

A Study on Technology Acceptance for Cloud Service System Development

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Abstract

The ultimate goal of software development is to satisfy the user requirements. Requirement analysis and user acceptance test are most important activities during the software development process. However, major users of a cloud service system are usually outside the organization and the requirement specifications and system validation anticipated by the insiders before going to online service may not satisfy the potential users. This study combines the concepts of Technology Acceptance Model (TAM) and Information Systems Success Model (ISSM) to be integrated to the iterative incremental development process of a cloud service system. It aims to establish a bridge to incorporate the empirical investigation results as user requirements feedback in the agile software development process, in order to help elevating user acceptance and satisfaction of the cloud service system.

Keywords: Technology Acceptance Model, Information Systems Success Model,
Agile Software Development

1. Introduction

The success of a cloud service system, like traditional application systems, depends on the acceptance and satisfaction of end users. However, most of the ubiquitous end users of a cloud service system are usually outside the organization. The requirement specifications and system validation anticipated by the insiders before going to online service satisfy the potential users. On the other hand, Technology Acceptance Model (TAM) has been broadly used to observe the user acceptance and satisfaction of a booming software technology (Venkatesh and Davis, 2000). Information Systems Success Model (ISSM) has also been proposed to find out the essential system features to make a software service successful (DeLone and McLean, 2004). However, most TAM or ISSM studies contribute to investigate whether specific technology advancements achieve user acceptance and satisfaction and wish those findings useful for future references. There has been little research addressing a mechanism to convert the investigation feedbacks into further system development process.

SCRUM is an iterative and incremental agile software development framework for managing the development process. The role of Product Owner is responsible for mediating the user requirements and system development throughout the overall development process to incrementally examine the user acceptance and satisfaction. Scrum emphasizes more on effective human interaction, confidence, and morale, to facilitate the distribution of knowledge specified in formal documents (Sutherland and Schwaber, 2007).

This study combines the concepts of TAM and ISSM to be integrated to the iterative incremental development process of a cloud service system. It aims to establish a bridge to incorporate the empirical TAM and ISSM concerns as user requirements feedback in the SCRUM process, in order to strengthen the potentials of user acceptance and satisfaction of the cloud service system.

2. Literature Review

2.1. Cloud Service

Cloud Service comes from cloud computing with large scale IT functionality via online virtual computer room. Cloud Services are typically divided into 3 levels (Iyer and Henderson, 2010). (1) Software-As-A-Service (SaaS) is provided as an application software or a web service so that the user does not install and maintain/update the application software and the associated hardware equipment. Microsoft Office Online and some online ERP are examples. (2) Platform-As-A-Service (PaaS) is provided as a software development platform

to facilitate rapid application development, such as Google App Engine, Microsoft Azure, and Hadoop. (3) Infrastructure-As-A-Service (IaaS) can be rented by the users as IT utilities, such as hardware, server, storage, network, etc. Various Amazon services are representative examples.

There are 3 types of cloud services (Iyer and Henderson, 2010; Nabil, 2010): (1) Public Cloud allows users to pay as you go. There are humangous and extendable resources in the Public Cloud. (2) Private Cloud ensures the sensitive organization data only accessed inside the organization without payment. (3) Hibrid Cloud usually combines both. It typically makes Private Cloud as the major service providers, and Public Cloud as accessory or backup role.

For developing a public cloud service system, the service providers need to anticipate the user requirements of the ubiquitous outsiders. Most system development methodology does help justifying the appropriateness of the user requirements. They are usually elicited by interviewing the major operators or the domain experts. However, it may be better guarded for the success of system implementation with sufficient insight investigation or feedback from the potential users.

2.2. Technology Acceptance Model

Technology Acceptance Model (TAM) has been proposed to estimate and predict whether the users accept a newly developed information technology (Davis, 1986). TAM adopts the view point of internal perception to judge the user acceptance of a new technology (Davis, 1989). Following the track of Theory of Planned Behavior (Fishbein and Ajzen, 1975) and Innovation Diffusion Theory (Rogers, 1983), TAM is more suitable to measure IT acceptance, including: (1) Perceived Usefulness, (2) Perceived Ease of Use, (3) Attitude Toward Using, (4) Intention to Use, (5) Usage Behavior. They are illustrated in Figure 1.

