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20. Diffusion and Evaluation of E-Government Systems: A Field Study in China

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Abstract

As IT/IS application in governmental organizations gains more and more attention from both academics and practitioners in China, the diffusion of e-government systems has become one of the central research issues in this fast growing economy. In this paper, we follow a conceptual model consisting of two dimensions to evaluate the IT/IS application status of Chinese governments. With a field study conducted in a local government in Beijing, the capital of China, we utilize the model to determine the e-government development level in this administrative district. Furthermore, a behavioral research model for analyzing the factors influencing e-government systems evaluation in the Chinese cultural context is proposed based on classical IT/IS adoption theories. In the light of survey data, the relationships between ease of use, usefulness, fitness, and user evaluation towards e-government systems are validated, providing us with more in-depth understanding about the characteristics and process of e-government diffusion in such Chinese organizations.

Keywords: IS diffusion, IS evaluation, e-government, fitness, Chinese culture

Introduction

In recent years, e-government has created a lot of interest among researchers in the IS field. The adoption of IT/IS leads to dramatic changes in the relationships between governments and citizens (G2C), governments and businesses (G2B), and governments and governments (G2G). On the other hand, policy makers and practitioners are confronted with new challenges as e-government systems are introduced. Issues regarding IT/IS evolution, adoption, and diffusion in governmental organizations have been widely addressed at international academic conferences, as well as major MIS journals (Grant 2005; Hackney et al. 2005; Srivastava et al. 2006). However, to the extent of our knowledge, the studies on e-government in China on either theoretical or empirical perspectives are still scarce.

As the economy of China keeps growing rapidly, IT penetration brings dramatic changes to organizations and individuals on various respects. To some extent, the impact of IT/IS application in China might be even deeper than that in any other country, as China is changing from an isolated centrally-controlled economy to a market open to the global economy (Martinsons 2005). As one of the driving forces of IT/IS application, the Chinese government has long been striving to promote the use of information systems and was rewarded with continuously rising ranking in the global chart of e-government application (or readiness) (Liu 2006; UN. 2005; West 2006).

However, observations demonstrated that, quite often, IT/IS adoption in Chinese governments is not developing smoothly. In the practice and research of IT application and management, it is often questioned why some systems or software are well utilized, while others are not (Legris et al. 2003). While the power of information technology continues to improve dramatically, IT practitioners are still troubled with the long-existing problem that end-users are often unwilling to use available information systems that, if used, would generate significant performance gain (Davis 1989). In the context of Chinese governmental organizations, this is even a more perplexing problem concerning CIOs or IT officials. Consequently, it is worthwhile to explore the potential patterns regarding diffusion of IT/IS in Chinese governmental organizations, which may provide helpful reference for both practitioners and scholars to better understand the situation of IT/IS application in the particular environment of China.

As a typical Eastern civilization, Chinese culture has always been deemed as very much different from the West in many aspects (Hofstede 2001). Some studies have examined the characteristics of IT/IS management in Chinese companies (Guo et al. 2005; Mao et al. 2006; Martinsons 2005). While a lot of Chinese companies have already transformed into international enterprises, in which different cultures are fusing gradually, governments in China remain as traditional Chinese organizations where all the characteristics of Chinese culture are preserved. Therefore, it is meaningful to take the culture issues into account while studying the IT/IS diffusion in Chinese governments.

Most of our field research that will be presented in this paper was conducted in the government of an administrative district in Beijing, the capital of China. The district is one of the largest in Beijing, accounting for a big portion of the capital's economy. It is also where the Central Business District (CBD) of the city and the main venue of 2008 Olympic Games are located. There are over 3,000 foreign capital enterprises in the district, and 130 of them are among the 500 largest companies globally.

The first target of the study was set at evaluating the current state of IT/IS diffusion in the district government through an empirical survey with an analytic model which incorporates two conceptual diffusion dimensions, so as to identify the critical issues in IT/IS application and management in the government. Base on the results of this tentative analysis, a user-centric model for analyzing the factor influencing IT/IS evaluation in Chinese government is postulated and validated in the light of survey data. Furthermore, the results of the above empirical surveys are discussed from a cultural perspective (Hofstede 2001), aimed at more in-depth understanding about the characteristics and process of e-government diffusion in such Chinese organizations.

