

New service design of medical cloud service: A perspective of Activity Theory

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Abstract. This study explores the new service design (NSD) of medical cloud service (MCS) based on the perspective of activity theory. The activity theory consists of six elements concerning object, tool, subject, rule, community, and division of labor. This study adopts the method of case study. The secondary data of the case originally has 2,322 events about service innovation; however, only 109 events are directly related to NSD projects through analyzing the collected data. Based on semantic analysis, content analysis and in-depth interviews, this study obtains the following findings: There are 32 NSD models existing in MCS innovation, where the community plays key driver role and objective is the least. MCS is provided with master-slave NSD model and slave model is driven by community. In addition, the collaboration and quality control between subject and community can be contributory to NSD performance.

Introduction

Through information communication technology, cloud service makes business to develop new service and spread service. Medical cloud service (MCS) was a potentially huge market. In report of the results of Statistics Bureau of China, sixty-five years old will have been to reach 800 million grow up every year in China. In Taiwan, elderly population was more than 10% of total population. The United Nations defines that the aging society in refers to people aged sixty-five years old, and above accounted for 7 percent of the country's total population. Besides, medical service market was over three hundred billion RMB per year in China. Through ICT, community may become collaborative relationship by professional sharing and activating. MCS provides how to get the best choice, the information about illness will be directly relating to socio-economic [1]. However, the literation about MCS focus on quality of medical and care (e.g., [2]; [3]; [4]), patient privacy protection (e.g., [5]; [6]), customization medical (e.g., [7]), medical information system designs (e.g., [8]), and medical data analysis (e.g., [9]) on before. There are few exploring topic about resource of service design activity, and development performance. This study explores MCS service design model based on a perspective of activity theory, finally this study obtains the business strategy management implications.

Literature Review

New service design

A new service design is the introduction of service innovation of existing services [10]. A new service product been implement consists of a characteristic change or quality improve by new service design [11]. 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 [12]. As the service sector continues to grow up, 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 existing market [13].

As mentioned above, the new service designs research literature mainly focuses on market demand, service development, and service model design. There are few exploring topic about new service design activity system.

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 [14], which is always conceived in terms of activity as a system of relations [15]. 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 [16]. 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 [17]. Engeström [18] 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 object, subject, tools, rules, community, and division of labor.

Medical cloud service

MCS provides electronic medical records to share and consult service. 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 [19]. 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 by community [20]. Resolving social and environmental issues remains an important issue in the era of ever-increasing medical technology [21]. Routine data from general practices can highlight needs that are dealt with in primary care [22]. The application of MCS goes to provide a new service design [23]. Through the appropriate network monitoring users can access and use shared resources anytime, including self-service requirements [24]. It is important about new service design for MCS, this study explores NSD based on activity theory.

Method

This study is an exploratory research. A hospital in Taiwan is selected as the subject. Based on activity theory, this paper analyzes secondly data of MCS events of hospital of case aims to explore NSD. The method of data collection concerns to construct secondary database from 1973-2013 years in Digtimes database, in-depth interviews, official website of the case, and related studies etc. Finally the study has collected secondary data of the case originally has 2,322 service innovation events; However, only 109 events are directly related to service innovation projects through combining the collected data from 181 MCS innovation events. Furthermore, the study bases on the framework of activity theory consisting of object, subject, tools, rules, community, and division of labor to analyze the collected data, and this study defines that MCS platform have three main activity system include health cloud, care cloud, and medical cloud in MCS platform. The data analysis strategies include pattern matching and explanation building [25].

Results

Activity theory regards between activity elements as a system relationship ([15]; [26]). It provides analysis model between fields by special professional ([27]; [28]). There elements construct mutual-system on interconnection relationship. According to this paper, takes relationship of six elements

through semantic analysis based on service innovation activity event organized into MCS new service model. The result indicates medical cloud (49.54%) is the most, followed by the health cloud (31.19%), and care cloud (19.27%) is the least in three main activity systems. The lowest the care cloud than both medical and health cloud. Government should more pour resource will be a construct of care cloud [29]. It indicates the innovation activity of medical cloud service innovation had consistent results with trend market in this paper that is sample provided with typically.

This paper deploys driven model of MCS six elements into Table1. The table1 indicates MCS driven model list based on a perspective of activity theory. This study defines that the driven means service innovation promoter in current market includes subject (26.6%), object (1.8%), tools (9.2%), rules (4.6%), community (45.0%), and subject-community (12.8%), and the community percentage is most, followed by the object, and the subject is least in MCS three main service system, division of labor was not exists driven model. Moreover, the statistic result indicates community (50.0%) is the most, followed by the object (26.5%) in three main activity system, and care cloud as same as medical cloud driven ranks of count.

Overview of above can observed regardless the number count of activity or model. In three main activity systems, the highest the community, followed by the subject, and the lowest the object. This phenomenon illustrating in fact the broad community included policy and industry promote mainly driven of medical cloud service innovation activity at present.

