Brief Communication
A Business Model Analysis of Telecardiology Service

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Abstract
Telecare has become an increasingly common medical service in recent years. However, new service must be close to the market and be market-driven to have a high likelihood of success. This article analyzes the business model of a telecardiology service managed by a general hospital. The methodology of the article is as follows: (1) initially it describes the elements of the service based on the ontology of the business model, (2) then it transfers these elements into the choices for business model dynamic loops and examines their validity, and (3) finally provides an empirical financial analysis of the service to assess the profit-making possibilities.

Key words: business model, telecare, service innovation, dynamic loops, business model ontology, cost–volume–profit analysis

Introduction
The concept of “telecare” is nothing novel. Over the past few decades, the interest in telecare development has constantly grown, not only in research but also in its applications because of advances in fields such as information and communication technology. It is an area with vast future opportunities in the healthcare industry.

In recent years, a considerable quantity of research papers regarding state-of-the-art telemonitoring devices and clinical outcomes have been published.1–6 However, the economic and financial aspects are relatively rarely cited, not to mention discussions of the business models employed.

Chesbrough7 argued that advanced technology is not a guarantee of market success. He provided specific examples to prove that new technology needs an appropriate business model to survive in the market.

OBJECTIVES
The purpose of this article was to analyze the business model of a service innovation case via the examination of a telecardiology service provided by a general hospital.

Materials and Methods
THEORIES FOR BUSINESS MODEL ANALYSIS
In this case study, a telecardiology service provided by a general hospital ("hospital C" hereafter) was chosen as the object for analysis. The process of analysis method is shown in Figure 1. First, a description will be given to explain why the hospital introduced the telecardiology service to its patients and the importance of the business model to this service innovation. Second, the elements of the business model will be described. In this case, the ontology of the business model created by Osterwalder and Pigneur8 will be used in expressing the business model element of the telecardiology service. Next, the dynamic loop method proposed by Casadesus-Masanell and Ricart9 will be applied to examine the effectiveness of the telecardiology service. Here, the business model elements will be converted into the choices and consequences to display how the business works. Finally, a discussion of the implications for the telecare business model will follow.

SERVICE INNOVATION: THE IMPORTANCE OF AN APPROPRIATE BUSINESS MODEL
Just as there is no unified model of service innovation, there is no universal consensus on how service innovation is achieved. It can, for example, be a new customer interaction channel, a distribution system, a technological concept, or a combination of them. Chesbrough and Spohrer10 employed the example of FedEx’s online tracking system, which allowed customers to log in and view the status of their packages without human intervention. The service not only produces value by satisfying customers’ needs but also saves on the cost of notification.

The belief that new technology equals service innovation is commonly held. Jim Spohrer, the director of Almaden Research Center, IBM, expressed his views on this opinion in a Business Week article regarding the difference between new technology and service innovation.11 He pointed out that people are often aware of technological innovation but not service innovation. Spohrer gave the light bulb as an example that the average person knew that Thomas Edison invented the light bulb, but only a few knew how the light bulb entered houses and schools, how the price of electricity was set, and how the service was maintained. He called the whole process “service innovation.”

As mentioned earlier, new technology alone does not guarantee the survival and the sustainability of a new service. Drucker12 argued that simply “brilliant ideas” do not form an innovation. The true test of an innovation lies in whether it could provide new value for users and the general public. The same principle should apply to the telecare service, such that it can be tested in the market to demonstrate that it is possible to sustain and can provide a new value proposition to its end users.

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Service innovation does not necessarily originate from new technology. According to the position proposed by this article, a new service using an existing technology to provide a new value proposition to customers is eligible to be considered as a service innovation. This may occur as the result of the integration of an organization’s current resources without the adoption of a new technology. Additionally, a new integration of technology with an appropriate business model may create new opportunities for service, improve efficiency, and increase the likelihood of success.