2. E-Government Diffusion Status Analysis

Overviews of IT/IS Application in the District Government

More than 10,000 employees work for the local government of the studied district, including all of its departments and other subsidiaries. Since China's accession to the World Trade Organization (WTO) in 2001, the district government started its adoption of advanced information technologies to improve international communication. Especially since 2003, the executive officers have paid more and more attention to e-government services and electronic data storage/exchange in the local government, and consequently lots of applications have been implemented, such as the "One-Stop Service System", the "E-Document Exchange

System”, and the “Public Service Management System”. Currently, the government allocates 4 million dollars in its annual budget to the development of e-government. Combined with the IT budgets of all subsidiaries, the annual IT/IS spending of the government has exceeded 20 million dollars and the number is increasing continuously (CINC. 2006). While the large amount of IT/IS investment has contributed to the fast and extensive network connections in the district, some serious problems are increasingly concerning the officials, such as the lack of utilization of established systems, the conflicts between different systems, the “information island” problems, and so on. The most critical view looks upon IT/IS implementation as a “money burning” behavior of the government with high expenditure and low performance. Facing such difficulties, most of the government officials feel that it would be helpful to develop efficient instruments for measuring the IT/IS diffusion state in the local government in search of enlightenment regarding e-government practice.

Dimensions of IT/IS Diffusion: Width and Depth

Since the innovation diffusion theory (IDT) was established by Rogers in 1962, the process of technology diffusion has been described as a phenomenon like spread of water waves all along (Rogers 1995). While studying the diffusion of software engineering technology, Bayer and Melone noticed that different users and organizations may adopt and utilize new technologies in different depth (Bayer et al. 1989). Later, Chen and Reimers defined the two dimensions for judging the states of IT/IS diffusion in enterprises. One is Diffusion Width, or the degree of expansion, representing the extent to which IT/IS has reached in the organization. The other is Diffusion Depth, or the degree of penetration, representing the extent to which an organization depends on IT/IS (Chen et al. 2002). Ideally, the IT/IS diffusion in governmental organizations should progress on both directions. In practice, however, expanding is often easier than penetrating. In order to examine the status of IT/IS diffusion in our focus government, we inherited the two dimensions in this research.

Method and Data Collection

We conducted a survey through the intranet among CIOs of all subunits (including 42 sub-districts and 50 departments) of the focus government to estimate the current state of IT/IS diffusion. CIOs can download the questionnaires from the intranet and respond via e-mail or fax during one week. We received 63 responses in total. With uncompleted questionnaires omitted, 56 examples were used in our statistic analysis finally.

Using some instruments of former studies as references (Finlay et al. 2000; Guo 2005), the measurement scales of the two dimensions, diffusion width and depth, are shown in Table 1. The items were measured using a five point Likert-type scale, ranging from “strongly disagree” (1) to “strongly agree” (5).

The results of principal component analysis (PCA) with varimax rotation for the two diffusion constructs are also shown in **Table 13**, indicating good convergent validity and discriminant validity. As the Cronbach Alphas of the two constructs are higher than 0.7, the internal consistency reliability of the scales are deemed adequate (Gefen et al. 2000).

In addition, we also included three multi-options questions regarding the basic tasks of IT/IS personnel, goals of IT/IS adoption, and fatal disadvantages of unsuccessful systems respectively. While the first two questions were inherited from a former survey conducted in business settings (Guo 2005), the third question can be regarded a pilot question for the empirical study of the user-centric model to be discussed below.