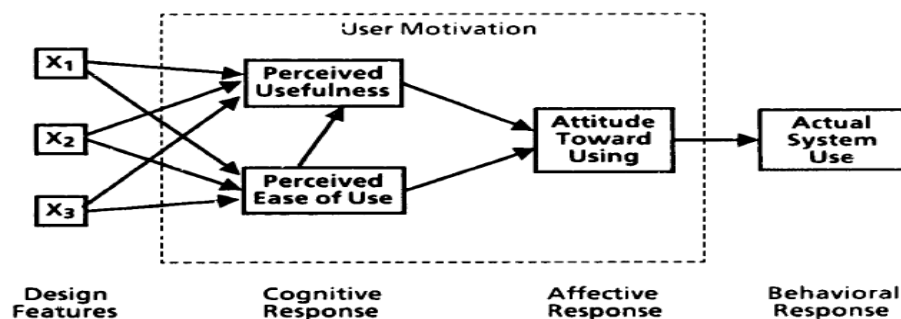


Figure 1. Technology Acceptance Model

Source: Davis, F.D. A Technology Acceptance Model for Empirically Testing New End-User Information Systems : Theory and Results, Doctoral Dissertation, MIT Sloan School of Management, Cambridge, MA, 1986.

TAM studies have been popular for many kinds of information technologies including: work processing (Davis, 1989), computer training (Schneberger, Amoroso and Durfee, 2007/2008), telecommunication (Djamasbi, Fruhling and Loiacono, 2009), healthcare (Chau and Hu, 2002), network banking (Guriting and Ndubisi, 2006), etc. Some researches develop similar investigation instruments, such as: Unified Theory of Acceptance and Use of Technology (Venkatesh, Morris, Davis and Davis, 2003). Others compare and discuss among various acceptance models (Taylor and Todd, 1995). Venkatesh and Davis (2000) develop TAM2 to add various affecting factors and adjust the model construct.

Hung, Liang and Chang (2005) conduct a meta-analysis based on 58 articles published in major IS journals during 1989-2003. The article reveals that more 50% of the hypothesis tests are significantly positive and concludes that TAM is a table instrument for IT acceptance measurement. However, they do not consider the extension of TAM bring more explanation power. Therefore, the original TAM should be enough to measure the continuous IT innovation, such as mobile computing, social network in the cyberspace, e-commerce, e-service, cloud services, etc.

The reason to measure is to make improvement. Although TAM has been popular in the IS literature to make early acceptance measurement in order to develop the improvement strategy, there has been little research addressing a systematic approach for continuous acceptance improvement. In addition to increase the IT perception knowledge, it should be contributable to establish a workable framework to convert the investigation feedbacks from TAM studies into user requirements of future system development process.

2.3. Information System Success Model

DeLone and McLean (1992) propose a model of information system success consisting 6 aspects: System Quality, Information Quality, Use, User Satisfaction, Individual Impacts, and Organization Impacts. In addition, Molla and Licker (2001) proposed to add “trust” and “services” into the consideration. Later, DeLone and McLean (2003) modify the model as shown in Figure 2.

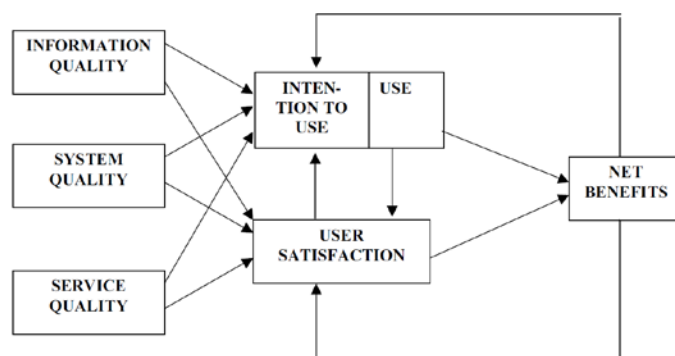


Figure 2. Updated DeLone & McLean IS Success Model

Source: DeLone, W. H. and McLean, E. R. "Measuring e-Commerce Success: A Applying the DeLone and McLean Information Systems Success Model," *International Journal of Electronic Commerce*, (9:1), 2004, pp.31-47.