ONTOLOGY OF THE BUSINESS MODEL: THE ELEMENTS

Osterwalder and Pigneur described four areas while tackling the e-business model: product innovation, customer relationship, infrastructure management, and financials. The four areas were further divided into nine elements: value proposition, target customer, distribution channel, (customer) relationship, value configuration, capability, partnership, cost structure, and revenue model. The relationships of and links between these elements were mapped as the ontology of the business model. The ontology was developed as a concept tool to describe certain company’s business models and focus on their value configurations.

THE DYNAMIC LOOPS OF THE BUSINESS MODEL: THE VIRTUOUS CYCLE

Casadesus-Masanell and Ricart introduced a way of demonstrating how the business model works by using a dynamic loops method. According to their theory, the business model is a set of choices and consequences. The content of choices includes policy, assets, and governance structure. Policy refers to a series of actions taken to maintain a company’s operations such as locating factories in rural areas or encouraging employees to fly economy class. Assets refer to tangible resources, including, for example, manufacturing facilities or a satellite communication system for offices in different locations. Governance refers to the structure of arrangements and decisions on policies and assets. For instance, when a company decides to use a fleet of trucks for transportation, it can rent or buy the vehicles. The decision constructs the company’s business model and might reflect on the company’s management or profit.

The method employed by Casadesus-Masanell and Ricart is to represent all of the (important) causes and effects of a company in one single diagram. The relationships between choices and consequences are strengthened through each repetition. Once the model starts functioning, it continues to operate like a machine with its own internal momentum. When the arrangement of the policies and assets forms a closed loop, it means that the business model has a virtuous cycle and is likely to sustain its operation.

ANALYSIS FINDINGS OF HOSPITAL C’S BUSINESS MODEL

A brief description of hospital C. Hospital C was established in the 1960s in Taipei, Taiwan. Its original mission was to provide polio-rehabilitation services as a charity. In the early 1990s, the hospital developed into a full-service hospital and became distinguished as a leader in cardiovascular surgery and cardiology in Taiwan. From 1997 to 2007 there were 623 cases of heart transplants performed in Taiwan (Bureau of National Health Insurance). Of the 623 cases, hospital C managed 179 transplants (28.7%). Not only did hospital C handle almost 30% of the heart transplants in Taiwan, but also its 3-year survival rate was 79%, which was close to its counterparts in the United States. The survival rate of recipients aged 18 and above in the United States between 2003 and 2005 was 80.72% according to the Scientific Registry of Transplant Recipients.

Results

ELEMENTS OF THE TELECARDIOLOGY BUSINESS MODEL

Following the theory described by Osterwalder and Pigneur, hospital C’s business model is as follows:

VALUE PROPOSITION

Using a portable electrocardiography (EKG) recorder allows patients to record their EKG data whenever they feel heart problems occur. There have been several clinical research results published regarding its benefit, including a decrease in death rate, improved quality of clinical care, and more efficient diagnosis.

In hospital C’s case, the value proposition offered to the patients includes:

1. An emergency mechanism that allows instantaneous intervention and saves lives.
that it must be built on one’s strength.

The value proposition offered for the hospital includes:
1. Enhancement of hospital service, allowing it to fill the gap in unsatisfied clinical needs such as diagnosis, disease monitoring, follow-up, and rehabilitation after surgery.
2. A decrease in the after-surgery death rate, enhancing hospital C’s reputation.

RELATIONSHIP
The telecardiology center offers a 24/7/365 customer hotline service staffed by experienced nursing personnel. The nurses also assist in dealing with emergent requests on behalf of the doctors. When there is an emergent request, for example, a call from someone who is having a heart attack, nurses can guide the patient to facilitate and expedite emergency care before any orders are received from a doctor.

TARGET CUSTOMER
Target customers are the cardiovascular patients, including those who have symptoms but have not been finally diagnosed, those who have been diagnosed but need to prevent or manage an emergent event, and those who need to be followed after heart surgery.

DISTRIBUTION CHANNEL
The main distribution channel is set at the outpatient department (OPD), inpatient department (IPD), and emergency patients. They include cardiology and cardiovascular surgery patients and the patients referred from other departments.