Table 13: Measurement scales and PCA results of the two diffusion dimensions

Constructs	Scale Items	PCA	
		1	2
Diffusion Width	DW1: Most of the employees in the unit use IT/IS applications in day-to-day government activities.	0.84	0.14
	DW2: Most of the day-to-day government transactions in the unit are completed through IT/IS applications.	0.72	0.43
	DW3: IT/IS applications have been installed in most of the workplaces in the unit.	0.86	0.04
Diffusion Depth	DD1: The core government transaction of the unit depends on IT/IS applications highly.	0.35	0.83
	DD2: The critical decision-making process of the unit depends on IT/IS applications highly.	0.04	0.94
	DD3: The supervision and examination of working performance in the unit depend on IT/IS applications highly.	0.15	0.83

Results and Implications

As expected, the IT/IS diffusion width and depth are not on an even level in the focus government. Diffusion width got a higher mean value than diffusion depth (4.28 versus 3.19). With 3.5 as a boundary value (Guo 2005), a chart illustrating the distribution of surveyed units is shown in *Figure 3*.

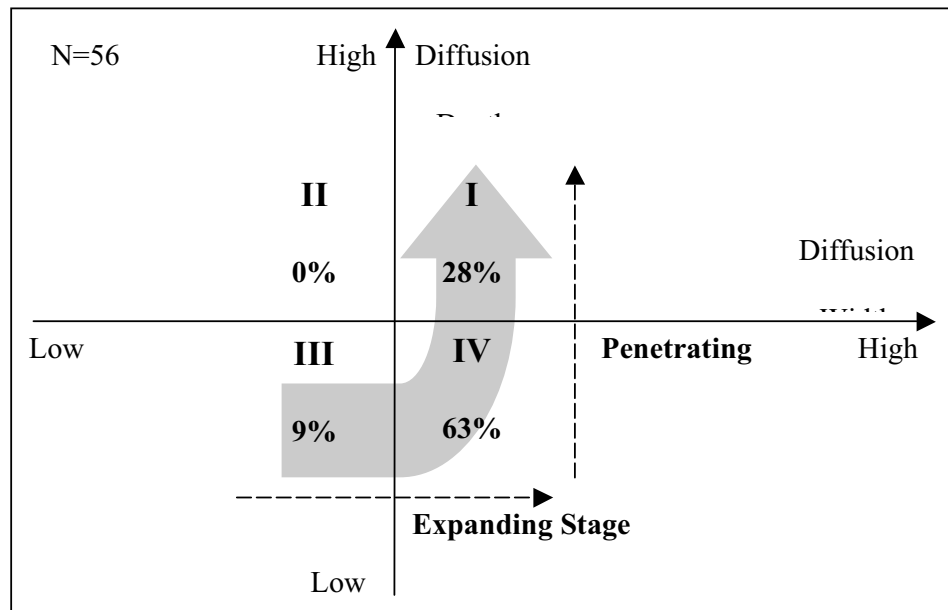


Figure 3: Current IT/IS diffusion state in the focus government: diffusion width and diffusion depth

While 28% of the subunits, including some early IT/IS adopters such as the police and finance department, have reached high values on both dimensions, two thirds of the samples report a high value of diffusion width together with a low value of diffusion depth. It can be inferred that most subunits of the focus district government tend to follow a path from the expanding stage to the penetrating stage in their IT/IS practice process, as indicated with the

arrow in *Figure 3*. Consequently, it can be concluded that, in the current period, the most important task of IT/IS application and management in the focus government lies in improving the depth of IT/IS diffusion which means developing IT/IS applications compatible to the core transactions of government, rather than satisfying superficial needs.

Generally, CIOs of the subunits are supposed to be the right persons who is not only good at IT/IS theory and practice, but also familiar with the business of the unit. Our survey results, however, indicate that most efforts of the CIOs have been expended on maintenance and support work rather than requirement analysis and IT/IS strategy design (See Q1 in *Table 14*).