Regarding to the success of e-commerce systems, DeLone and McLean (2004) also suggest to consider more factors. Wang (2008) considers Perceived Value as important. Schaupp, Bélanger, and Fan (2009) consider Individual Impacts as critical. Hevner, Collins and Garfield (2002) consider the rapid changing market and uncertain customers as the major challenges affecting the success of e-commerce system development. They are summarized in Table 1.

Table 1. E-Commerce Software Development Research Model

Organization Structure and Inter-Unit Communications	New Technology Development Environment	Relationship with the External Environment
1. Achieving Effective Communication in Organizational Flux	4. Leveraging E-commerce Technology	7. Maintaining Customer Engagement
2. Managing Market Versus Customer Goals	5. Provisioning E-commerce Standards and Skill Sets	8. Unearthing the Requirements
3. Positioning the Product Function	6. Measuring for Improvement	

Source: Hevner, A. R., Collins, R. W. and Garfield, M. J. "Product and Project Challenges in Electronic Commerce Software Development," *Database for Advances in Information Systems*, (33:4), 2002, pp. 10-23.

Peterson, Kim, Kim and Tamura (2002) review the literature to summarize 19 articles in 20 years and conclude 18 key factors affecting the success or failure of an information system, as listed in Table 2.

Table 2. Eighteen IS (Failure) and Success Factors

IS development factors	
1. (Lack of) Top management support	10. (Lack of) Project leader's project monitoring/control
2. (Lack of) User participation in the project	11. (In) Adequate training for the team members
3. (III) Alignment of project and corporate goals	12. (Insufficient) Peer review on project progress

4. (No attempt) Reengineering business process	13. (In) Experience of team members
5. (Lack of) Clearly stated objectives	14. (Lack of) Team member commitment
6. (Lack of) Detailed project plan	15. (Lack of) Team member self-control
7. (Im) Proper project scope	16. (Little use) Utilizing a prototype
8. (Lack of) Project leader's feedback to team	17. Utilizing an (in) effective methodology
9. (In) Experience of project leader	18. Use of (in) appropriate technology

Source: Peterson, D. K., Kim, C., Kim, J. H. and Tamura, T. "The Perceptions of Information Systems Designers from the United States, Japan, and Korea on Success and Failure Factors," *International Journal of Information Management*, (22:6), 2002, pp. 421-439.

Yeo (2002) points out that the failure rate for information system development is higher than other high technology project. A number of other articles address the failure factors of information system development. Most of them agree the important factors include: requirement specification, human resource management, schedule control, cost control, quality control, and efficient development process with appropriate implementation disciplines communication. Therefore, the research and practice issues for better development process and tools have been addressed continuously in order to improve the dilemma.

2.4. System Development Process

The information system development process includes requirements analysis, system analysis and design, program coding, testing, and maintenance. Development methodology has been evolved from the traditional waterfall model (Royce, 1970), incremental model (Mills, 1971), prototyping, spiral model (Boehm, 1988), Rational Unified Process (Kruchten, 2004) or the generalized Unified Process (Jacobson, Booch and Rumbaugh, 1999), to more advanced concepts. Since the "Manifesto of the Agile Alliance" proposes some useful guidelines (Beck et al. 2001), the agile development has been getting popular. The agile development emphasizes more on effective teamwork collaboration and software outcomes of good quality, rather than the routine process and documents.

SCRUM is an iterative and incremental agile software development framework for managing software development process. There are three major roles. Product Owner is responsible for deciding functional specifications, development schedule, and completion definition. Scrum Master is responsible for the coordination and communication among team members to eliminate obstacles of teamwork in the Scrum process. Team Members with appropriate skills are responsible for the implementation of the system development.

The Scrum process consists of several kinds of meeting: Release Planning Meeting, Sprint Planning Meeting, Daily Scrum Meeting, Sprint Review Meeting, Sprint

Retrospective Meeting. The work products during the Scrum process includes: Product Backlog, Sprint Backlog, and Burndown Chart. The overall Scrum process is iterative and incremental as shown in Figure 3.

