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Exploring Innovation Model and Evolution of Cloud Services: Case Study of Chunghwa Telecom

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Introduction

Under the context of cloud services, users can process and store their data in remote servers. In addition, service providers can quickly upgrade and renew their services to respond market changes. New service development is achieved through integration of different organizations, company relations and advantages to create value for customers (Maull, Geraldi, and Johnston 2012). This process includes automated storage, processing and exchange, as well as the digital redesign process within companies (Hitt, Keats, and DeMarie 1998). However, the previous literature about cloud services focused on technology development and business competitiveness (e.g., Buyya et al. 2009; Rosenthal et al. 2010), cloud business model (e.g., David 2009; Kloch, Petersen, and Madsen (2011); Marston et al. 2011; Sultan 2010), security and private protect (Çokpınar and Gündem 2012), and cloud service application (e.g., Rimal et al. 2011; Streitberger and Eymann 2009). There were few studies concentrating cloud service innovation. A service supply chain is defined as a network of suppliers, distributors, business service providers (BSP) and customers linked together by the internet and other electronic media to create value (Cui and Hertz 2011). These relationships achieve superior business operations compared with competition. The value-added process is intangible because supply chains in the virtual market use information systems for processing. Therefore, the perspective of service supply chains provides a better understanding of cloud services. This study aims to explore the types and distribution of cloud service innovation based on the perspective of service supply chain. Moreover, this study analyzes the development of cloud service innovation in the telecommunications industry, so as to understand the development trend of cloud service and further propose managerial implications.

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Research Method

This study is a case study of Chunghwa Telecom. There are three reasons for selecting Chunghwa Telecom. First, Chunghwa Telecom has been in numerous case studies in international academic journals, international commercial journals, and international news research and reports. Second, Chunghwa Telecom is a leader in Taiwan's cloud service industry. Third, Chunghwa Telecom jointly developed cloud services with over a hundred companies well-known to the international society.

Based on a perspective of service supply chain consisting of three roles as supplier, service designer and service provider, this study develops an innovation model of cloud services and explores the evolution of the model. Through collecting the relevant secondary data of the case from 2001 to 2011 and in-depth interviews, this study has collected 1,761 events of service innovation. Each event is treated as an analysis unit. The data analysis is through pattern matching, explanation building, time-series analysis and program logic model (Yin 2003). This study analyzes the content of service innovation events from the perspective of interactions among members of service supply chain, and bases on the five dimensions of cloud services to construct a cloud service innovation model. Time-series analysis is then performed for the three stages, so as to understand the development of service innovation in the cloud service industry.

The service innovation model is defined as the model for cloud service innovation in the five dimensions of cloud services provided through collaboration within service supply chain. The analytical framework, shown in Figure 1, bases on the definition, where SaaS is Software as a Service, IaaS is Infrastructure as a Service, PaaS is Platform as a Service, DaaS is Data as a Service, and CaaS is Communication as a Service. For example, "suppliers" of SaaS are defined as purchases made by Chunghwa Telecom or SaaS (excluding service design) established in cooperation with suppliers. "Service designers" have three feedback sources: (1) Service reengineering adopted by Chunghwa Telecom in response to changes in market demand; (2) Cooperation and service reengineering process adopted by suppliers to comply with services provided by Chunghwa Telecom; (3) Customized design based on customer feedback. Chunghwa Telecom is a cloud service provider, providing customers with diverse services. The paths in