Table 14: Top three answers of the multi-options questions

Options	Amount	Percent
Q1: The core tasks of CIO and IT/IS office in the unit are		
Maintaining current systems and providing technical support.	52	93%
Analyzing and predicting requirement of IT/IS investment.	7	13%
Designing and developing IT/IS applications in the particular situation.	6	11%
Q2: The goals of IT/IS adoption and utilization in the unit are		
Increasing the efficiency of transactions.	42	75%
Enhancing the governance and control of the government.	25	45%
Improving the image and trustworthiness for of the government.	10	18%
Q3: The fatal disadvantages of unsuccessful IT/IS applications in the unit are		
The system does not fit with day-to-day government activities or other implemented IT/IS applications. (lack of fitness)	39	70%
The system is too complex to be operated freely by users. (lack of ease of use)	39	70%
The functions of the system are not powerful enough, can not meet users' demands. (lack of usefulness)	22	39%

Currently, the majority of systems are implemented top-down in the government. Although support from top leader may help overcome some obstacles, IT/IS diffusion depth is still likely to run into some bottlenecks in the situation. With such conditions, a user-centric evaluation framework may be helpful for understanding the IT/IS implementation in the government. As the first emphasis of e-government at the current stage is increasing the efficiency of government to enhance the governance and control, rather than improving e-service to citizens to heighten the image of government (See Q2 in *Table 14*), we will focus our user-centric study on the government employees in the subunits who use IT/IS in work. Meanwhile, the answers of the Q3 provide us with exploratory support for constructing the user-centric IT/IS evaluation analysis framework for governmental organizations.

E-Government Evaluation Model and Its Empirical Test

Reviews on User-Centric IT/IS Evaluation

Based on the analysis of current IT/IS diffusion state in the focus government and the responses to some related questions, we concluded that the lack of fitness between the systems and the attitude of end-users is the major obstacle in current top-down IT/IS implementation. Therefore, constructing a user-centric IT/IS evaluation framework will be a

feasible way to guide IT/IS development in Chinese governmental organizations as they are transiting from the expanding stage to the penetrating stage.

The evolution of user-centric IT/IS evaluation model is shown in **Figure 4**. In the early 1980s, motivated by management's desire to improve productivity of IS, researchers started to measure and analyze user satisfaction. As the first variable that described individual's feeling, satisfaction was an inclusive concept that covered many aspects of one's reactions to the target IT/IS (Bailey et al. 1983). With increasing attention on user perception to IT/IS, the famous technology acceptance model (TAM) (Davis 1989) has been prevailing in the area of IT/IS research through the past two decades. Dividing satisfaction into usefulness and ease of use as the two most important dimensions for user recognition regarding the systems, TAM has been used in both adoption studies and evaluation research extensively (Keil et al. 1995; Legris et al. 2003; Venkatesh et al. 2000). Around the Millennium, the third generation of IT/IS evaluation models appeared with the addition of some factors from usability design and human-computer interaction (HCI) research. Microsoft usability guideline (MUG) is one of the most influential, comprising five specific categories: content (close to usefulness for some kinds of systems such as web sites), ease of use, promotion, made-for-the-medium (MFTM), and emotion (Agarwal et al. 2002).

