

Human Resource Development in Cloud Computing: An Empirical Investigation in Taiwan

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Abstract

Cloud computing is an emerging platform that enables information and communication technologies, such as mobile commerce and big data analysis, to thrive. In recent years, the proliferation of cloud computing has stimulated the needs of the cloud-related workforce. The purpose of this research is to explore the human capital needs induced by the development of the cloud computing industry in Taiwan. This study uses both quantitative and qualitative research design to portray a comprehensive picture of cloud human resource development, including conducting job mining and investigating manpower requirements of cloud companies, by interviewing with 20 firms and holding two focus group interviews. The findings of the study provide an overview of job trends and summarize challenges related with selection, staffing, training, and retention in effort to aid cloud human resource development and cultivation. This study provides groundwork for a preliminary understanding the status quo of cloud-related human resource development in Taiwan. Our findings can allow to firms and policy makers to formulate human resource strategies through cloud computing.

Keywords: Cloud computing, Manpower requirements, Human resource development, Focus group discussions, Job mining

1. Introduction

With the evolution of information and communication technology (ICT), cloud computing has instigated a new paradigm shift toward an elastic IT infrastructure. According to the investigation of International Data Corporation (IDC), the worldwide spending on public IT cloud service was approximately \$47.4 billion in 2013 and is estimated to reach \$107 billion in 2017 (IDC, 2013). By adopting cloud computing, firms can access computing resources remotely via a network or the Internet and only need to pay for what they use (Fan et al, 2013). Firms can focus on developing core competencies. Cloud computing has had profound impacts on the business environment and enables ICT applications, such as mobile commerce and big data analysis, to thrive.

Cloud computing has been regarded as one of the crucial industries in Taiwan. To provide political support, the Ministry of Economic Affairs (MOEA) announced the Cloud Computing Industry Promotion Office to drive ICT firms to transform into cloud service providers. According to estimates, the overall cloud computing services market value amounted to NT\$10.4 billion in 2013 (MOEA, 2013). With a compound annual growth rate of 17.1%, the market value will achieve a value of NT\$13.9 billion by 2016. The proliferation of the cloud computing industry also extends the needs of human resources. Firms need not only employees familiar with emerging cloud techniques but also employees that can cope with problems in the provision cloud services.

The purpose of this research is to understand the human capital needs induced by the development of cloud computing in Taiwan. In this study, we employ the human capital allocation and development theory proposed by Lepak and Snell (1999) as our analytical framework. By interviewing 20 firms and holding two focus group interviews, we explore how firms adjust their allocation of human resources to cope with the changes that could possibly arise as a result of increased cloud computing. In addition, this study also discusses the recruitment, induction, development, and retention of cloud computing human capital. The findings provide a preliminary understanding of the status quo of cloud-related human resource development in Taiwan. This study can allow firms and policy makers to formulate human resource strategies for cloud computing.

This paper is organized as follows. In the next section, we review the development of cloud computing in Taiwan and present its theoretical background. The research methods and research procedure are described in the third section. Then, the findings are presented in the fourth section. Finally, the findings are discussed, followed by their implications and suggestions for future research.

2. Research Background

2.1 The Development of Cloud Computing

Building on existing techniques, including virtualization, distributed computing, utility computing, and networking techniques, individual and organizational users can lease computing resources through network with a pay-as-you-go pricing model (Vouk, 2008; Weinhardt et al., 2009). According to the definition of the National Institute of Standards and

Technology (NIST), cloud computing refers to a network-accessed computing resources pooling, including network, storage, application, and other computing service (Mell & Grance, 2011). The service models of cloud computing can be separated into Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS), each of which have five essential characteristics: on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service.

Governments around the world have regarded cloud computing as an essential IT infrastructure for the development of a country (Chandrasekaran & Kapoor, 2010). The US proposed the Federal Cloud Computing Initiative (FCCI) in 2009 and also initiated several projects to enhance cloud implementation at federal institutions. NIST also proposed standards for the foundation of cloud computing development. The UK government initiated the Digital Britain Project in 2009 and constructed a platform (CloudStore) for cloud service procurement for the public sector, which now has 257 providers and provides more than 1,700 services. Approximately 50% of ICT expenditures of the UK government in 2011, approximately GBP 0.9 billion, were enabled by CloudStore. As for Asian countries, Singapore announced the iN2015 (Intelligent Nation 2015) in 2006. China's 12th Five-Year Plan listed cloud computing as one of the seven strategic emerging industries. Japan approved the Digital Japan Creation Project in 2009 to establish cloud-based ICT infrastructure to share resources and increase efficiency. To improve the service quality of public sectors, South Korea implemented a cloud-based IT environment and deployed a government cloud computing platform in 2011 (Lee & Kim, 2013). Table 1 presents the strategies of governments across the world.

