The impact of culture differences on cloud computing adoption

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Abstract. To cut cost, while increasing competitiveness, more and more small and medium-sized enterprises (SMEs) are considering cloud computing technology for supporting their business processes. However, initial cost, possible long term cost, security, accessibility and transformation issues are concerned by the organizations. By adopting LEADing Practices and Hofstede [16] national culture dimensions, this study provides substantive conclusions about the transformation effects of national culture dimensions on cloud computing acceptance in organizations.

Keywords: Key words: Cloud Computing, National Culture, Acceptance, ERP

1 Introduction

During the last decade, many small and medium-sized enterprises (SMEs) have tried to adjust their business operations to cope with dramatic changes in the market. Over the past few years, many initiatives have come to life for organizations: Initiatives from service–oriented architecture (SOA), business process management (BPM), value management (VM), enterprise resource planning (ERP), and with this not only the enablement of technology and information to put it into the cloud. SMEs are trying to adopt a better solution to improve the effectiveness, efficiency and quality of their business processes. Benefits from ERP systems are obvious. Gattiker and Goodhue [1] describe the ERP benefits in following aspects: (1) improving the integration of information

flow between sub-units; (2) centralizing the administrative activities, such as accounts payable and payroll; (3) reducing costs of system maintenance; (4) increasing the ability to deploy new IS functionality; (5) enabling transformation from inefficient business processes to accepted best practices. In this case, an ERP system seems to be one of the best to SMEs [2]. Since the majority of large companies have already implemented ERP systems, today ERP vendors are shifting their focus towards SMEs. Several reasons have encouraged the interest of ERP vendors towards SMEs. These include the saturation of the market, as most large enterprises have implemented ERP software, the supply chain integration between large and small enterprises, the high number of SMEs compared to the number of large enterprises, and the technologies development together with the availability of relatively cheap hardware. However, to compete in the new economy, SMEs are now facing challenges to become more responsive and agile. Most SMEs operate in a highly dynamic world, where both internal and external requirements may change [3]. Changes may come from the need to be more cost-effective, from customers in the form of requirements for new products and product variants, from government agencies in the form of regulations, or by advances in technology. Often the SME is the weaker part in a supply chain and thus the ability to adapt to changes imposed by customers or suppliers will be an important competitive factor. Most SMEs have utilized the flexibility that comes from having a lower number of orders, customers, employees, etc. when changing processes and practices. It is therefore important that this flexibility is retained when new IT systems are implemented. [4] Scheruhn et al developed an agile Information Reference Model Framework for large and small enterprises exemplified by comparing case studies of different demo companies using SAP ERP and SAP Business byDesign. The use of commodity software, such as ERP systems, may force a more rigid structure on a SME and thus weaken their competitive advantage. It is critical to launch an investigation about the firm performance after SMEs adopted ERP systems.

In recent years, after many SMEs adopted various ERP packages from different ERP vendors, there is a new technology/concepts available in ERP adoption for SMEs called Cloud Computing. Cloud computing is an emerging business and technology concept to support an on-demand delivery of computing, storage and applications for executing business processes over the Internet. A recent IDC report shows global revenue in cloud software market reached to $22.9 billion and it will grow to $67.3 billion in 2016 [5]. This projection includes revenue generated by the shift from on-premise to on-demand providers as well as by the planning and architecture behind the shift. Comparing to ERP, cloud computing seems like intangiable because both hardware and software are not under control by the business who adopted this technology. Therefore, what are the key factors that may impact the acceptance of this technology by business will be a good research question.

2 Literature Review

The usage of the word “cloud” in cloud computing implies the architecture taking the form of a cloud which is easily accessible for business and users from anywhere in the world on demand [6]. It has important links to management aspects and also helps in cost reduction and driving innovation in a firm. In this sense, cloud computing means that instead of IT departments hosting data centers on the premises of companies themselves, this hosting is outsourced to third parties and made available via per-usage subscription fees that typically scale, along with the underlying infrastructure, with demand. Cloud Computing refers to a large, abstract pool of dynamically scalable on-demand infrastructure and on-demand software provided and /or accessed over the Internet.

Customers (= IT users) can access IT-capacity /services that is/are available in the Cloud. Cloud computing is a term used to describe both a type of application, platform and infrastructure. Cloud computing involves the delivery of hosted or virtualized services via the internet. Cloud computing is different from traditional hosting in several ways. Cloud services are flexible and can provide as much or as little of a particular service as a user needs at a given time. Cloud services are managed completely by the provider. The user needs only a computer and access to the internet to take advantage of these services. A cloud computing platform dynamically provisions, configures, reconfigures, and deprovisions servers as needed. Cloud computing also describes applications that are extended to be accessible through the Internet. These cloud applications use large data centers and powerful servers that host Web applications and Web services [7].