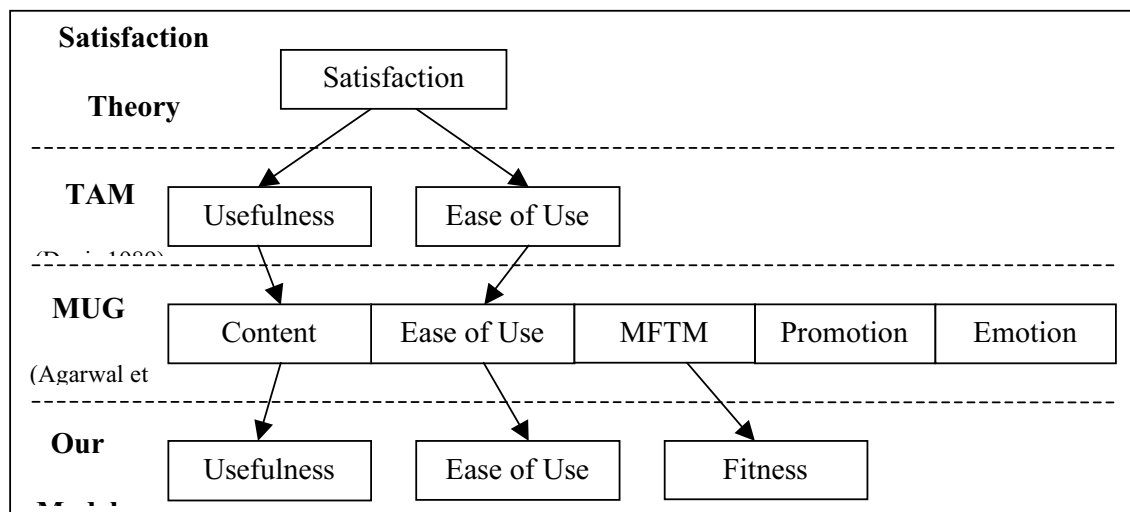


Figure 4: The evolution of theoretical models of user's IS evaluation

Although MUG provides a powerful model that has been used to evaluate some on-line e-commerce systems (Agarwal et al. 2002; Venkatesh et al. 2006a; Venkatesh et al. 2006b), some MUG factors have been proved not compatible for government settings. While promotion, representing advertising investments and their performance, is very important to web sites, it generally has little influence on user's evaluation of the system in the mandatory adoption setting of governmental organizations. Similarly, the discussion on emotion is more meaningful regarding a hedonic website rather than a system in workplace. Therefore, we derived a new IT/IS evaluation model for studying the practice in Chinese governmental organizations based on the interrelated works mentioned above.

IT/IS Evaluation Model in Chinese Governmental Context

As shown in **Figure 4**, our model consists of three dimensions. With inclusion the two TAM variables, the model inherited the three basic hypotheses listed below:

Hypothesis 1: Perceived usefulness will have a positive effect on general evaluation toward the target system.

Hypothesis 2: Perceived ease of use will have a positive effect on general evaluation toward the target system.

Hypothesis 3: Perceived ease of use will have a positive effect on perceived usefulness.

While some implemented systems such as the office automation (OA) systems contributed to IT/IS diffusion in the expanding direction, specialized systems which are compatible to core transactions of the units will enable the process of IT/IS diffusion of the government to develop in the direction of penetration. As shown by Q3 in **Table 14**, fitness with daily work and other IT/IS applications is at least as important as usefulness and ease of use while evaluating the system. Comparing with MFTM in MUG, where fitness represents the system's agility for meeting users' changeable needs in time (Agarwal et al. 2002), the fitness factor in our model describes a more stable task-system fit.

The other factor similar to fitness is a classical IDT attribute, compatibility, defined as the degree to which an innovation is perceived as consistent with the existing values, past experiences, and client needs (Rogers 1995). As a user-centric model, we omit sociocultural aspects of the factor and focus on the triangle relations among user, task, and IT/IS. Thusly we define fitness as user perceptions on the extent to which the system fit with all aspects of work, including daily activities, work style, and other systems used in work. We believe that fitness perceptions would influence on IT/IS evaluation both directly and indirectly through perceived usefulness as perceived ease of use does. Then we have the below hypotheses:

Hypothesis 4: Perceived fitness will have a positive effect on general evaluation toward the target system.

Hypothesis 5: Perceived fitness will have a positive effect on perceived usefulness.

Method and Data Collection

To test the power of our model for interpreting user's attitudes, we conducted another survey to investigate users' evaluations and perceptions of a new public service management system implemented in the focus district government in 2006. The system we studied was designed as an integrated workflow management system to support and routinize procedures of public service in sub-districts. Approximately 200 service-agents in 42 sub-districts are supposed to be the end-users of the system. As the questionnaires were distributed after a series of trainings, we assumed that all potential responders had known about the main functions of the system and had more or less experiences of usage. Finally, we got 97 valid responses used in data analysis.