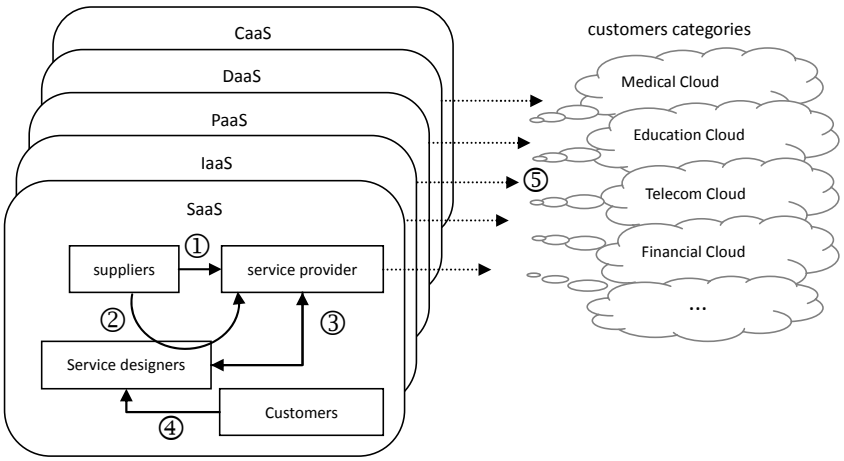

Figure 1 Analytical framework of cloud service supply chain

Figure 1 are further explained below. Path ①: Suppliers indirectly provide services to customers through Chunghwa Telecom. Path ②: Services of suppliers enter the service design process and are indirectly provided to customers via Chunghwa Telecom after service reengineering. Path ③: Services received by Chunghwa Telecom enter the service design process and are provided to customers after service reengineering. Path ④: New services are developed from the service design process based on customers' demand, and are indirectly provided to customers by Chunghwa Telecom. Path ⑤: Chunghwa Telecom integrates services from suppliers, service designers, and self-developed services, and then provides the services to customers (include path④).

In order to explore the development process, this study bases on important turning points of Chunghwa Telecom and major international events at the time. This study further divides the company's history into three stages:

1. Capitalization stage: Chunghwa Telecom was listed in Taiwan Stock Exchange in October 2000, and its business operations shifted towards smart network services (Kang 2009).

2. Privatization stage: "Mobile Taiwan" was launched in 2005 and government holdings of Chunghwa Telecom dropped to under 50% in August the same year. Chunghwa Telecom thus transformed from a state-owned enterprise into a private enterprise, increasing the flexibility of its decision-making (Hwang, Huang, and Wang 2007).

3. Open Cloud Manifesto stage: Chunghwa Telecom and a hundred multinational enterprises jointly announced the "Open Cloud Manifesto" in March 2009 to bring more communities into the development of cloud services. Chunghwa Telecom launched its cloud projects at the same time and directed its efforts into developing cloud services (Yang and Hsu 2011).

Based on the principle of "using multiple sources of evidence" proposed by Yin (2003), this study constructs a database of Chunghwa Telecom's cloud service innovation. There are four sources of data: 1. Secondary data of Chunghwa Telecom; 2. Open data reported by related government organizations; 3. The Institute for Information Industry's MIC AISP e-newsletter, and news reports of TWNIC and DigiTimes form the preliminary database of this study. The database of cloud service innovation events of Chunghwa Telecom contained 1,761 events. In addition, the fourth sources of data are expert interviews. The interviews were carried out in two stages concerning five interviews in the first stage and eight interviews in the second stage.

Results and Discussions

This study summarizes and screens secondary data related to cloud service innovation in 2001-2011, and supports the data with in-depth interviews. First, semantic analysis is performed on the 1,761 service innovation events. Results are obtained using content analysis, and statistics are displayed according to supplier, service designer, and service provider. The statistics by innovation categories and subcategories are shown in Table 1. Moreover, for the time-series analysis, the results are shown in Table 2 and Figure 3. Table 2 and Figure 3 show the three-stage trend analysis of service innovation, where the "Frequency / % / Rank" is arranged based on calculations for each of the three members within service supply chain. The discussions for the results are described as follows.

The majority of service innovation events by suppliers in the service supply chain are (A1) Platform as a Service (PaaS) with 34.2% and (A2) Infrastructure as a Service (IaaS) with 33.3%, indicating that services supplied are mainly PaaS and IaaS. Table 1 shows that PaaS (C1) by providers accounted for 60.0%, far higher than PaaS (A1) by suppliers at 34.2% and PaaS (B1) by designers at 35.9%. This shows that PaaS is not only provided by suppliers, the general customers can also develop applications on the platform of service providers. Some studies also believe that service providers should jointly develop service innovations with customers and suppliers.