For enterprises, Cloud Computing can be adopted as one of the following services [8-12]:

- Software as a service (SaaS): providing software subscription services
- Storage as a service: providing remote storage resource services
- Database as a service (DaaS): providing remotely hosted database services
- Information as a service (INaaS): providing remotely hosted information services
- Business Process as a service (BPaaS): providing business processes based on remote resources
- Application as a service: also known as SaaS
- Testing as a service: providing testing services for local or remote systems
- Platform as a service (PaaS): providing a complete platform to support application development, interface development, database development, storage, information and testing
- Infrastructure as a service (IaaS): providing a service to access computing resources remotely
- Security as a service: providing core security services remotely over the Internet
- Integration as a service: providing a complete integration stack service

According to Beaubouef [13], there are three Cloud Models of ERP adoption:

- Software as a service: a subscription model for small customers who share hardware.
- Hosted ERP: a typical solution for large customers who have separate hardware and instances.
- Hybrid ERP: a combination solution that maintains on-premise software as well as integrated a degree of on-demand services.

Additionally, according to Gartner's report [13], more and more companies are considering on-demand services in different applications (Figure 1).

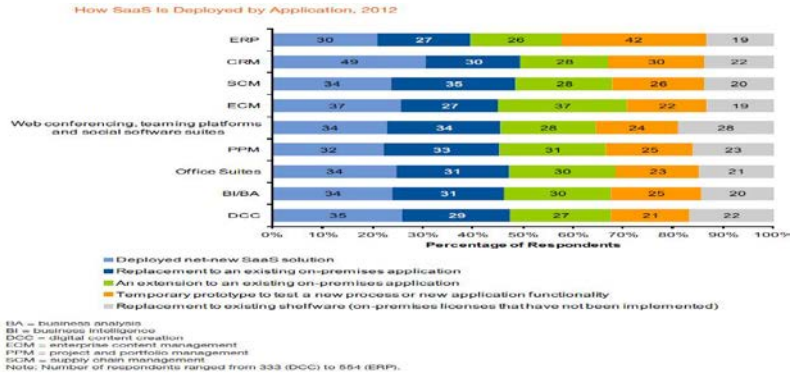

Fig. 1. How SaaS Is Developed by Application

2.1 Aspects of Cloud Computing

For years, researchers focus their cloud computing studies on advantages, disadvantages, acceptance procedures. [14-15]. The most evident advantage of Cloud Computing is the possibility to outsource processes in the way that somebody else might do this service at a low cost. More broadly, cloud computing can be thought of as the urge to stop worrying about how a process weakness cluster you might have or an unproductive, inefficient and ineffective process or flow in an organization should be resolved in order to focus on how the process can cut cost or done better (value potential).

There is no need to invest in infrastructure for platforms. Furthermore the Cloud provider is in charge of the professional management of the IT-solution, which reduces the need of human and technical resources. The total IT cost (TCO = Total Cost of Ownership) of Cloud Services are and remain low. The time requirements for the implementation of new IT systems can be massively reduced. By using Cloud services companies have resources at their disposal, which are easily accessible, highly scalable, flexible and location-independent. "On demand" infrastructure is – as its name says it – accessed on demand and charged by utilized units.

While calculation of costs for an individual Cloud Computing solution depends on numerable things, basically it is based on the six following factors:

1. Initial cost: depending on type of cloud solution

2. Computing Resources: number of CPUs & size of memory
3. Occupied disk space
4. Duration of use / operation
5. Number of Cloud Management User
6. Number of licenses (optional)

Many researchers adopted case studies to study cloud computing issues in different countries [16-17]. However, limited studies paid attention to the role of national culture in explaining cloud computing acceptance across countries. According to Waarts and Van Evaerdingen [8], national culture is one of the key factors influencing IS innovation adoptions founded by an empirical study of firms across Europe. Therefore, this paper tries to explain the relationship between cloud computing and national culture. United States and China are two countries with dramatic differences in national culture. Therefore, in this study, we are focusing the comparison of these two countries.

3 Theoretical Background

Hofstede [19] introduced a five dimension classification of cultures based on a survey of employess in IBM subisdiaries located in fifty courtries: power distance, individualism/collectiveism, masculine/feminine, uncertainty avoidance, and long versus short-term orientation. He argues that national cultures can be differentiated in values. Therefore, we can identify and describe national cultures quantitively in difference categories.