While inheriting the measurement scales of usefulness and ease of use from Davis' original work (Davis et al. 1989), we developed the scale items for the new construct, fitness, with a categorization-prioritization method (Davis 1989) through a pilot study among employees of the IT/IS office of the focus district government. In 16 candidate items drawn from former

studies regarding related factors such as compatibility, MFTM, task-technology fit, job fit, and job relevance (Agarwal et al. 2002; Goodhue et al. 1995; Moore et al. 1991; Thompson et al. 1991; Venkatesh et al. 2000), the final three items listed in *Table 15* were selected for our survey. In addition, the two items of the construct of user evaluation have also been inherited from some former studies (Davis et al. 1989; Venkatesh et al. 2006a). All the 13 items for the three independent constructs and one dependent variable were measured by a five points Likert-type scale.

The assessment of reliability and validity follow the same methods used in the first survey of our study. *Table 15* illustrates the PCA results of the three independent constructs and all the Cronbach's Alphas of four variables are higher than 0.8, demonstrating that the reliability and validity of the validation study are all on a satisfying level.

Table 15: Measurement scales and PCA Results of the three IT/IS evaluation dimensions

Constructs	Scale Items	PCA		
		1	2	3
Usefulness origin from Davis (1989)	USE1: Using the system would improve my job performance.	0.79	0.26	0.11
	USE2: Using the system in my job would increase my productivity.	0.82	0.36	0.13
	USE3: Using the system would enhance my effectiveness on the job.	0.83	0.15	0.26
	USE4: I would find the system useful in my job.	0.74	0.02	0.47
Ease of Use origin from Davis (1989)	EOU1: Learning to operate the system would be easy for me.	0.16	0.84	0.09
	EOU2: I would find easy to get the system to do what I want it to do.	0.30	0.71	0.29
	EOU3: It would be easy for me to become skillful at using the system.	0.13	0.85	0.23
	EOU4: I would find the system easy to use.	0.17	0.84	0.21
Fitness	FIT1: Using the system is compatible with my day-to-day work.	0.44	0.26	0.70
	FIT2: Using the system fits into my work style.	0.16	0.20	0.89
	FIT3: I would find the system fits well with the other IT/IS applications used in my work.	0.22	0.30	0.85

3.4 Validation Results

We used the PLS-Graph software (version 3.0) for the analysis, utilizing the bootstrap resampling method (200 resamples) to determine the significance of the paths within the structural model (Chin et al. 2003; Gefen et al. 2005). *Figure 5* shows the results of the test of the hypothesized IT/IS evaluation model.

The results reveal that the new factor, fitness, has significantly positive effects on both evaluation and usefulness, demonstrating its importance in this user-centric evaluation

framework in the current IT/IS diffusion state of the focus government, which is characterized with a high expansion degree and a low penetration degree.

Meanwhile, while four of the five hypotheses in the model are supported by the statistical results, the impact of ease of use on evaluation was not validated in our study. Additional interviews with some service agents in the government who gave low scores to perceived ease of use reveal that most of them tend to appeal for more training and will still keep using the system. The reason for this unexpected result may lie in some characteristics of Chinese culture, which will be discussed in the next section.