Table 1 Cloud service innovation classfication coding and frequency【2001-2011】

Categories	Frequency	%	Rank	Subcategories	Frequency	%	Rank
A Supplier							
A1 PaaS	138	34.2	1	A11 Portal Platform Supply (PPS)	5	1.2	13
				A12 Multimedia Platform Supply (MTPS)	57	14.2	2
				A13 Mobility Services Platform Supply (MSPS)	33	8.2	5
				A14 Application Service Platform Supply (ASPS)	43	10.7	4
A2 IaaS	134	33.3	2	A21 Host Facilities Supply (HFS)	19	4.7	6
				A22 Mobile Devices Supply (MDS)	104	25.8	1
				A23 Terminal Equipment Supply (TES)	7	1.7	12
				A24 Information Security Facilities Supply (ISFS)	2	0.5	14
				A25 Network Agent Construction Supply (NACS)	2	0.5	14
A3 SaaS	74	18.4	3	A31 Software Service Supply (SSS)	57	14.2	2
				A32 Information Security Software Supply (ISSS)	17	4.2	8
A4 CaaS	46	11.4	4	A41 Wired Communications Supply (WCS)	19	4.7	6
				A42 Wireless Communications Supply (WLCS)	16	4.0	9
				A43 New Communication Technologies Supply (NCTS)	11	2.7	10
A5 DaaS	11	2.7	5	A5 Database as a Service Supply (DSS)	11	2.7	10
	403	100.0			403	100.0	
B Service Designer							
B1 PaaS	186	35.9	1	B11 Portal Platform Design (PPD)	2	0.4	15
				B12 Multimedia Service Design (MTSD)	54	10.4	6
				B13 Mobile Service Design (MSD)	58	11.2	4
				B14 Application Services Design (ASD)	57	11.0	5
				B15 Experience Design (ED)	15	2.9	10
B2 IaaS	74	14.3	4	B21 Host Facility Design (HFD)	36	6.9	8
				B22 Mobile Devices Design (MDD)	27	5.2	9
				B23 Information Security Facility Design (ISFD)	8	1.5	12
				B24 Network Agent Construction Design (NACD)	3	0.6	14
B3 SaaS	82	15.8	3	B31 Software Development and Design (SDD)	73	14.1	1
				B32 Information Security Software Design (ISSD)	9	1.7	11
B4 Caas	171	33.0	2	B41 Wired Communication Design (WCD)	65	12.5	2
				B42 Mobile Communications Design (MCD)	64	12.4	3
				B43 Communication Technology R & D (CTRD)	42	8.1	7
B5 DaaS	5	1.0	5	B5 Database as a Service Design (DSD)	5	1.1	13
	518	100.0			518	100.0	
C Service Provider							
C1 PaaS	510	60.7	1	C11 Portal Platform Provide (PPP)	20	2.4	10
				C12 Multimedia Services Provide (MTSP)	93	11.1	3
				C13 Mobile Services Provide (MSP)	244	29.0	1
				C14 Application Service Provide (ASP)	153	18.2	2
C2 IaaS	115	13.7	3	C21 Host Facilities Provide (HFP)	29	3.5	8
				C22 Mobile Devices Provide (MDP)	71	8.5	4
				C23 Information Security Facilities Provide (ISFP)	2	0.2	13
				C24 Network Agent Construction Provide (NACP)	13	1.5	12
C3 SaaS	58	6.9	4	C31 Software Services Provide (SSP)	24	2.9	9
				C32 Information Security Software Provide (ISSP)	34	4.0	7
C4 Caas	138	16.4	2	C41 Wired Communication Services Provide (WCSP)	68	8.1	6
				C42 Mobile Communication Services Provide (MCSP)	70	8.3	5
C5 DaaS	19	2.3	5	C5 Database as a Service Provide (DSP)	19	2.3	11
	840	100.0			840	100.0	
Summary	1761	100.0					