Telecare as a service innovation can change the geographical limits of clinical services by attracting patients from remote areas and expanding market coverage.

VALUE CONFIGURATION
The Swiss CardGuard CG7100 portable EKG recorder is used by the system. It has a mobile phone-like size and is easy to carry. Moreover, most people can effectively use it after only 10 min. The device provides real-time recording and transferring of data over telephone lines and mobile phone systems. The media used for transferring the data are general home phones and mobile phones, with no special setting necessary.

The telecardiology center and the hospital coordinate on-call schedules for the call covering doctors to reduce workloads and costs.

CAPABILITY
Hospital C’s central competence lies in its cardiology and cardiovascular surgery expertise, and telecardiology is the new application of this core competence. Additionally, this crucial ability may form the foundation of the hospital’s competitive advantage. Drucker also illustrated that one of the conditions of success in innovation is that it must be built on one’s strength.

PARTNERSHIP
The telecardiology center is managed by the cardiology department as an independent unit outside the hospital, though its primary partner is hospital C. The center has the capacity to cooperate with hospital C’s medical resources such as its emergency service and hospital C is available to provide a full range of clinical services if required.

COST STRUCTURE
The telecardiology center and the hospital share the same on-call schedule for the doctors to minimize costs. Further, because the distribution channel encompasses current OPD, IPD, and emergency department patients, there is no additional cost in finding new customers.

REVENUE MODEL
The model charges users directly and is not through the national health insurance system. The majority of hospital’s revenue comes from National Health Insurance (NHI) service. NHI’s payment is often criticized by hospital managers for not connecting to hospital’s running cost. Without the intervention of NHI, the price could be decided by management cost and appropriate profit margin, thus increasing the possibility of breaking even. Moreover, users are charged for the service and not for the device, such that the absence of burden from the usage of the device raises the willingness to subscribe to the service.

DYNAMIC LOOPS OF THE TELECARDIOLOGY BUSINESS MODEL
Dynamic loops are based on the Osterwalder and Pigneur’s description of business model elements, whereas the elements are taken as the choices in the dynamic loops method presented by Casadesus-Masane and Ricart. The choices lead to certain consequences, and the consequences may lead to further consequential interactions. Table 1 explains why these choices potentially lead to their consequences. The interrelationships form a diagram that expresses the working of the business model.

FINANCIAL OUTCOMES
The telecardiology service of hospital C began operation in November 2006. The total annual deficit of 2007 was 3,590,000 NT (New Taiwan Dollar) or 290,000 NT per month.