Table1 MCS driven model list (A perspective of activity theory)

Activity theory driven elements	MCS platform		Health cloud			Care cloud			Medical cloud		
	count	%	count	%	Model count	count	%	Model count	count	%	Model count
Subject	29	26.6	9	26.5	5	4	19.0	3	16	29.6	5
Object	2	1.8	1	2.9	1	1	4.8	1	0	0.0	0
Tools	10	9.2	4	11.8	3	2	9.5	1	4	7.4	1
Rules	5	4.6	2	5.9	2	2	9.5	1	1	1.9	1
Community	49	45.0	17	50.0	8	8	38.2	5	24	44.4	6
Division of labor	0	0.0	0	0.0	0	0	0.0	0	0	0.0	0
Subject-Community	14	12.8	1	2.9	1	4	19.0	4	9	16.7	9
Total count	109	100%	34	100%	20	21	100%	15	54	100%	22

Next, deploys the MCS innovation driven system into table2, the table2 indicates organization list of innovation driven system include subject-community (N1-N8), subject (N9-N17), and community (N18-N32) in MCS. It indicates MCS innovation system have master-slave structure, this study defines that master driven means the subject was main driven. Slave driven means subject has been promote by community. MCS have two innovating driven model, the one of subject driven includes N9-N17 (26.6%) nine models. It prompts service innovation model in progress of master driven service innovation activity; the other one, community driven include N18-N32 (44.9%) fifty models. Through in-depth interviews, the community is master structure in new service design activity, and subject is slave structure.

Observes table1, division of labor has been driven by other activity elements a collaboration mechanism coordinator between subject and community (Table2, N1-N8 percentage 12.8% of Subject-Community driven model); In addition, this study defines that division of labor means division of work based on professional and capability. Through in-depth interviews, the collaboration and quality control by subject and community can be contributory to service innovation performance.

Table2 Table2 The MCS driven model

Driven model	Model count	MCS platform count(%)	Health cloud count(%)	Care cloud count(%)	Medical cloud count(%)
Subject-Community(N1-N8)	8	14(12.8%)	1(02.9%)	4(19.0%)	9(16.7%)
Subject(N9-N17)	9	29(26.6%)	9(26.5%)	4(19.0%)	16(29.6%)
Community(N18-N32)	15	49(44.9%)	17(50.0%)	8(42.9%)	24(44.4%)
Total count	24	92(84.3%)	27(79.4%)	16(80.9%)	49(90.7%)

Conclusions

MCS innovation activity driven consists of six elements. By understands activity theory structure can to redirect new target [30]. The study finds other driven elements total percentage reach up to 98.2% excluded object, and object have only 1.8%, it indicates service design not as fit as target. Division of labor element have the improvement factor of procedure and quality, it combined activity system of community cause to affect subject. This suggests that medical institution should looking for collaborates with community to join MCS market for take resource. In addition, Government should be going to arrange policy management about industry policy and medical science [31], and conducts MCS industry development. The NSD of business have been affect by Specification factor, Market orientation, Demand orientation, and Government policy [32]. MCS is provided with master-slave innovation model. By new technology develops, community have be collaborated more recently, and division of labor have professional ability, and will to present complicating activity model development. It's important that subject can to promote service innovation, not only medical specialty but also service manager are significant. The purpose are taking professional resources, ensure quality, internal - external control, and improve processes, not only can lead MCS design by subject self, but also have community audit mechanism. The collaboration and quality control by subject and community can be contributory to service design performance.

The study theoretical contributions: The firstly, before, medical research focus on medical treatment, health care ([2]; [3]), and living care [33]. Secondly, the new service design literation focus on service model design [34], reconstruction, and improvement of service procedure [35]. This study is going to MCS new service design based on six elements of activity theory, comprehensive explores the important factor of new service design. Because the hospital of case develops evolution complete, which is established on 1973 year, and It is a regional teaching hospital in Taiwan, can coverage for activity theory each element had consistency and typical in current market.

References

- [1] Samir, T., & William, S, Cloud Computing and its Security in Higher Education, Proc ISECON, 26 (Washington DC): 2314 (refereed), 2009, p.5.
- [2] Lundsgaard, J, Choice and Long-Term Care in OECD Countries: Care Outcomes, Employment and Fiscal Sustainability, European Societies, 8(3), 2006, pp. 361-383.
- [3] Grootegoed, E., Knijn, T., and Roit, B, Relatives as paid care-givers: how family carers experience payments for care, Ageing and Society, 30(3), 2010, pp. 467-489.
- [4] Sonehara, N, Cloud Computing in Japan: The Role of the Japaness Government, Business & Information Systems Engineering, 3(3), 2011, pp. 179-181.
- [5] Dembe, A. E., and Himmelstein, J. S, Contract provisions to ensure quality in workers' compensation managed care arrangements, Journal of Insurance Regulation, 17(3), 1999, pp. 289-326.
- [6] Parker, J. S, Lost in the cloud: protecting end-user privacy in federal cloud computing contracts, Public Contract Law Journal, 41(2), 2012, pp. 385-409.
- [7] Califf, R. M, Defining the balance of risk and benefit in the era of genomics and proteomics, Health Affairs, 23(1), 2004, pp. 77-87.
- [8] Adler, P. S, The Evolving Object of Software Development, Organization, 12(3), 2005, pp. 401-435.
- [9] Zhivan, N. A. and Diana, M. L, U.S. hospital efficiency and adoption of health information technology, Health Care Management Science, 15(1), 2012, pp. 37-47.
- [10] Djellal, F., & Gallouj, F, Innovation in services and entrepreneurship: beyond industrialist and technologist concept of sustainable development, New horizons for the role and production of services, 2008, 9.