Table 1. Cloud Computing Strategies of Governments across the World

Strategic Foci	Country (Time-Initiated)						
	US (2009)	UK (2009)	AU (2011)	CN (2010)	SIN (2006)	JA (2009)	SK (2009)
Standard Development	✓	✓	✓	✓		✓	
Industrial Development		✓	✓			✓	✓
Technique Development	✓					✓	✓
Setting Regulations				✓			
Common Procurement	✓	✓	✓				
Open Data	✓			✓	✓	✓	
Big Data	✓		✓		✓		
Proof of Concepts				✓	✓		✓

Note: US = United States; UK = United Kingdom; AU = Australia; CN = China; SIN = Singapore; JA = Japan; SK = South Korea

The Taiwanese government listed cloud computing as an important developing industry and initiated the Cloud Computing Development Project in early 2009. Through 15 cloud-related application projects, cloud computing provides transformation opportunities for ICT firms in Taiwan. Furthermore, an evaluation policy for the government cloud computing project is provided, for "Value to citizens" and "Economy to the industry" as the planning and implementation target guidelines. After three years of effort, the Cloud Computing

Development Project was revised to become the Cloud Computing Application and Development Project at the end of 2012. The main goals are to accommodate the diversity of domestic demand and technological competition from international industries. Government cloud applications should be transparent to the general public and should lead the development of the cloud computing industry in Taiwan. The Cloud Open Platform offers a supply-demand channel for governmental agencies and hardware and software vendors in cloud computing applications.

The development of cloud computing in Taiwan provides opportunities to explore new markets for vendors including cloud servers, storage, terminal devices, and other cloud solutions. The experience of ICT manufacturing industry also provides a foundation for cloud service providers (Fan et al., 2013). The government and firms continuously infuse resources to develop cloud-based techniques and solutions. The increasing cooperation among firms and research institutions has created thriving cloud platforms. The development of the cloud industry, the construction of the cloud environment, and the positioning in the international cloud market will increase the needs for cloud-related human resources.

2.2 Cloud-Related Human Resource

Taking into account the resource-based perspective, human resource development has profound impacts on the competitive advantage of a firm (Boxall, 1996; Colbert, 2004; Richard & Johnson, 2001; Wright et al., 2001). Human capital is regarded as an important production factors and has been described as valuable, autonomous, unique, inimitable, deliberate, and important (Becker, 1964). Effective human capital management increases the competitive advantage and organizational performance of a firm (Bontis et al., 2000; Hitt et al., 2001; Jiang et al., 2012). Firms can obtain needed human resources through internal development and external acquisition (Lepak & Snell, 1999). Drawing on the resource-based perspective, human capital theory, and transaction cost economics, Lepak and Snell (1999) advocate four different employment modes: internal development, acquisition, contracting, and alliance.

Companies in Taiwan continue to allocate resources to enter the cloud computing market. With the rise of emerging cloud-related applications, the needs of cloud-related human resources, including technical and managerial resources, are increasing. According to statistics from the government, the growth of the overall cloud market will be five times greater than the traditional ICT service market. Therefore, firms that both adopt cloud computing or plan to become cloud service providers all face human resource development issues, including recruitment, induction, development, and retention. Cloud human resource management will be a key for firms to successfully transform into cloud and intelligent solution providers.

3. Research Method

This study employed both quantitative and qualitative research methods to investigate the human resource development in Taiwan. A questionnaire was developed for the quantitative research design to investigate the manpower requirements of cloud companies. The target sample frame included 200 cloud service providers in Taiwan. A copy of the questionnaire

with the statement of study objective, together with a prepaid reply envelope, was sent to qualified informants. We received a total of 84 usable responses for further analyses, with a response rate of 42%. In addition, this study cooperated with a manpower company in Taiwan. A job mining was conducted through using the job database of this firm. With the comparison of two years variation, the findings can provide some picture of cloud-related manpower development in Taiwan.

By interviewing 20 firms and holding two focus group discussions, this study explored how firms adjust their allocation of human resources to cope with the changes brought about by cloud computing. The collected data emphasizes the recruitment, induction, development, and retention of cloud computing human capital.

In order to explore the impacts of cloud computing on the firm's human resource strategy, this research adopted the multiple-case replication design (Yin, 2003). Several semi-structured questions were developed, and cross-case analysis was conducted to summarize issues and problems of cloud-related human resource development (Benbasat et al., 1987). The firms providing cloud-related service were invited to participate. The interviews, ranging from 1 to 3 hours, were conducted from June to November 2013. As shown in Table 1, 20 organizations were selected for this study. The interviewees were responsible for planning and leading the cloud-related service, products, or projects of their organizations. For confidentiality, the name of companies, participants, and product information will be presented anonymously.