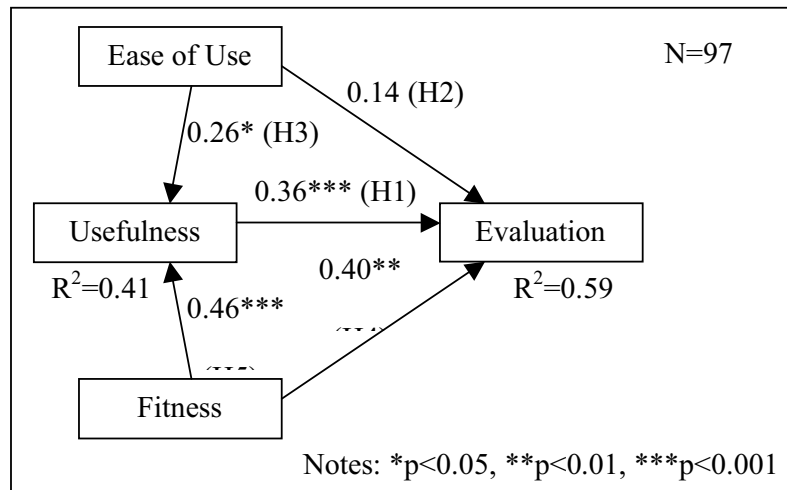


Figure 5: The PLS validating results of the IS evaluation model

Discussions

From the results of the two parts of our study, we found that while there is a high value of diffusion width and a low value of diffusion depth in the IT/IS application of the focus government, end users care more about fitness rather than ease of use when they are evaluating an information system. It is not easy to explain this phenomenon with classical theories such as IDT and TAM. As mentioned above, we suggest to probe into this result from a cultural perspective.

In Hofstede's famous UAI-PDI matrix, China has been described as a culture with long power distance (defined as the extent to which the less powerful members in an organization accept and expect that power is distributed unequally) and weak uncertainty avoidance (defined as the extent to which a culture programs its members to feel either uncomfortable or comfortable in unstructured situations) (Hofstede 2001). Moreover, there is a long existing principle in Chinese administration which is called "government by man", in contrast to the Western idea of "government by law" (Hofstede 2001). In this case, when the head of government recognizes the importance of IT/IS application, implementation will be carried out smoothly under direct supervision of top administrators. Such strong support enables Chinese government to do well in IT/IS development during the expanding stage characterized by high diffusion width and the success of governmental portals (UN. 2005).

Unfortunately, the effects of such characteristics of Chinese culture change when IT/IS application in governmental organization evolves to the penetrating stage. With leader-centric

evaluations and top-down implementation patterns, many systems implemented are superficial. They facially fit with the bosses' expectations but actually conflict with the real needs of tasks. Obviously, such systems would never be used effectively. The problem has more or less impeded most of IT/IS applications. As far as the system studied in this paper is concerned, service agents were the last one to know about the system. They were expected to accept the system without any participation in the design and evaluation before or after the implementation. This phenomenon was observed not only in the cases of small systems with hundreds users, but also in the cases of large public e-service systems facing millions of citizens. While a lot of MIS studies emphasized top-leader supports in IT/IS implementation (Chen et al. 2007), our study provides evidence to show that top-leaders' determination can often lead to harm in the e-government practice in a Chinese cultural context.

In our IT/IS evaluation model, the significant impact of fitness has been validated by empirical tests among users, which can also be linked with Chinese cultural characteristics. Harmony, a more nonobjective concept than fitness, has played a continuously important role in Confucian values since 500 B. C. and rooted in Chinese society in all ages (Hofstede 2001; Hofstede et al. 1988). In other words, the fitness between the technology and all other aspects of work are considered more important in the Chinese culture.

The lack of direct relationship between ease of use and evaluation in user's perceptions has been observed in other studies in China and its neighboring countries (Mao et al. 2006; Straub et al. 1997). Ease of use is of the most important characteristics of an excellent system. When a user feels that a system is difficult to use, the reason may lie in either the system or the user. The responses in additional interviews showed that most service agents in the government would choose self-examination, a typical behavior by the standard of Confucian traditions (Hofstede et al. 1988). In our survey, all respondents have used the system less than three month. Comparing with the answers to Q3 in *Table 14*, we predict that after longer time of using, the users with low perceived ease of use all the time will lose their patience gradually and the impact of ease of use will show up.

Conclusions

Based on analysis of IT/IS diffusion state in a Chinese local government through diffusion width and depth dimensions, the paper discussed a user centric IT/IS evaluation model composed of three determinants, namely usefulness, ease of use, and fitness, in Chinese governmental contexts. After validating four of the five hypotheses through empirical tests, we also analyzed the results from a cultural perspective. These findings may help better understand the IT/IS diffusion characteristics in Chinese governmental organizations and evaluate e-government applications in a more feasible way.

To further test the dimensions of IT/IS diffusion state and the evaluation model in Chinese governments, on-going research will compare different adoption stages in different organizational contexts.

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