Zhao [25] described the business model as "a statement of how a firm makes money and sustains its profit stream over time." Slywotsky [24] provided a similar conceptualization as "the totality of how a company selects its customers, differentiates its offerings, defines the tasks which ones it performs itself or outsources, configures its resources, goes to market, creates utility for customers and captures profits," and Morris et al. defined it as "a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create a sustainable competitive advantage in defined markets."

Other researchers have gone further to define the elements contained in a business model. Examples include Timmer [26], Hamel [10], Afuah and Tucci [1], Applegate [3], Chesbrough and Rosenbloom [6], Mitchell and Coles [13], and Osterwalder et al. [14]. A review of these studies suggests that the business model components can be divided into eleven categories, namely including organization, customers, service proposition, relationships, channels, resources, activities, partners, finance, customer value, and benefits (the summarized table is available on request). An integrative business model framework that contains five pillars, three levels of decision making, and eleven elements of decision areas is thus proposed. The pillars are the basis of a business model and contain the essential issues that a firm needs to address [14], and the decision making levels can help a firm to make a series of decisions to fulfill its business model.

Service Design

Service design helps a service organization to move from a strategic to an operational level [19]. Ponsignon et al. [17] suggested analyzing and designing service systems from a process-centric perspective. Shostack [21] [22] indicated the necessity of integrating the customer viewpoint into service design. These and relevant studies contribute to the foundation of the current study, namely the service strategy triad that is based on strategic concepts, a service process that focuses on process-thinking, and a service encounter that based on the customer experience perspective.

The three major elements of Roth and Menor's [19] service strategy triad include target markets, service concepts, and a service delivery system. Service providers segment customers into groups based on distinguishing characteristics so as to provide personalized services [15] [20]. The service concept concerns what the outcome is, and how it is achieved during the process [11] [17]. A service delivery system is the process through which customers experience the service outcome [9] [17].

A service process plays the role of "delivery" to ensure that the expected service outcome is received by the customer [9] and leaves the customer either satisfied or dissatisfied with the service experience [12]. In the service process, the service organization produces and delivers the service to customers through a series of activities and through the flows and interactions between those activities and resources [23].

Service providers contact customers, meet their needs and expectations, and create service experiences for them through service encounters. Bateson [4] considered service encounter as a triad formed by the interaction among service organization, contact personnel, and customer. It is mutually beneficial for the three parties to work together to create an efficient service and to achieve a service experience that customers perceive as positive [7] [8].

RESEARCH FRAMEWORK

For the construction of a business model in the service context, we propose a framework that illustrates a general and integrative business model and contains service perspectives. The business model framework is composed of five pillars and eleven components (see Figure 1).

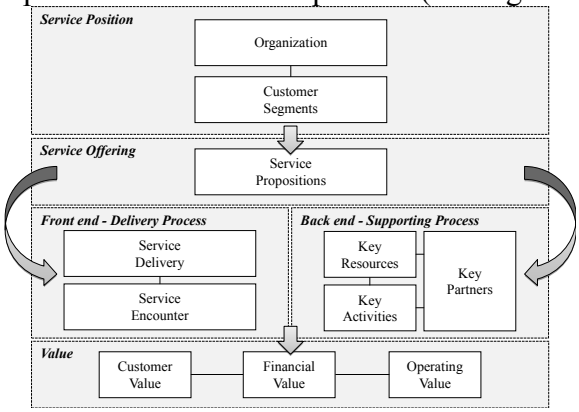

Figure 5. The business model framework

Moreover, there are three levels of decision making, which include foundation, proprietary, and rules levels, respectively [13]. At the *foundation* level, service organizations make industry-generic decisions as well as organization-specific decisions. These decisions include those on organization, customer segments, service proposition, service encounter, service delivery, key resources, key activities, key partners, financial value, customer value, and operating value. At the *proprietary* level, a service organization customizes its own business model to secure its marketplace advantage by developing unique combinations among decision areas. At the *rules* level, a service organization is supposed to establish specific guidelines and methods to run its business model. This level guides a firm's development and leads to the execution of decisions made at the previous two levels

CASE BACKGROUND AND DATA COLLECTION

NTUH focuses on teaching, research, educational systems, diagnostic and treatment techniques, as well as innovative research and development. NTUH contributes to the development of medical treatment and plays a leading role in the healthcare industry. NTUH pursues innovation and advancement to promote human health and has sought to develop e-health services. The project seeks to construct a continuous, integrated personalized healthcare platform. Through the platform, each patient acquires e-health services at home, obtains immediate and continual care and consultation from case managers, and receives medical care and treatment in case of emergency situations. In addition, the mobile platform allows patients to receive e-health services regardless of time and location. The goal of the

project is to improve patients' physiological condition and their quality of life, to promote favorable medical outcomes for NTUH, to help people live healthy lives, and to demonstrate a successful case for the healthcare industry in Taiwan.