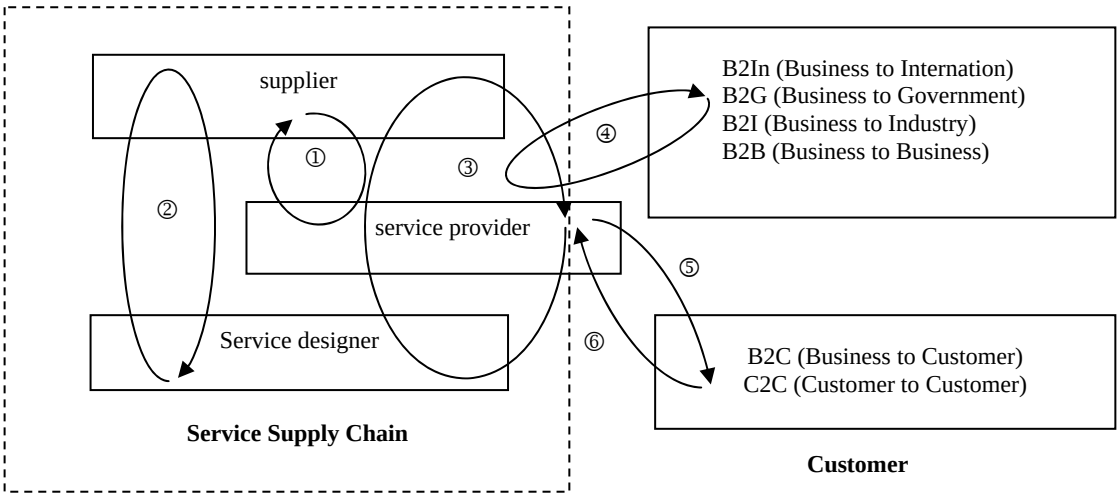

Figure 2 Industrial collaboration model

Table 2 Three-stage trend analysis of cloud service innovation

Service Supply Chain members	Cloud service innovation subcategories (see table 1 Subcategories)	trend	Stage 1 Frequency/ % / Rank			Stage 2 Frequency/ % / Rank			Stage 3 Frequency/ % / Rank		
A	A12 MTPS	inverted U-type	18	15.0	2	33	18.2	2	6	5.9	6
Supplier	A13 MSPS	inverted U-type	8	6.7	6	24	13.2	3	1	1.0	10
	A14 ASPS	sharp decline	23	19.2	1	13	7.2	5	7	6.9	5
	A21 HFS	U-type	7	5.8	7	3	1.7	10	9	8.9	3
	A22 MDS	sharp increasing	12	10.0	4	59	32.4	1	33	32.7	1
	A31 SSS	U-type	18	15.0	2	19	10.5	4	20	19.8	2
	A32 ISSS	U-type	7	5.8	7	3	1.7	14	7	6.9	5
	A41 WCS	U-type	9	7.5	5	5	2.7	7	5	5.0	8
	A43 NCTS	U-type	2	1.7	12	1	0.5	11	8	7.9	4
B	B12 MTSD	decline	27	13.9	3	24	11.3	5	3	2.7	9
Service designer	B13 MSD	inverted U-type	14	7.2	6	31	14.6	1	13	11.7	4
	B14 ASD	decline	29	14.9	2	19	8.9	6	9	8.1	6
	B21 HFD	increasing	8	4.2	8	8	3.8	12	20	18.1	1
	B24 NACD	Meaningless	3	1.5	12	-	-	-	-	-	-
	B31 SDD	decline	33	17.0	1	28	13.1	4	12	10.8	5
	B41 WCD	decline	26	13.5	4	30	14.1	2	9	8.1	6
	B42 MCD	increasing	19	9.8	5	30	14.1	2	15	13.5	3
	B43 CTRD	sharp increasing	13	6.7	7	12	5.6	8	17	15.3	2
C	C12 MTSP	inverted U-type	28	8.2	4	55	15.6	2	10	7.0	7
Service provider	C13 MSP	sharp decline	106	31.0	1	113	31.8	1	25	17.5	1
	C14 ASP	U-type	73	21.3	2	55	15.6	2	25	17.5	1
	C21 HFP	increasing	10	2.9	10	5	1.4	10	14	9.8	5
	C22 MDP	sharp increasing	8	2.3	10	41	11.5	4	22	15.3	3
	C31 SSP	U-type	15	4.4	7	3	0.8	10	6	4.2	7
	C41 WCSP	U-type	30	8.9	3	24	6.8	6	14	9.8	4
	C42 MCSP	increasing	26	7.6	5	31	8.7	5	13	9.1	6