There are five dimensions in Hofstede's model. Power distance index (PDI) is more about social structure rather than personalities. It identifies how societies under different cultures regulate the behavior of their members. In large power distance countries, the less powerful members expect and accept the unequality of power distribution. Lower power members are required to be obedient and respectful to higher power members. For example, employees are rarely encouraged to challenge their superiors. In countries with lower distance power, children are allowed to contradict their parents or challenge their teachers. In ERP usage, power users are a special group of people who have especially strong computer systems aptitude, provide a "first-call" options for other users, and answer most basic user questions within a department, division or other working group before escalating those calls to help desk or experts. According to Hofstede [19], organizations in countries with high power distance are often characterized by centralized decision structures, authority, and formalized rules. High level of centralization, authority and formalization will give more power to higher level users in ERP systems under the constrained hierarchical organizational structure. Therefore, adopting cloud computing may decrease the managerial control of the organization Hence, we suggest the following hypothesis:

H1: The higher the country's PDI score, the more likely companies in that country are NOT to adopt cloud computing.

According to Hofstede [19], uncertainty creates anxiety and people feel threatened by uncertain or unknown situations, for example, knowledge of a life after death. Uncertainty Avoidance Index (UAI) describes how people adapt or cope with these uncertain or unknown situations. In high UAI cultures, people tend to adopt technology, law, rules, and religion to decrease the ambiguity of situations by making events clearly interpretable and predictable. Organizations in high UAI cultures will not take unnecessary risks and only plan and complete those projects with enough value that they can explicitly approve in the market.

Since cloud computing is still a quite new technology to most of the organizations, there are uncertain issues that may cause problems to the business in the future. Therefore, to avoid uncertain issues of cloud computing, organizations in high UAI cultures are inclined to stay in mature technologies. Hence, we suggest the following hypothesis:

H2: The higher the country's UAI score, the more likely companies in that country are NOT to adopt cloud computing.

Individualism and collectivism index (IDV) represents the relationship between the individual and collectivity or the group in a certain society. Individualism and collectivism impact the decision making of a person in the society. Individualism culture is more toward personal decision making with less influence from the surrounding collectivity or group. For example, converting oneself from believing one religion to another is a highly individual activity in the countries with high individualism score while, in high collectivism countries, it is more reasonable that people tend to change their views together with their surrounding groups. In organizations with high individualism culture, employees are more likely to get more freedom in controlling ERP systems and follow their own pace and schedule in completing business processes. Hence, we suggest the following hypothesis:

H3: The higher the country's IDV score, the more likely companies in that country are to adopt cloud computing.

The fourth dimension in Hofstede's model is Masculinity (MAS) and Femininity. Basically, Hofstede [19] argues that gender differences come from the natural differences between men and women. Culture could be more Masculinity or more Femininity according to how the societies define and follow norms in different ways. From his survey, Hofstede found two basic facts. First, historically, masculine cultures tend to be more militaristic; second, masculine cultures tend to be more competitive while feminine cultures try more to encourage cooperation. Masculine cultures focus more on ambition, competition, and material values. Therefore, to increase the competition, organizations with higher MAS scores tend to adopt new technologies. Hence, we hypothesize the following:

H4: The higher the country's MAS score, the more likely companies in that country are to adopt cloud computing.

In his second edition of Culture's Consequences, Hofstede [19] defines a new dimension of national cultures: Long- Versus Short-Term Orientation. This Long-Term Orientation Index (LTO) score is based on a Chinese Value Survey (CVS) conducted in 1985 from students in 23 different countries. Cultures with high LTO scores tend to persist for a longer time with higher perseverance. The key words in LTO connotations summary are persistence, perseverance, personal adaptability to different circumstances, and believe of the happening of the most important events in life in future. On the contrary, people in Low LTO cultures expect quick results, prefer personal steadiness and stability, and believe that the most important events in life occurred in past or occur in present instead of future. Therefore, we expect that organizations in high LTO cultures are more likely to focus on future results with long strategy and operations planning, and more receptive to changes which may offer better results in the future, while as companies in low LTO cultures tend to emphanize short term benefits and are resistant to change. Obviously, cloud computing will lower the IT-related cost immediately by just paying monthly fee instead of the large amount initial investment of IT. However, the cost of cloud computing eventually will be larger than a typical ERP system. Therefore, organizations in high LTO cultures will prefer the lower cost system rather than a cloud computing system.

H5: The higher the country's LTO score, the more likely companies in that country are NOT to adopt cloud computing.

In the following sections, we will focus on the five hypotheses we mentioned above to explain the method of our ERP usage analysis and discuss the analysis results.

4 Research Method and Results

To exam the research model, a survey was conducted. The survey was sent to 547 SMEs in three US cities (one large city, one mid-size city and one small town) and 783 SMEs in three Chinese cities with similar city size pattern. A total of 246 surveys were completed and 235 (141 from US and 94 from China) were used in the analysis. Table 1 shows the industry distribution of the companies.