Table 2. Overview of Companies in the Study

ID	Date	Industrial Type	Capital Size (NTD Million)	Number of Employees	Interviewee(s)
A	6/13	System Integration	200	435	<ul style="list-style-type: none"> Vice President Marketing Manager
B	6/27	Software	760	1,156	<ul style="list-style-type: none"> Vice President
C	7/2	System Integration	1,000	789	<ul style="list-style-type: none"> Marketing Manager
D	7/2	Software	210	1,328	<ul style="list-style-type: none"> General Manager
E	7/11	Software	670	350	<ul style="list-style-type: none"> Vice President
F	7/13	Software	200	63	<ul style="list-style-type: none"> Chief Marketing Officer
G	7/18	System Integration	150	1,031	<ul style="list-style-type: none"> Director Adviser
H	7/22	Telecom	34,200	2,959	<ul style="list-style-type: none"> Chief Operating Officer Director
I	7/25	Telecom	550	140	<ul style="list-style-type: none"> Assistant General Manager Deputy Manager
J	7/26	Telecom	32,600	5,873	<ul style="list-style-type: none"> Executive Vice President Assistant General Manager Deputy Manager
K	9/30	HR Agency	340	497	<ul style="list-style-type: none"> Director of System Operation
L	9/30	Computers	5	750	<ul style="list-style-type: none"> Assistant General Manager
M	10/1	Computers	35,900	3,701	<ul style="list-style-type: none"> Assistant General Manager
N	10/2	Internet Service Provider	130	150	<ul style="list-style-type: none"> Assistant General Manager
O	10/4	Computers	1,600	4,200	<ul style="list-style-type: none"> Chief Operating Officer
P	10/8	System Integration	2,600	1,916	<ul style="list-style-type: none"> Assistant General Manager Director
Q	10/17	Research Institute	N/A	5,800	<ul style="list-style-type: none"> Manager
R	10/18	Software	90	190	<ul style="list-style-type: none"> Product Manager
S	11/12	Research Institute	700	1,431	<ul style="list-style-type: none"> Vice President HR Manager
T	11/13	Software	12	40	<ul style="list-style-type: none"> General Manager

Two focus group discussions were hosted respectively on November 21, 2013 and December

3, 2013. Each focus group consisted of one moderator and six participants. The two focus groups were moderated by two separate experts who did not have further involvement with participants after the focus group study (Morgan & Scannel, 1998). To ensure sufficient diversity of opinions, participants familiar with the development of cloud-related human resource were invited. Table 3 presents the overview of focus group participants.

Table 3. Overview of Focus Group Participants

Round	Role	Type of Organization	Title/Job level
1st Focus Group	Moderator	University	Professor (Computer Science)
	Participant	University	Professor (MIS)
	Participant	HR Agency	Manager
	Participant	Online Retailer	Senior Specialist
	Participant	System Integration	HR Deputy Manager
	Participant	Computers	Technical Deputy Manager
	Participant	Software	Project Manager
2nd Focus Group	Moderator	HR Agency	Manager
	Participant	System Integration	Technical Manager
	Participant	System Integration	Project Manager
	Participant	Software	Deputy Manager
	Participant	Networking	Technical Director
	Participant	Computers	HR Manager
	Participant	Telecom	HR Section Manager

All focus groups were organized at a professional survey center. A session room design was adopted to conduct the focus groups. Each focus group lasted approximately 120 minutes and was facilitated by a moderator and an assistant moderator (observer), who took notes during the discussions and made sure the moderator did not overlook any participants trying to add comments. All focus group discussions were audio-taped after obtaining the permission of the participants. The focus group discussions included five parts: introduction, overview of cloud computing development, HR issues in cloud computing, future directions, and summary and close. Table 4 shows the summary of focus group procedural structure.

Table 4. Summary of Focus Group Procedural Structure

Question Type	Time (min)	Procedures/Questions
Introduction	10	<ul style="list-style-type: none"> • Opening statement • Self-introduction of participants
Overview of cloud computing development	30	General discussion about the impacts of cloud computing on the participants' firms, including: <ul style="list-style-type: none"> • Internal influence • External influence
HR issues in cloud computing	50	Free discussion on the following issues: <ul style="list-style-type: none"> • The quality/quantity of cloud-related human resource • The way of capability identification • On-the- job training • Fresh graduates • Retention
Future directions	30	Free discussion on the following issues: <ul style="list-style-type: none"> • Big data analysis • Mobility • The diffusion of cloud-based applications
Summary and close	5	Summary of main issues and outcomes

4. Analysis Results

4.1 The results of the quantitative research

According to the current and future needs, cloud-related jobs were designated into Star, Comet, Meteor, and Dark Matter. The cloud manpower development in Taiwan is shown in Figure 1. The results of the job mining are shown in Figure 2.