The industrial collaboration model of Chunghwa Telecom is shown in Figure 2: ①Service providers provide services transformed from services supplied by suppliers; ②Service improvement and innovative design are carried out by suppliers to comply with service contents of service providers; ③Service innovation is jointly developed by suppliers and service providers; ④Customized service innovation is provided based on feedback from customers with different attributes; ⑤The majority of services are directly provided by service providers to general customers; ⑥General customers not only receive services provided by service providers, but also provide services through provider platform.

In sum, cloud service innovation models can be divided into three types: 1. Cooperation between upstream members of the service supply chain and major clients in providing customized services (as shown in the path①②③④); 2. Upstream members of the service supply chain cooperate to provide standardized services to general clients (as shown in the path①②③⑤); 3. General customers provide services to general customers via the platform jointly constructed by upstream members of the service supply chain (as shown in the path①②③⑥⑤). Accordingly, we obtain the following five propositions as follows.

【Proposition 1】 There are three types of cloud service innovation models: 1. Cooperation between upstream members of the service supply chain and major clients in providing customized services; 2. Upstream members of the service supply chain provide standardized services to general clients; 3. Upstream members of the service supply chain link together general clients.

【Proposition 2】 Upstream members of the service supply chain consistently emphasize PaaS. Moreover, suppliers emphasize IaaS and service designers emphasize CaaS.

【Proposition 3】 Cloud services are developed from PaaS towards IaaS.

【Proposition 4】 SaaS is developed from collaborative design by service providers and suppliers towards independent design by service providers. In addition, SaaS is from internal use for service providers towards customer-oriented services.

【Proposition 5】 Cloud services jointly designed by suppliers and service designers have greater depth and width, and perform better than services directly supplied to service providers. The collaborative design becomes a trend of service design.