- [11] Schumpeter, J. A, Business cycles: a theoretical, historical and statistical analysis of the capitalist process. Porcupine Press, Philadelphia, 1989.
- [12] Jacobides, M. G. & Winter, S. G, The co-evolution of capabilities and transaction costs: Explaining the institutional structure of production. *Strategic Management Journal*, 26(5), 2005, 395-413.
- [13] Tether, B. S, The sources and aims of innovation in services: Variety between and within sectors, *Economics of Innovation and New Technology*, 12(6), 2003, 481-505.
- [14] Wiredu, G. O, "Mobile computing in work-integrated learning: problem of remotely distributed activities and technology use," department of information systems, the London school of economics and political science university of London, UK, 2005, p. 140.
- [15] Leont'ev, A. N, Activity, consciousness and personality, Englewood Cliffs, CA: Prentice Hall, 1978.
- [16] Attwell, G. & Elferink, R, "Developing an Architecture of Participation, Author manuscript," published in "Conference ICL2007, Villach : Austria, 2007, pp.1-14.
- [17] Kaechele, M, "Teacher and Technology: The Computer In Education," *Interactive Educational Multimedia*, Number 13, 2006, pp. 37-58.
- [18] Engeström, Y, "Activity theory and individual and social transformation', in Y Engeström, R Miettinen," & R-L Punamäki (Eds), perspectives on activity theory, Cambridge University Press, Cambridge, 1999, pp. 1-16.
- [19] Robinson J, Elkan R: Health needs assessment, theory and practice. New York, Churchill Livingstone, 1996.
- [20] Harley, K., & Jones, C. Quality of Scottish morbidity record (SMR) data. *Health Bull* 1996, 54: 410-417.
- [21] Hawe P: Needs assessment must become more change-focused. *Aust N Z J Public Health* 1996, 20:473-478.
- [22] Wilkinson JR, Murray SA: Health needs assessment - Assessment in primary care: practical issues and possible approaches. *BMJ* 1998, 316:1524-1528.
- [23] Chen, Cloud strategy, Commonwealth magazine publishing Co., Ltd., Taipei of Taiwan, 2010,
- [24] Mell, P., & Grance, T, Draft NIST Working Definition of Cloud Computing, 2009.
- [25] Yin, R.K, Case Study Research: Design and Methods. (3rd Edition), California: Sage Publications, 2003.
- [26] Frans, P, A theory of organizing informed by activity theory: The locus of paradox, sources of change, and challenge to management, *Journal of Organizational Change Management*, 19(4), 2006, pp. 471-490.
- [27] Hasu, M, Constructing clinical use: An activity-theoretical perspective on implementing new technology, *Technology Analysis & Strategic Management*, 12(3), 2000, pp. 369-382.
- [28] Tenkasi, R. V., & Hay, G. W, Actionable Knowledge and Scholar-Practitioners: A Process Model of Theory-Practice Linkages, *Systemic Practice and Action Research*, 17(3), 2004, pp. 177-206.
- [29] Hsu, C. H. Care cloud construct in cloud age and medical cloud care platform, <http://www.ectimes.org.tw/Shownews.aspx?id=110731232821>, 2013.
- [30] Schulz, K. P., & Geithner, S, Individual and Organizational Development as Interplay: An Activity Oriented Approach, *Zeitschrift für Personalforschung*, 24(2), 2010, pp. 130-151.
- [31] Klimoski, R, Introduction: Physician Heal Thyself, *Academy of Management Learning & Education*, 6(1), 2007, 81-83.

- [32] Chang, Y. C., Shih, C. T., Chien, W. C., & Su, C. H, National R&D Program Evaluation and Policy Management: The Perspective of R&D Internalization, *Journal of Management & Systems*, 16(1), 2009, pp. 25-52.
- [33] Rubenfeld, G. D, Using computerized medical databases to measure and to improve the quality of intensive care , *Journal of Critical Care*, 19(4), 2004, pp. 248-256.
- [34] Paswan, A., D'Souza, D., & Zolfagharian, M. A, Toward a Contextually Anchored Service Innovation Typology, *Decision Sciences*, 40(3), 2009, pp. 513-540.
- [35] Song, L. Z., Song, M. D., & Benedetto, C, A Staged Service Innovation Model, *Decision Sciences*, 40(3), 2009, pp. 571-599.