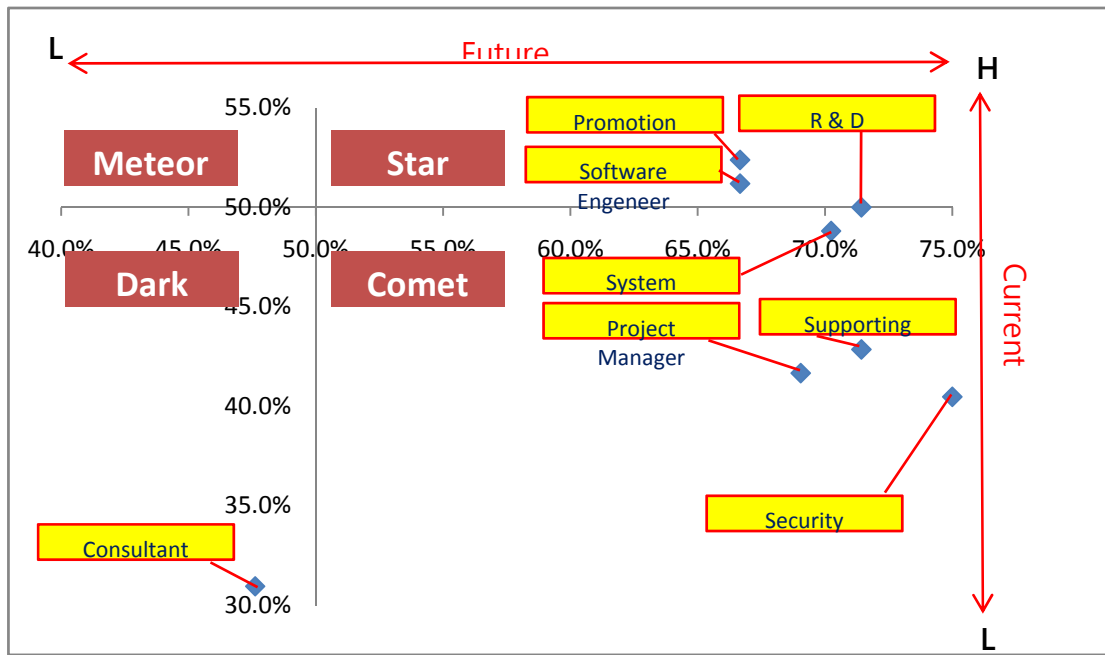


Figure 1. Human Development Trends

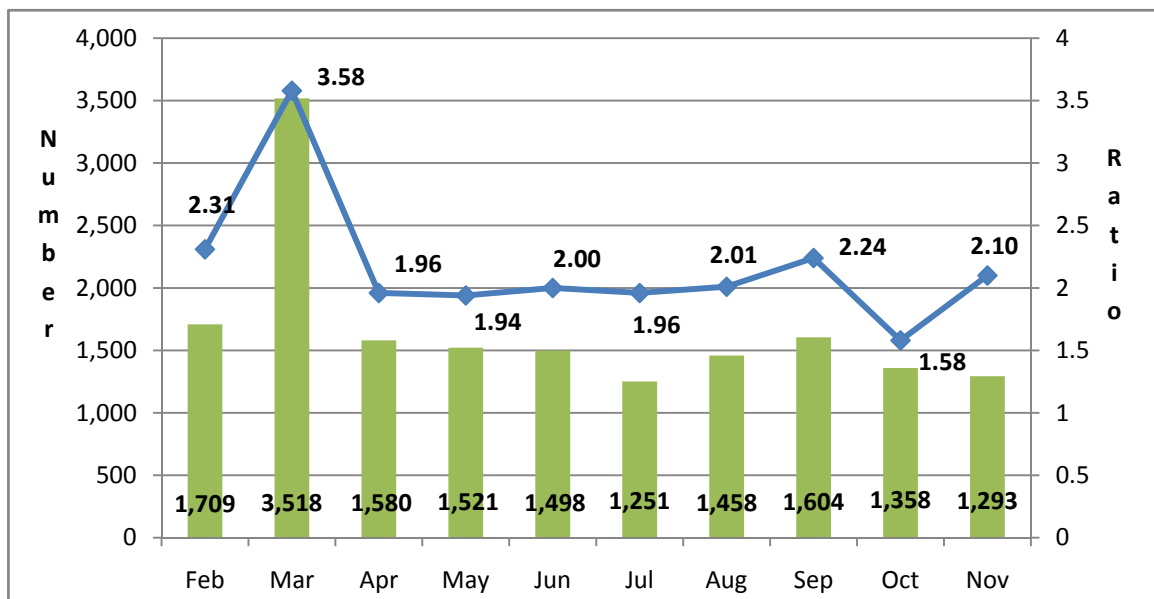


Figure 2. Job Mining Results

4.2 The results of the qualitative research

Table 5 presents the results of cross-case analysis. After conducting two focus group discussions and interviewing 20 cloud service providers, the following issues arose. Firstly, according to the high developing costs, firms declined to hire fresh graduates. Because of the economic recession, the budget for human resource development was reduced. Companies tended to hire people with work experience. On average, the training period of an employee with one to two years of work experience is about three to six months. Therefore, higher training costs and long training periods will decrease the firms' inclination to hire fresh

graduates. Interviewees also point out the possible explanation for the gap between education and manpower market: school and course programs do not conform to market needs, most teachers are not familiar with the emerging techniques, and students lack practical experience.

Secondly, the turnover rate was high. Firms faced job-hopping problems from their competitors, especially for cloud-related specialists. An employee with three to five years of work experience will switch to competitors' jobs. The high turnover rate will increase the cost for retention and new employee training.

Thirdly, firms also indicated that the human resource market in Taiwan still lacks people who have cloud-related software architecture development skills. Despite of the proliferation of IaaS and PaaS service in Taiwan, the needs of related software architecture development are increasing. In addition, most ICT firms have shifted the focus from developing hardware to providing value-added service. Therefore, the needs for user interface experience and user interface (UX/UI) are also increasing.

Table 5. Cross-case Analysis

Issues		Company ID																			
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Market Focus	IaaS						✓	✓	✓	✓	✓	✓	✓		✓	✓	✓				
	PaaS			✓	✓	✓	✓	✓							✓	✓		✓	✓		
	SaaS	✓	✓		✓	✓					✓	✓	✓	✓	✓		✓		✓		✓
Recruitment	Internal	✓	✓	✓	✓	✓	✓	✓					✓	✓		✓			✓		✓
	Acquisition	✓		✓	✓				✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	Contracting			✓						✓									✓	✓	
	Alliance	✓	✓		✓						✓										
Development	On-job Training	✓	✓					✓				✓	✓				✓	✓	✓	✓	
	External Training	✓			✓							✓			✓	✓	✓			✓	
Retention Plan					✓								✓	✓			✓				
Cross-Domain Cooperation		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓		✓	✓	✓	✓	