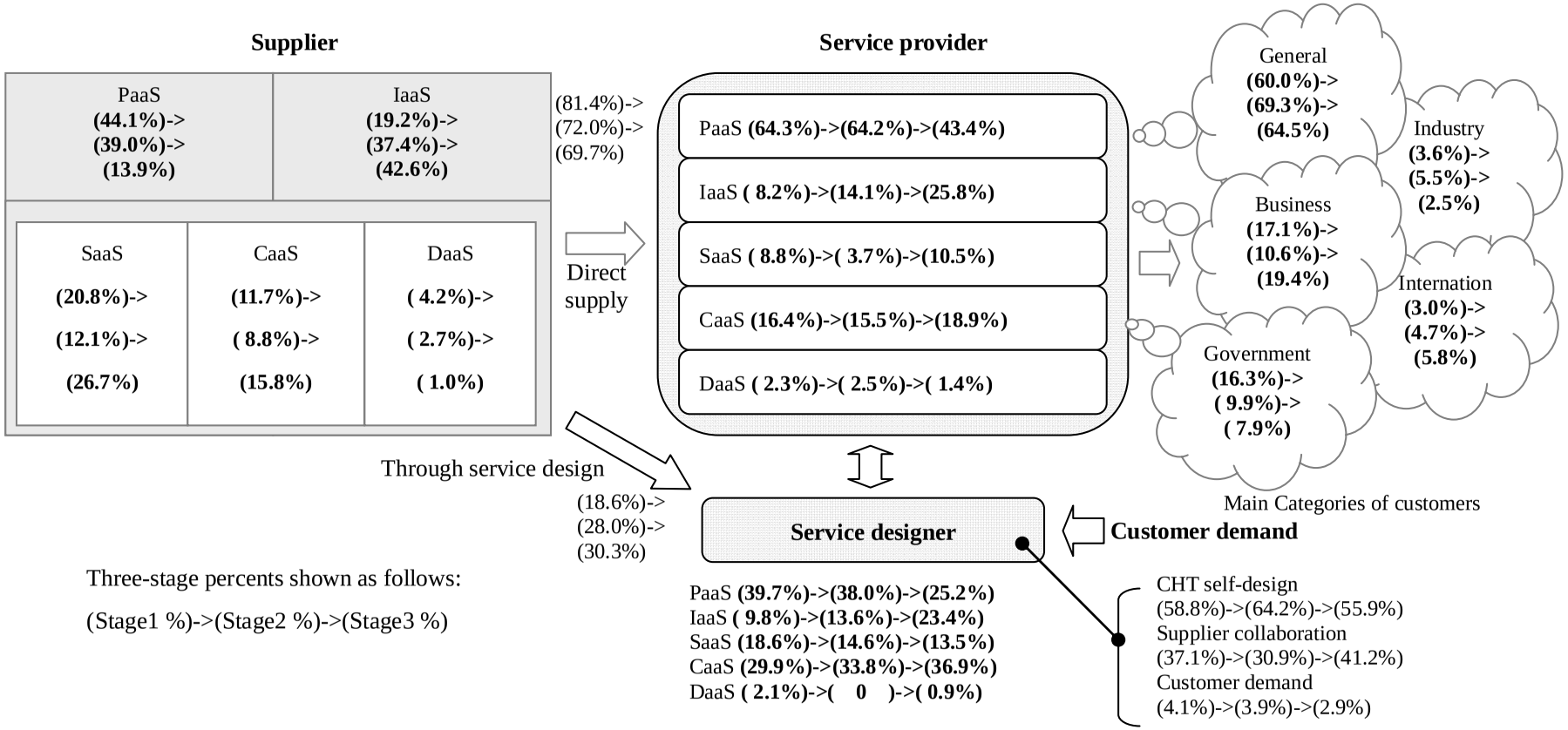

Figure 3 Cloud service innovation trend analysis based on a perspective of service supply chain

Conclusions and Management Implications

Proposition 1 means that service providers cooperate with suppliers, rapidly adjust business strategies in response to market changes, and adopt the open framework of network services can make inter-organization communication more flexible. Most scholars believe that service companies emphasize service development and innovation in cooperation with customers and suppliers. Suppliers' service technologies and capabilities combined with their advantages and customers' opinions produce synergistic effects, which is the result of open innovation. Proposition 2 believes that service supply chains link together business service providers and customers via the internet and other electronic media to create value. The acquisition of real-time information relies on telecommunications technology, so major companies view telecommunications technology as a key development item. Companies must ponder on how to use information technology to improve their business processes, and not just apply information technology in functional departments. Proposition 3 indicates that suppliers gradually shifted from providing PaaS to IaaS products. IaaS is still quite expensive to provide and unaffordable to most small and medium enterprises. Thus, infrastructure outsourcing has become an alternative and makes cloud service more flexible. Accordingly, Chunghwa Telecom must accelerate the establishment of IaaS and strengthen market confidence, security and privacy protection. Proposition 4 indicates that there is still room for Chunghwa Telecom to develop software application services. Chunghwa Telecom should actively develop cloud service technologies for this market, including market-based resource management strategies. Therefore, Chunghwa Telecom can actively increase to provide virtual services, cloud testing and SaaS. Finally, Proposition 5 describes that strategic alliances among members within service supply chain is a development trend. The cooperation among members of the cloud service supply chain will only become closer, not only expanding scope of services, but also improving service performance. Chunghwa Telecom must establish long-term strategic alliances with domestic and foreign companies and customers. This can affect the development of cloud services in the entire supply chain to establish technical support system and service models, and further create value. Furthermore, suppliers should be a driving force and collaboratively design services based on customer requirements.