Table 1. Industry Distribution

Industry	Number	Percentage
Industrial Manufacturing	51	28%
Public Sector	9	8%
High Technology	68	25%
Education	15	6%
Healthcare	44	13%
Utilities	9	4%

Agriculture	11	4%
Others	28	12%

The items used in this survey were adapted from Hofstede's IBM and China survey questionnaires. The reliability of the items was evaluated using Cronbach's alpha [19]. The coefficient alphas for the PDI, UAI, IDV, MAS, and LTO were 0.76, 0.82, 0.83, 0.71, and 0.86, respectively. Pearson's correlation coefficients were also determined to assess the convergence validity. Since all the attribute coefficients were somewhere from high to moderate ranges, they were all retained for future analysis. Additionally, there were no concerns about multi-collinearity because none of the coefficients was extremely high.

The data were analyzed using multiple linear regression analysis. The purpose of a regression analysis is to relate a dependent variable to a set of independent variables. Regression analysis, therefore, was the most appropriate analytical technique in this study to determine the relationship between customer commitment and innovation characteristics, between customer attitude and innovation characteristics, and between customer commitment and customer attitude. Table 1 shows the hypothesis testing results along with the conclusions whether the hypothesis is supported by the statistical analysis at a<.05.

Table 2. Summary of Regression Analysis Results

Hypothesis	Independent Variable	t-value	Significance	Support
H1	PDI	-2.370	0.025	Yes
H2	UAI	-2.876	0.011	Yes
H3	IDV	5.205	<0.001	Yes
H4	MAS	1.098	0.276	No
H5	LTO	-4.341	<0.001	Yes

5 Discussion & Conclusions

As demonstrated by the data analysis above, this empirical study supports hypothesis 1, 2, 3, and 5, while hypothesis was not supported. Consequently, we can answer the research question in our study. First, national cultural variables, such as PDI, UAI, IDV, and LTO are related to acceptance of cloud computing in SMEs; Secondly, national culture should be added to the acceptance framework in cloud computing studies. Table 3 shows the summary of hypotheses testing of this study.

Table 3. Summary of Testing the Hypotheses 1 to 5

Culture Variable	Hypothesized influence on Cloud Computing Adoption	Results

Power Distance Index (PDI)	Negative	Confirmed
Uncertainty Avoidance Index (UAI)	Negative	Confirmed
Individualism Index (IDV)	Positive	Confirmed
Masculinity Index (MAS)	Positive	Not Confirmed
Long-Term Orientation Index (LTO)	Negative	Confirmed

The findings indicate that level of MAS is not an issue related to cloud computing acceptance. The possible reason to explain this result may be because US and China have a similar culture in this dimension. According to Hofstede [19], the MAS score of US and China are 62 and 66, which are very close. Therefore, the results may not show a significant difference between these two countries under a limited sample size.

Our study provides substantive conclusions about the effects of national culture dimensions on cloud computing acceptance in organizations. We formulated a number of hypotheses regarding the influences of various national culture dimensions, such as PDI, UAI, DVI, MAS, and LTO. According to our data analysis, we found evidence to support most of our hypotheses. We can conclude that national culture does influence the cloud computing acceptance in organizations. Hofstede dimensions appeared to be a good theoretical background for cloud computing acceptance study. Higher level of the individualism positively influenced the cloud computing acceptance, while higher level of the Power Distance, Uncertainty Avoidance, and Long-Term Orientation has a significant negatively influence on decision making of cloud computing adoptions.

This research is the first study distinguishing cloud computing acceptance differences between different national cultures by adopting Hofstede's cultural dimension model. Our findings suggest that attention should be paid to differences between different areas, such as China and US. According to different culture and regulations, Chinese and US companies have different management styles and decision-making strategies. Additionally, the results from this study can help global organizations to adjust their strategies regarding to the information systems acceptance policies according to each country's cultural traits.

This empirical study would also provide theoretical background to researchers who are working on cloud computing research. This is the very first paper discussing cloud computing acceptance under cultural circumstances. This research not only provides substantive conclusions about the effects of national culture dimensions influencing cloud computing acceptance, but also emphasizes the importance of culture differences in cloud computing acceptance in SMEs. Culture issue could be an additional dimension in many other cloud computing acceptance studies. Researchers therefore can further expend their research models to more generalized applications.

The empirical findings would be beneficial in the theoretical understanding of the adoption behavior of cloud computing technology. It may also help in driving the development and execution of a better acceptance framework in cloud computing research.

In this study, we only focus on two different cultural areas in the cloud computing acceptance research. In the future, we are planning to expand to other nations, such as

European countries [19] to further test the relationship between the cultural differences and cloud computing acceptance. Furthermore the authors plan to integrate information objects of cultural aspects into existing Enterprise Information Reference Model Frameworks [4,21] .

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