Fourthly, the need for people who have cross domain knowledge will increase in the coming years. Most firms indicated that they lack middle managers, especially those who have three to seven years of work experience. For instance, a project manager of the cloud service should be familiar with the whole network of cloud production and services, including major functions and application trends.

Finally, the applications for new techniques, especially big data, will drive other needs for human capital. With the evolution of cloud applications, big data analysis has become an important area for development for firms. Companies need people who are familiar with analytical techniques and can turn outcomes into different business models.

5. Discussion and Conclusions

Cloud computing has become an important foundation to enable thriving ICT applications, such as mobile commerce and big data. The purpose of this research is to understand the human capital needs induced by the development of cloud computing in Taiwan. Focus group discussions and cases analysis shed light on several key issues. The results indicate that firms are inclined to hire people who have work experience and an IT or computing-related background. Initially, firms acquired and developed the needed people from internal incumbent. However, firms face the job-hopping problems from their competitors. The human resource market in Taiwan still lacks people who have cloud-related software architecture development skills. The needs of people who are knowledgeable of UX/UI are increasing. To focus on developing specific domain applications, firms must find people who have cross domain knowledge. Companies are inclined to hire people who can make use of emerging techniques. This study is a groundwork that provides a preliminary understanding of the current status of cloud manpower development in Taiwan. Our findings can help firms and policy makers formulate human resource strategies for cloud computing.

This study provides following suggestions for future research. Firstly, based on this work, future research should conduct quantitative research to provide a more comprehensive overview of cloud-related human resource development in Taiwan. Secondly, future research should further investigate human resource management issues, such as the relationships among human resource characteristics, turnover rate, and firm performance. Finally, the variation of cloud-related manpower still warrants attention. Future research should conduct longitudinal analysis to enhance the understanding of cloud human resource trends.

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