The costs of using the device and the communications were calculated as variable costs, whereas the cost of nursing staff and on-call duty doctors are counted as fixed costs. The revenue of the service is largely based on the service subscription fee. As of 2007, there were 13.4 patient encounters a month paying for the service. Cost–volume–profit analysis using the figures for 2007 determined that the break-even point was 85 patient encounters a month. If we assume that the service has a growth rate of 60% every year, the service will reach the break-even point in the fifth year. Table 2 shows the relationship between the telecardiology service growth rate and corresponding break-even points.
<table>
<thead>
<tr>
<th>ELEMENTS OF THE BUSINESS MODEL</th>
<th>CHOICES</th>
<th>THEORIES/LOGIC</th>
<th>CONSEQUENCES</th>
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<tbody>
<tr>
<td><strong>Value proposition</strong></td>
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<tr>
<td>Emergency mechanism</td>
<td>Intervention at first timing could prevent patients’ condition from getting worse</td>
<td>Quality of care improved</td>
<td></td>
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<tr>
<td>Real-time EKG transfer</td>
<td>Real-time EKG transfer can detect abnormal data, which is not easy to find by using a usual Holter machine; hence, diagnosis process time shortened</td>
<td>Efficient examination and diagnosis process</td>
<td></td>
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<tr>
<td>Managed by cardiology department</td>
<td>Telecardiology helps improve the integrity of existing cardiology and cardiovascular surgery services</td>
<td>Telecare strengthens clinical services</td>
<td></td>
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<tr>
<td><strong>Customer relationship</strong></td>
<td></td>
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<tr>
<td>24/7/365 call service provided by experienced nurses</td>
<td>Patients may contact professional staff at any time</td>
<td>Quality of care improved</td>
<td></td>
</tr>
<tr>
<td>Managed by cardiology department</td>
<td>Telecardiology helps improve the integrity of existing cardiology and cardiovascular surgery services</td>
<td>Telecare strengthens clinical services</td>
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<tr>
<td><strong>Target customer</strong></td>
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<tr>
<td>Focus on acute instead of chronic diseases</td>
<td>Patients with acute illness have more awareness of their health</td>
<td>High willingness to pay</td>
<td></td>
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<tr>
<td>Current OPD/IPD patients as telecare customer base</td>
<td>Database of existing patients promoted. No new customers need to be found</td>
<td>Low cost in finding new customers</td>
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<tr>
<td><strong>Channels</strong></td>
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<tr>
<td>Current OPD/IPD patients as telecare customer base</td>
<td>Database of existing patients promoted. Patients will find the clinical service more complete</td>
<td>Telecare strengthens clinical service</td>
<td></td>
</tr>
<tr>
<td>Attract new patients via service innovation</td>
<td>Telecare could expand the existing market of the hospital</td>
<td>Market expanded (market share increased)</td>
<td></td>
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<tr>
<td><strong>Real-time EKG transfer</strong></td>
<td></td>
<td></td>
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<tr>
<td>Using mobile phone/home phone as transfer media</td>
<td>The easy-to-use device increases the success rate of data transfer</td>
<td>High success rate of transfer</td>
<td></td>
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<tr>
<td>Center and hospital share same stand-by schedule</td>
<td>Same medical team as the hospital, no extra on-call doctors needed</td>
<td>Low cost of doctors’ stand-by service</td>
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Table 1. The Logic of Choices and Consequences of the Telecardiology Business Model Using Osterwalder and Pigneur’s8 Business Model Ontology Elements and Casadesus-Masanell and Ricart’s9 Dynamic Loops Method

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Table 1. The Logic of Choices and Consequences of the Telecardiology Business Model Using Osterwalder and Pigneur’s Business Model Ontology Elements and Casadesus-Masanell and Ricart’s Dynamic Loops Method continued

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<th>THEORIES/LOGIC</th>
<th>CONSEQUENCES</th>
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<tr>
<td>Capability</td>
<td>The application of core competence–new service</td>
<td>Telecardiology is the new application of hospital C’s core competence and enhances its competitive advantage.</td>
<td>Core competence advantage strengthened</td>
</tr>
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<td>Partnership</td>
<td>Hospital provides full clinical support</td>
<td>Hospital C provides a full range of clinical services if the center needs</td>
<td>Quality of care improved</td>
</tr>
<tr>
<td>Cost structure</td>
<td>Center and hospital share same stand-by schedule</td>
<td>The telecardiology center and the hospital adopt the same on-call schedule for doctors to reduce costs</td>
<td>Low cost of doctors’ stand-by service</td>
</tr>
<tr>
<td></td>
<td>Current OPD/IPD patients as telecare customer base</td>
<td>The existing patients are the customer database. No need to find new customers</td>
<td>Low cost of finding new customers</td>
</tr>
<tr>
<td>Revenue model</td>
<td>Charge directly from customers</td>
<td>Charge directly from the patient. No national health insurance intervention. The price is decided by the center</td>
<td>Reasonable price determined by hospital</td>
</tr>
<tr>
<td></td>
<td>Charge for services, not devices</td>
<td>Avoidance of the device cost lowers the threshold to subscribe to the service</td>
<td>High willingness to pay</td>
</tr>
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EKG, electrocardiography; OPD, outpatient department; IPD, inpatient department.