We chose the following cases: NTUH Telehealth Center, Changhua Chris-tian Hospital (CCH) Long Distance Health Management Center, Far Eastern Memorial Hospital (FEMH), Far Eastone Telecommunications (FET), Cheng Hsin General Hospital (CHGH) Telecare Services Center, and Min-Sheng Healthcare. We interviewed administrators, physicians, and case managers to investigate the feasibility and difficulties of developing NTUH e-health services. In addition, to develop the e-health business model, it is necessary to understand customer's exact needs. We therefore also conducted a questionnaire survey to understand the patients' expectations for e-health services. The information collected was arranged into a table to define general decisions at the foundation level, competitive decisions at the proprietary level, and executing guidelines at the rules level to capture an e-health business model for NTUH.

CASE ANALYSIS

Because the industry-level decision problems in the eleven components of the business model framework are commonly understood, this paper focuses on the organization-level decision problems in the analysis. Through interviews, questionnaires, and secondary data collection, we develop the proprietary and rules levels of the NTUH e-health business model. The assessment of the NTUH e-health business model is shown in Table 1.

Table 1. Assessment of the NTUH e-health Business Model

Suggestion or Ideal planning	Assessment
Organization	
NTUH's objectives 1) Reduce the number of outpatient stays, hospitalizations, ED visits, etc. to contribute to marginal benefits for NTUH 2) Have the ability to independently balance revenues and costs	1) Underway: NTUH has tried to verify that e-health may improve outcomes not only for patients but also for NTUH by conducting various pilot plans. 2) Not yet: Far from this stage
NTUH's goals 1) Short-term: Incorporate the project's diabetes care into the NTUH Telehealth Center 2) Medium-term: Become a routine, comprehensive and independent department 3) Long-term: Become an important department to maintain people's health	1) Underway: Now it is in the consolidation process. 2) Not yet: Far from this stage 3) Not yet: Far from this stage
JSH's goals 1) Short-term: Extend the types of disease care, ranging from diabetes to heart diseases or hypertension 2) Medium-term: Promote this model to the community	1) Not yet: Currently mainly focusing on diabetes or other chronic diseases 2) Underway: JSH has set up Health Stations to build a positive relationship with the community as well as actively execute home visiting to keep in touch with patients.
Customer Segments	
An e-health business model between the two extreme markets 1) Crisis Management as the exclusive market: patients with Type 1 diabetes, severe cardiovascular diseases, or complications, hereditary, complex or long-term diseases 2) Health Management as the mass market: people who feel healthy but hope to become healthier may also participate or who feel unwell but hope to return to their original healthy states may participate	1) Finished: NTUH has offered related care for patients with Type 1 diabetes and severe cardiovascular diseases, which is differentiated from most hospitals operating for chronic care. As for patients with complications, hereditary, complex or long-term diseases, there are some issues facing the capability of e-health platforms, the difficulty of commercial operations and the integration of each department. 2) Finished: NTUH Telehealth Center has targeted the customer groups and offered services.
Service Proposition	
Integrated services 1) Integrate platforms: Including patients' electronic medical records, physiological value, medical information platforms, etc. 2) Integrate services: Related services of each department	1) Underway: Some have been integrated, such as Diabetes care network, COPD care network, Diet care website and Hospice care network.