Taiwan has advantages on hardware development and hence neglects software technology. This study further shows that the ratios of SaaS supply and SaaS design are significantly higher than SaaS provision. There is time delay in SaaS design and it causes services from being provided in time. Hence, accelerating the design process is an important topic, and Taiwanese government should invest considerable resources in the establishment of a superior software industry environment and policies. The formation of an industrial cluster will further drive the development of SaaS.

This study collected 1,761 service innovation events. After comparing the interpretations of three research groups, the coefficient of agreement of the coding by analyzers reached 0.9. Furthermore, this study interviewed top managers and senior managers and employees of Chunghwa Telecom, and examines each service innovation event one by one to increase validity. Finally, participant observation is employed for triangulation. There are limitations to the external validity of this study because only Chunghwa Telecom is studied, but this makes it suitable for in-depth context inquiry and increase the practical value Chunghwa Telecom is not a leading company in a global cloud service industry, but is a benchmark company in the telecommunications industry in Taiwan. In addition, it cooperates with over a hundred multinational enterprises. Furthermore, Chunghwa Telecom is often the case studied in papers published in international journals and news reports. Future studies will compare multiple companies (selecting multinational enterprises) to increase external validity and the representativeness of the cases. In response to the trend of developing cloud services in Taiwan, as well as customers' diverse requirements on services, future studies can also adopt a user experience perspective to propose a more complete service supply chain model.

References

Buyya, Rajkumar, Chee Shin Yeoa, Srikumar Venugopala, James Broberg, and Ivona Brandic (2009), "Cloud Computing and Emerging IT Platforms: Vision, Hype, and Reality for Delivering Computing as the 5th Utility," *Future Generation Computer Systems*, 25(4), 599-616.

Çokpınar, Samet and Taflan Imre Gündem (2012), "Positive and Negative Association Rule Mining on XML Data Streams in Database as a Service Concept," *Expert Systems with Applications*, 39 (8), 7503-7511.

Cui, Lianguang and Susanne Hertz (2011), "Networks and Capabilities as Characteristics of Logistics Firms," *Industrial Marketing Management*, 40(6), 1004-1011.

David, Hilley (2009), "Cloud Computing: A Taxonomy of Platform and Infrastructure-Level Offerings College of Computing Georgia Institute of Technology," CERCS Technical Report, College of Computing Georgia Institute of Technology(April), 1-37.

Hitt, Michael A., Barbara W. Keats, and Samuel M. DeMarie (1998), "Navigating in the New Competitive Landscape: Building Strategic Flexibility and Competitive Advantage in the 21st Century," *Academy of Management*, 12(4), 22-42.

Hwang, Kevin P., Yi-Ting Huang, and Ming-Kuen Wang (2007), "A Selection Hierarchy for Possible Strategic Alliances of Taiwanese Telecom Operators," *Asia Pacific Management Review*, 12 (6), 311-321.

Kang, Chao-Chung (2009), "Privatization and Production Efficiency in Taiwan's Telecommunications Industry," *Telecommunications Policy*, 33(9), 495-505.

Kloch, Christian, Ebbe B. Petersen, and Ole Brun Madsen (2011), "Cloud Based Infrastructure, the New Business Possibilities and Barriers," *Wireless Personal Communications*, 58(1), 17-30.