Fig. 2. Analysis of telecardiology business model of vis-à-vis Casadesus-Masanell and Ricart’s model. Underlined: choice; Boxed: rigid consequence; Plain text: flexible consequence.
Bretani\(^{17}\) pointed out that the development and design of new services has a trial-and-error characteristic. Problems encountered in the market must be fixed before the business model becomes successful. This business case model highlights options for alterations, for achieving a financial balance.

**Discussion**

**USER-CENTERED DESIGN FOR DEVICE**

From a healthcare provider point of view, new technology must be elderly user-friendly because the elderly constitute a large proportion of telecare users. Therefore, a good telecardiology business model should adopt a policy to use only elderly friendly devices—the only way to make new technology quickly and widely accepted by the users. The business model will probably only be successful when the majority of the users feel that the device is easy to use and the device has a high acceptance rate.

One of the characteristics of cardiac disease is that the patient might have an acute event or symptoms at any time but become completely normal in the presence of a doctor while having an EKG. Therefore, the selection of a device is crucial to the business model design. A device that can record EKG signals anytime anywhere and transfer the data back to the telecardiology center without delay actually helps doctor diagnose and save lives before fatal events occur. Unlike a lot of telecare programs that use the Internet to transfer data, this model differentiates itself by using phone lines and mobile phones as the data transfer medias. The main benefit for the predominantly elderly population of patients who use this system is its simplicity and avoidance of the unfamiliar complexities of the Internet. Only the basic functions of dialing and receiving of telephone calls are required—3G, Bluetooth, or other new technological applications are not necessary. Thus, the purpose of the device policy is clearly to reduce the complexity of use and build a user-friendly environment.

**CORE COMPETENCE ENHANCED THROUGH APPLICATION**

Prahalad and Hamel\(^{16}\) argued that core competence does not diminish with use; on the contrary, core competence will be enhanced with application and sharing. They also pointed out that to maintain leadership in a company’s core competence, the market of the core product needs to be expanded. In hospital C’s case, the telecardiology service may be regarded as the new application of the core competence because telecardiology is an extension of the cardiology and cardiovascular surgery service. Further, a sustainable telecardiology service not only assists in keeping hospital C’s leadership status in cardiovascular medicine but also extends its market share.

**TELECARDIOLOGY EXTENDS MEDICAL GEOGRAPHY**

Cutchin\(^{15}\) pointed out that the development of telemedicine changes the geography of medicine, whereby a new virtual medical geography will be constructed with the implementation of tele-

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The purpose of this table is to show the possibility to break even. The values in bold indicate the possible year. The service in the first year served 13 person-times a month on average. It means that there were 13 persons every month who subscribed to the service for the whole month. If the service has a growth rate of 20% per year, the break-even point will be in the 12th year. If the growth rate is 60% per year, it could be achieved in the fifth year.
medicine. Based on this theory, telecardiology could extend the boundary of a single hospital and open new market opportunities.

CLINICAL CARE QUALITY IMPROVEMENT IS THE KEY TO THE SUCCESS OF TELECARDIOLOGY

The dynamic loops analysis method by Casadesus-Masanell and Ricart reveals that policies such as the emergency procedures, 24/7/365 service and hospital support, lead to improvement in the quality of clinical care. The improvement may lead to a better reputation for the hospital, and a better reputation may induce patients to pay for the service, forming a virtuous cycle.

The options in value proposition and customer relationship in hospital C case are based on the improvement of the quality of care patients receive. Thus, they include providing the emergency procedures, 24/7/365 service, and the EKG device that can transfer data for immediate use by clinicians. The integration of the cardioclinic into existing clinical care processes is aimed by all policies to enhance value and relationships. When the care quality improves, patients will feel that the service is reliable and continue to subscribe to it.

Conclusions

The industry must look at how telecare can integrate best with existing medical services to improve the quality of medical care and optimize positive synergies for all parties involved. This study demonstrates how telecare development can focus more on the application of the business model to achieve this outcome. One of the central findings of this article is that the telecardiology service described continues to succeed because of the mutual benefits it offers for providers and users. A telecare service is meaningful to the general public only when the business model is sustainable.

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