Exploring Service Innovation Mechanisms of Health Cloud Service: A Perspective of Activity Theory

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***Abstract*-This study is a case study of Show-Chwan hospital of Taiwan. Based on a perspective of activity theory, this study develops an innovation model of health cloud services (HCS) and explores the evolution of the model. This study collected the related secondary data of the case between 1995 and 2012andin-depth interviews. The findings are: 1)Epidemic prevention mechanism is a primary development mechanism of health cloud activity; 2) Electronic medical record management is a core mechanism to promote health cloud activity; 3) Personal health management is a business mechanism of health cloud activity; 4) Privacy protection mechanism is a critical issue of health cloud activity, however, it hinders the development of health cloud activity.**

Keywords- service innovation; activity theory; health cloud service; Show-Chwanhospital.

I. INTRODUCTION

The definition of aging society in the United Nations refers to people aged 65 and above accounted for 7 per cent of the country's total population. Elderly population in Taiwan has more than 10% of total population. Besides, medical marketing in mainland China has over 3 hundred billion yuan per year. In report of the results of Statistics Bureau of China, the number of people in mainland China aged over 65 will rise to 800 million every year. Furthermore, Japan has been paid into the Tele-Medical project, which is the application of policies to promote the medical field including remote care and Tele-Medical applications. Through ICT, cloud services make enterprises rapidly develop new services and spread the services. The partners may become collaborative relationship by professional sharing and activating. Health cloud service (HCS) provided the other choice.

Remote, simplification and virtualization become the development trend of information software [1]. Through ICT, cloud services make enterprises rapidly develop new services and spread the services. Thus HCS become a potentially huge market. However, there were few studies concerning service innovation issues of health cloud service. Past studies related to the issues of cloud service, mainly focused on technology development and competitiveness of firms(*e.g.,*[2]; [3]; [4]; [5]), cloud service business model (*e.g.,*[6]; [7];[8]; [9]), security and privacy (*e.g.,*[10]; [11]) and cloud service application (*e.g.,*[12]; [13]).

Knowing how to get the best out of the medical service and gaining access to healthcare facilities, particularly gaining information about illness are directly related to socio-economic status[14]. Monitoring the outcomes of treatment and quantifying patients' functional status have assumed a prominent role in quality assurance programs [15].

This study based on activity theory perspective aims to explore innovation mechanism of HCS.

II. LITERATURE REVIEW

A. Service Innovation

Service innovation is the introduction of a new service product or an improvement of existing service products[16]. This includes all innovations involving changes in the characteristics of service products and in design of service. Service delivery innovation involves new or altered ways of delivering services to clients[17]. This requires ability on

the part of service providers to identify and exploit heterogeneity in consumer demand. Opening a new market may depend on their being an unfulfilled consumer preference[18].As the service sector continues to grow, technologies change and user needs are shifting. Continuous innovation efforts therefore become an imperative for incumbent service providers to reduce costs, to enhance existing service quality, and to expand current service offerings to increase market share in existing markets or to enter new ones[19].As mentioned above, the service innovation research literature mainly focuses on market demand, service design and development, service model design and government service policy.

B. Activity Theory

Activity theory is a development-psychological theory of human development whose principles combine learning and tool mediation as inseparable components of any conscious human activity and skill development. It offers a cogent set of postulates on an approach to human development based on the cultural-historical, social psychological physiological implications of human activities [20], which is always conceived in terms of activity as a system of relations [21]. The Activity Triangle Model or activity system representationally outlines the various components of an activity system into a unified whole. Participants in an activity are portrayed as subjects interacting with objects to achieve desired outcomes [22].A new objective tool that allows new objective conditions will lead to the construction of a new awareness, leading to a redefinition of the object[23]. Engeström[24] describes Activity theory as providing a worthy unit of analysis for enabling a theoretical account of the constitutive elements of an object oriented, collective, and culturally mediated activity system in all its complex interactions and relationships. The minimum elements of this system activity theory include the object, subject, tools, rules, community, and division of labor, shown as figure 1..

Subject

A subject is working toward an object can influence their social relations, objects of action, and artifacts and so may also affect their own capacities for action. Subjects exercise agency individually or jointly, although the extent and form of agency are culturally and historically specific and can vary by social position. Thus subjects neither exist outside social structures nor are completely constrained by them. The paradox of agency lies in the understanding that subjects can also be instruments or objects of other subjects [45]and that the social and cultural practices of subjects reproduce existing social structures [35].

Object

In this model, the object of an activity system is the purpose behind the activity, which evolves during the course of activity. The concept of object is predicated on the dialectical relationship between a person's motive(s) and the object as an "objective" on which the person is acting. The object guides or directs individual actions, connects actions to collective activity, and culminates in outcomes, both desired and unintended. As they project onto outcomes, objects of activity systems serve as the motive for activities while providing broad meanings for people's actions([24];[35]).