Maull, Roger, Joana Geraldi, and Robert Johnston (2012), "Service Supply Chains: A Customer Perspective," *Journal of Supply Chain Management*, 48(4), 72-86.

Marston, Sean, Zhi Li, Subhajyoti Bandyopadhyay, Juheng Zhang, and Anand Ghalsasi (2011), "Cloud Computing: The Business Perspective," *Decision Support Systems*, 51(1), 176-189.

Rimal, Bhaskar Prasad, Jukan Admela, Katsaros Dimitrios, and Goeleven Yves (2011), "Architectural Requirements for Cloud Computing Systems: An Enterprise Cloud Approach," *Journal of Grid Computing*, 9(1), 3-26.

Rosenthal, Arnon, Peter Mork, Maya Hao Li, Jean Stanford, David Koester, and Patti Reynolds (2010), "Cloud Computing: A New Business Paradigm for Biomedical Information Sharing," *Journal of Biomedical Informatics*, 43(2), 342-353.

Streitberger, Werner and Torsten Eymann (2009), "A Simulation of An Economic, Self-Organising Resource Allocation Approach for Application Layer Networks," *Computer Networks*, 53(10), 1760-1770.

Sultan, Nabil (2010), "Cloud Computing for Education: A New Dawn?" *International Journal of Information Management*, 30(2), 109-116.

Yang, Shirley Ou and Carol Hsu (2011), "The Organizing Vision for Cloud Computing in Taiwan," *Journal of Electronic Commerce Research*, 12 (4), 257-271.

Yin, Robert Kuo-Zuir (2003), *Case Study Research: Design and Methods*, 3rd ed. California: Sage Publications.

This study is a case study of Chung-Hwa Telecom. Based on a framework of cloud service, this study develops an innovation model of medical cloud services (MCS) and explores the evolution of the model. Through collecting the related secondary data of the case from 2002 to 2011 and in-depth interviews, this study has collected 274 events of service i View.Â This study adopts a comparative case study to explore managerial difference of trading websites between mainland China and Taiwan. Taobao.com in mainland China and Yahoo! Taiwan are the selected cases. Through the credit rating system of the cases, this study collects a total of 3,243 appraisals of the sellers whose sale ranks first in eight indust View. Operator case studies from: Key partners: Senior sponsorsÂ 8. iPhone â€“ Impact and Evolution of Consumer Electronic Devices on the Mobile Industry. 9. Overview of UWB and Implications for PANs Mark Bowles, Board Member WiMedia Alliance. 6.Â Exploring Mobile Broadband Opportunities is free to all telecom service providers and government ofcials. Pre-registration is required. Please contact Beacon Events on info@BeaconEvents.com for further information. Chunghwa Telecom has the highest mmWave frequency spectrum of 600MHz in Taiwan, and is focusing its research and development on 5G, IoT, AI, information security and big data applications. Under the tripartite cooperation, Chunghwa Telecom is responsible for the enterprise-specific private 5G mmWave network deployed at ASE.Â - Sheih Chi-Mau, Chairman of Chunghwa Telecom. "Qualcomm is excited to play a role in the building of the worldâ€™s first smart factory powered by a private 5G mmWave network, demonstrating the cohesiveness and technological superiority of Taiwanâ€™s ICT industry.Â Equally important, if not more so, is its Amazon Web Services cloud computing business, which has long been the backbone of its profitability. 3h ago. More Stories. Like cloud service models, each cloud deployment model has its own unique setup with a range of differing requirements and associated benefits. Suggested read: The Many Benefits of Cloud Computing in 2021. Letâ€™s look closerÂ These emerging cloud services have evolved to meet technological innovations and tend to be cloud-native rather than traditional on-premises solutions. Below, we have explored the three most popular emerging cloud service categories: AI and Machine Learning Cloud Services.Â This constant state of evolution will give you opportunities almost daily to trial new solutions, or identify technologies that can take your business to the next level. If youâ€™re looking for WordPress website hosting, you should strongly consider Kinsta as your partner of choice.