3) Progressive development: As e-health gradually expands, more and more disease care will be contained in integrated services; all departments will eventually participate, like tele NTUH.	2) Underway: The same as above 3) Underway: Begin first with cardiovascular disease, which is more urgent and patients would be more willing to pay for it; diabetes care will also be included. Liver disease, kidney disease or postoperative patients are also prone to accept short-term care; additionally, some relevant departments or services, such as weight loss, sleep or rehabilitation, have also expressed interest.
Health management services 1) Design services focused on satisfying the basic necessities of life of diabetes patients to combine life care with e-health services 2) Cooperate with affiliate stores, such as a fitness center. For example, after assessing a patient's situation, NTUH could choose a fitness center and suggest that patients follow a particular diet or exercise plan	1) Not yet: Although there are related services in the platform, such as Diet records, it is still far from this type of service 2) Not yet: No related cooperation now
Offer basic and value-added services 1) Distinguish services at several levels to form basic and value-added services, making options more flexible	1) Underway: Currently we know users' demands and their priority of each service through the questionnaire survey, which can be a reference for development in the future
JSH's e-health services 1) Design life care services for the elderly	1) Not yet: Besides home visiting, there are no related life care services at the present time
Service Encounter	
The development of CDSS 1) Establish CDSS to automatically diagnose cases' status to reduce the burden on service personnel	1) Underway: Ongoing
The development of an online patients association 1) Let patients share information or provide emotional support in an online patients association	1) Not yet: The project has an initial idea, but has not yet implemented it.
Service Delivery	
Key Resources	
Improvement suggestions for the platform 1) User-friendly interface and improved fluency 2) More information after arranging 3) Quickly browse and query key information 4) New record field 5) Arranging function 6) More integrated 7) More useful indicators 8) Record temporary and acute changes 9) View data, process and make decisions	1) Not yet 2) Underway: Continuing to improve 3) Underway: Continuing to improve 4) Finished 5) Underway: Continuing to improve 6) Underway 7) Not yet 8) Not yet 9) Not yet
Improvement suggestions for JSH's instruments 1) Personal identification feature 2) User-friendly / graphical interface design for the elderly	1) Finished 2) Not yet
Resident physicians 1) When the e-health center reaches 1,000 or 2,000 cases, there must be resident physicians to stand by in the center.	1) Not yet: Far from this stage
Key Activities	
Design a scalable architecture 1) When the front-end auto filter discovers a problem, directly pass it to the back-end service group to handle it. Only the center has the ability to operate the back end, it could run the front end.	1) Finished: NTUH currently employs the scaled-up architecture to balance the burden of the telehealth group and provide services to more patients
Education and management of the e-health team 1) Offer case manager training 2) Cultivate a professional e-health team	1) Not yet: Because the number of cases currently does not reach a critical mass, it is difficult to plan related training. 2) Finished: NTUH has participated in various exchanges, certification and competitions to earn patients' trust.
Key Partners	
Cooperate with institutions, communities or branches 1) The community hospital, JSH, is responsible for the first line of treatment. By using the e-health system, it can screen relatively stable patients and pass severe cases to NTUH to accept treatment. 2) Through e-health, NTUH or JSH can offer some medical guidelines and consultation for the nursing facility, and the nursing facility can provide better care to patients and improve the quality of care. 3) The cloud can be used to filter patients to the center, so more manpower will not need to be added.	1) Finished: The mechanism is preexisting in general medical use and can also be applied in the e-health area. 2) Not yet: Although NTUH has such aims, it has not yet discussed a cooperative model with any nursing facilities . 3) Underway: NTUH and JSH both hope to realize this method in the future. Perhaps through e-health, as long as someone local can implement the doctor's orders, it is not necessary to set up an e-health team locally, which saves manpower and personnel costs.

Government: policies & regulations 1) In terms of legislation or health care, require patients to upload data to the platform; consider the rights and obligations of patients with Type 1 diabetes 2) Using the FFS model, for example, NHI can determine whether patients' HbA1c value is higher than 8%; NTUH can thus open medical orders to allow patients to use the instruments. Moreover, the instruments can be provided here by the NHI Bureau. 3) Using the Case payment model in the future, NTUH should research and verify that e-health indeed improves patients' health. If NTUH finds that e-health may decrease medical expenses, it will have more incentive to offer e-health service for free.	1) Not yet: The policies need to be provided to the relevant government agencies to deliberate. 2) Not yet: Through government grants and patient exam fees, it is difficult to grant patients even an instrument fee. 3) Underway: Various pilot plans conducted by NTUH and JSH are trying to confirm that Case payment can actually reduce medical costs and improve patients' health.
Financial Value	
Technology Transfer Fee 1) If the e-health business model can reach successful duplication and diffusion, NTUH is expected to earn technology transfer fees totally approximately $2,000,000 NTD.	1) Not yet: The model still has not reached the necessary size.
Customer Value	
Operating Value	

CONCLUSION

The business model for NTUH e-health services assures the sustaining operation and permanent offering of the services. Using eleven elements embedded in the five pillars to describe the model, we propose our findings and recommendations below.

First, to identify the service position for a competitive service design, NTUH can target patients with complications, hereditary, complex or long-term diseases to offer e-health services, which distinguishes it from other community hospitals or institutions focusing on long-term care for elderly patients. NTUH needs to first develop a successful model, and then extend it to other areas of disease care to realize its movement from Cloud Ward to Cloud Hospital. Second, for a customer-oriented service design, it is necessary first to understand target customers' demands. Most users had Type 1 diabetes, were aged 35-65, and showed interest in mobile care and health management services. Life care service for the elderly thus seems unsuitable because such service would result in waste of resources. Third, in the delivery process to interact with customers, NTUH makes e-health services continually accessible to customers. It can develop CDSS to monitor patients' situations to ease the burden on service providers and to create online patients associations to promote more experience sharing among patients. At NTUH, case managers are the main service personnel that give patients health consultations, build patients' personal health records, offer monthly health reports, and provide urgent care consulting; physicians would then assess patients' conditions in a timely fashion. Additionally, with physicians promoting the service, the patients' willingness to participate in e-health services will be higher, which is a channel that NTUH can consider. Fourth, in order to build supporting processes for e-health services, NTUH needs to integrate related resources and all departments to develop an integrated e-health service and platform. The platform concerns not only the inputting and browsing of patient data but also the support for case managers' and physicians' inspection and diagnosis. Lastly, values generated come from three aspects. Financial values include economic benefits brought to the hospital through the prices that patients are willing to pay for. Customer values refer to the degree of users' health improvement and satisfaction with the service and platform. Operating values can be observed in the improvement of important indexes, such as bed turnover rates and the number of simultaneously treated patients.

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