Tools

Relationships between subjects and objects are enabled by the use of mediating artifacts, or tools, which connect subjects to others and to their contexts, thus mediating social interaction, communication, action, and, ultimately, activity. Artifacts can be broadly considered both as tools that are learned and used in activity and as products of activity. Artifacts are both material and symbolic. Material artifacts include physical instruments that subjects employ in an activity. Symbolic artifacts include nonmaterial tools such as language, gesture, number systems, and images; and like their material counterparts, symbolic artifacts both constrain and afford action. Artifacts, both material and symbolic, shape human activity and allow human beings to shape activity [35].

Community

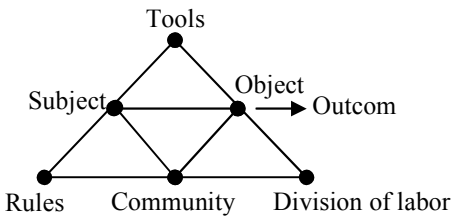
Object-subject-artifact relationships occur within communities. Wenger [44]defines communities in terms of their social and cultural practices, which are characterized by mutual engagement of members, a joint enterprise, and a shared repertoire of resources, language, and actions. These social and cultural practices can take the form of rules or divisions of labor. Through dynamic processes that involve participation and reification of practices and artifacts, communities are sustained over time and continually reenact ideologies and histories. Community provides the "social basis" of activity.

Rules

A community is characterized by shared sets of rules that emphasize certain objects and the use of particular artifacts. Rules, or schemas, are understood to be "virtually" in that they are actualized in a broad, indeterminable range of practices. They embody and reproduce the ideologies in the broader societal context. The communication and interaction among these individuals are mediated by rules. These rules may be formal and informal rules of communication bounded by the work arrangement itself and the structure and cultures of the work organization. These rules may vary between the different representing disciplines, and may be sources of conflicts [35].

Division of Labor

A community is also characterized by division of labor, which legitimates certain actions of subjects as they are positioned in coordinated relationships structurally united by a common object. Division of labor finds its conceptual and descriptive origins in the classical works of Adam Smith [46]and Emile Durkheim [47]. Division of labor requires the specialization of skills and knowledge among individuals in a community or organization as a way to increase economic efficiency and overall production [35].



Fiurg1. Activity theory midel

C. Health Cloud Service

Health cloud([25]; [26]; [27])provides electronic medical records for sharing and consulting service[26]. Social problems are worthy of paying attention. The policy obsession with need assessment has been prompted by a desire to reduce public expenditure, and this should not be detracted from the possibility of using need assessment, particularly that with community involvement, as a means of not only promoting good health but reducing inequalities in its distribution [28].Hospitals can be compared between practices and localities. Such data must be interpreted carefully, as demand and supply often have more influence on hospital usage than does need. Use of hospital service may not be a proxy for morbidity in the community [29]. Resolving social and environmental issues remains an important issue in the era of ever-increasing medical technology [30]. Routine data from general practices can highlight needs that are dealt with in primary care [31].The application of health cloud service goes to provide a new service [32]. Through the appropriate network monitoring users can access and use shared resources anytime, including self-service requirements [33].

III. METHOD

This study is an exploratory research. Show-Chwan hospital in Taiwan is selected as the subject. The method of data collection concerns secondary data from 1995 to 2012 in Digi-times database and in-depth interviews, official website of the case, related studies etc. Finally the study has collected 486 events of service innovations, where 188 events are related to health cloud service innovations. Each event is treated as an analysis unit. Furthermore, the study bases on the perspective of activity theory, consisting of object, subject, tools, rules, community, and division of labor. The data analysis strategies include pattern matching, explanation building, time series and program logic model [34].

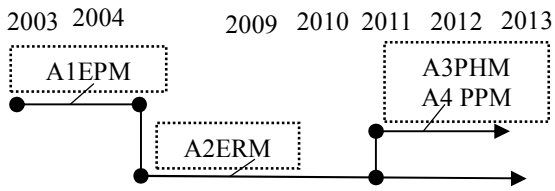
IV. RESULTS

The study collected health cloud service innovation events of Show-Chwan hospital between 1995 and 2012. The induced four mechanisms (TABLE 1) are shown as follows: [A1]EPM corrected 3 events (11.54%); [A2]ERM corrected 14 events (53.85%); [A3] PMH corrected 5 events (15.38%); [A4] PPM corrected 4 events (19.23%).

TABLE 1 EVENTS ANALYSIS OF SERVICE INNOVATION OF HCS

Service			Mechanism classifications	No.	%	Rank
HCS	A1	EPM.	Epidemic prevention mechanism	3	11.54%	4
	A2	ERM.	Electronic medical records management	14	53.83%	1
	A3	PHM.	Personal health management	4	15.38%	3
	A4	PPM.	Privacy protection mechanisms	5	19.23%	2
		Total		26	100%	

The purpose of the activity theory is to appropriately utilize resources and emphasize professional division of labor[48].Observing database and Figure 2,“A1 EPM” established between 2003 and 2004, SARS was the main factor. Object includes patients; Tools includes transfer technology application and automatic access of digital data; Rules includes prevention research plain; Community includes government and the medical community; Division of labor includes health management and preventive health care. Consequently this study derives the following findings:



Fiurg2. Mechanism Evolution Of Hcs

A. Finding 1:Epidemic Prevention Mechanism is a Primary development Mechanism of Health Cloud Activity.

This paper observes database, Figure 2, and the interviews,“A2ERM”service innovation. Object includes patients and peoples; Tools includes mobile devices, cloud services, application software, the frame of health care, medical information system, and medical electronic; Rules includes law of electronic signature, interoperability rules, and electronic medical record; Community includes government, remote care alliance, communications industry, information industry, manufacturing industry, and European Union; Division of labor includes physician IT create, health management, technology products development, database establish, and preventive health care. Consequently this study derives the following finding:

B. Finding 2: Electronic Medical Record Management is a Core Mechanism to Promote health Cloud Activity.

“A3PHM” service innovation. Object includes peoples; Tools includes physiological instrument, mobile devices, health application program, and store space; Rules includes preventive health records; Community includes information industry; Division of labor includes temples, charities, and government. Consequently this study derives the following finding:

C. Finding 3:Personal health management is a business mechanism of health cloud activity.

“A4 PPM” service innovation. It affects overall performance by expands of data volume. Object includes patients; Tools includes database and network equipment; Rules includes monitoring and tracing, certification of

international security and patient agreed; Community includes communications industry, and information industry; Division of labor includes database backups and hosting. Consequently this study derives the following finding:

D. Finding 4:Privacy Protection Mechanism is a Critical Issue of Health Cloud Activity, However, IT Hinders the Development of Health Cloud Activity.

V. CONCLUSIONS

This study is a case study of Show-Chwan hospital (SCH) of Taiwan. Base on activity theory model, the study develops an innovation model of HCS. Finally, according on the findings, the study proposes some managerial implications.

We found that epidemic prevention mechanism is a primary development mechanism of health cloud activity. The environment caused change of activities that these had a significant effect on activity and skill[36].Any active strategies caused interfere with other factor. Formulation of response strategies need to consider relationship of planning framework, target, and context [37].In Taiwan, IT industry growths complete, tools developing and providing to usage of community of vulnerable and elderly. Through designs of tools to grasp individual health management, intended to preventive health care. Community and division of labor cooperates may bring about competitive advantage[38]. Look for organization cooperates creating and sustaining superior performance objective to run the company with eternity. Employees be short of ethics when lack community sense of identity [39]. This study believes the privacy protection of perspective properly planning not yet of community and division of labor. Privacy protection mechanism becomes interfering mechanism of health cloud activity.

Secondly, we found that electronic medical record management is a core mechanism to promote health cloud activity. A medical record is the documentation of health history. Characteristic of cloud computing includes virtual infrastructure, flexibility, and network service subscription [1].They can make patients' medical history easily. Electronic medical records let you get the most information to help improve patient health condition. They help us to provide patients by making the fast medical care of critical health information. The government policy has promoting to adopt electronic medical records. The mainly of purpose is controlling about common pestilence and major diseases. As mentioned above, this research suggests if Show-Chwan hospital want reduce development costs, it can looking for a developers who can take a common software solution. The supplier integration into the database development process can be more fit of government rules in modular design.

In addition, we found that personal health management is a business mechanism of health cloud activity. Medical policy has always been the Government's fundamental philosophy. More disease generated more medical costs [40]. Government financial balance is important in terms of costs and quality of health care. Preventive medicine focuses on preventing diseases and promoting state of health by information data. Service supply chain is a system of activities, information, and resources supplier. Virtual Enterprises provides professional technology at support system. Activity Theory as providing a worthy unit of analysis for enabling a theoretical account of the constitutive elements of an object oriented, collective, and culturally mediated activity system in all its complex interactions and relationships [24]. Government through cross-sector partnerships can take more cluster effect expand industrial development to create business opportunities.

Finally, we found that privacy protection mechanism is a critical issue of health cloud activity, however, it hinders the development of health cloud activity. The National Health Insurance (NHI) is the full database of Taiwan's healthcare system. NHI in Taiwan grows complete can providing to hospital, clinic, and individual, fix policy of national medical science and health science [41].Cloud comp ting's facilities expensive and consume. It is important that how to use limited resources. This research believes the planning of economize are transmission capacity and storage space. Information transmission between doctor and patient includes medical image and data through network. Nursing staff affect the patient's hospice [42]. People need more health care knowledge. Create a good environment is corporate responsibilities, A good work environment can enhance efficiency. Cloud computing provides the facility to share resources and common infrastructure [43]. Cloud computing lets you use files and applications over the Internet. It is a tool for anything that providing hosted services. However, speed as the key, industrial upgrading is essential.

Past studies related to the issues of cloud service, mainly focused on technology development and competitiveness of firms, cloud service business model, security and privacy, and cloud service application, there were few studies concerning service innovation issues of health cloud service. This paper exploring service innovation mechanisms comprehensive with health cloud service based on activity theory. The future research suggest that communicate industry combines, propose a better health cloud service innovation model.

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