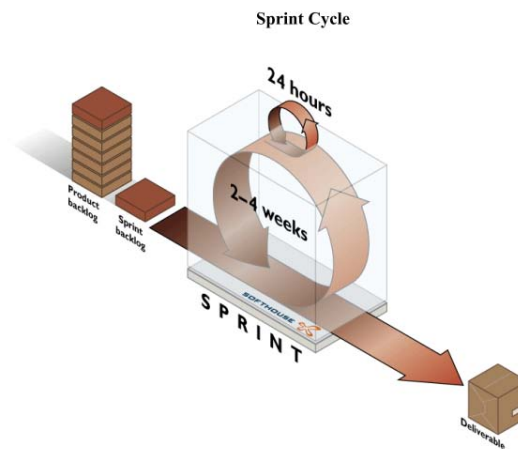


Figure 3. Scrum Process

Source: Sutherland, J., Schwaber, K. "The Scrum Papers: Nuts, Bolts, and Origins of an Agile Process," Draft, 2007 (available online at http://scrumtraininginstitute.com/home/stream_download/scrumpapers).

Agile software development promotes adaptive planning, evolutionary development and delivery, and encourages rapid and flexible response to change. With appropriate management, it should help to solve some of the problems associated with IS failures. However, it does not address the design issues which are closely related to software quality. Therefore, our earlier research (Tseng and Sung, 2012) integrates the concepts of software design framework, such as Struts, Spring, and Hibernate into Scrum process with agile flexibility (see Figure 4) to enhance the system scalability, maintainability, and reusability. In the literature about newer system development framework, there is still rare research integrating formal model with user acceptance and satisfaction issues which are most critical to the success of a software development. That induces our further research motivation.

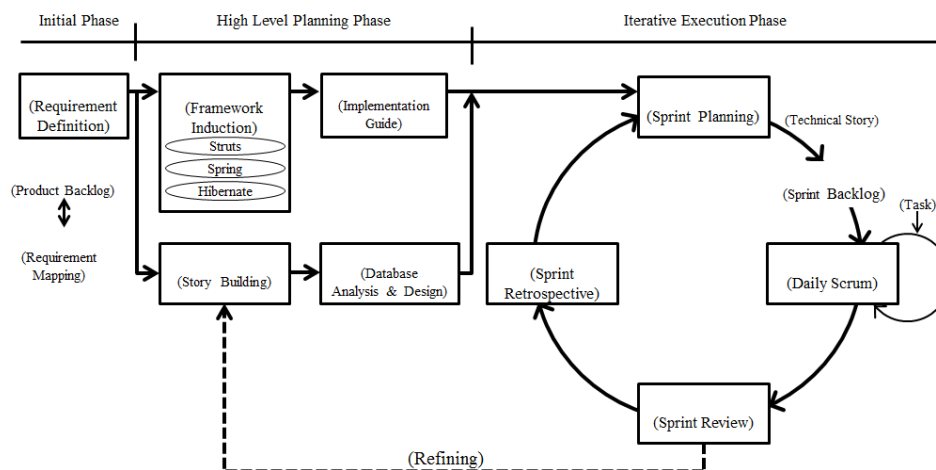


Figure 4. Development with SCRUM Process and SSH Framework

Source: Tseng, S.F. and Sung, H.H. "A Study on System Development based on Scrum Concept and SSH Framework," 23th International Conference on Information Management (2012 ICIM), Kaohsiung, Taiwan, May 2012.

3. Research Framework

This study intends to establish a bridge to incorporate the empirical TAM and ISSM concerns as user requirements feedback in the SCRUM process. The data analysis results can be incorporated into the Product Backlog of the next release and distributed to Team Members in the next Release Planning Meeting. The research framework is shown in Figure 5.

In the literature of TAM and e-commerce, Trust, Risk, Credibility are also important factors (Al-Gahtani, 2011; Gefen, Karahanna & Straub, 2003; Qiu & Li, 2008; Yoon, 2009). They should be related to security and service quality, and affect individual perceptions and intention to use, satisfaction, etc. They would be addressed in the Cloud Service Functions, Interfaces, and Features to include the concerns of ISSM, and mediate the TAM and SCRUM, as shown in Figure 5. Hypotheses would be formulated and tested in the later analysis.

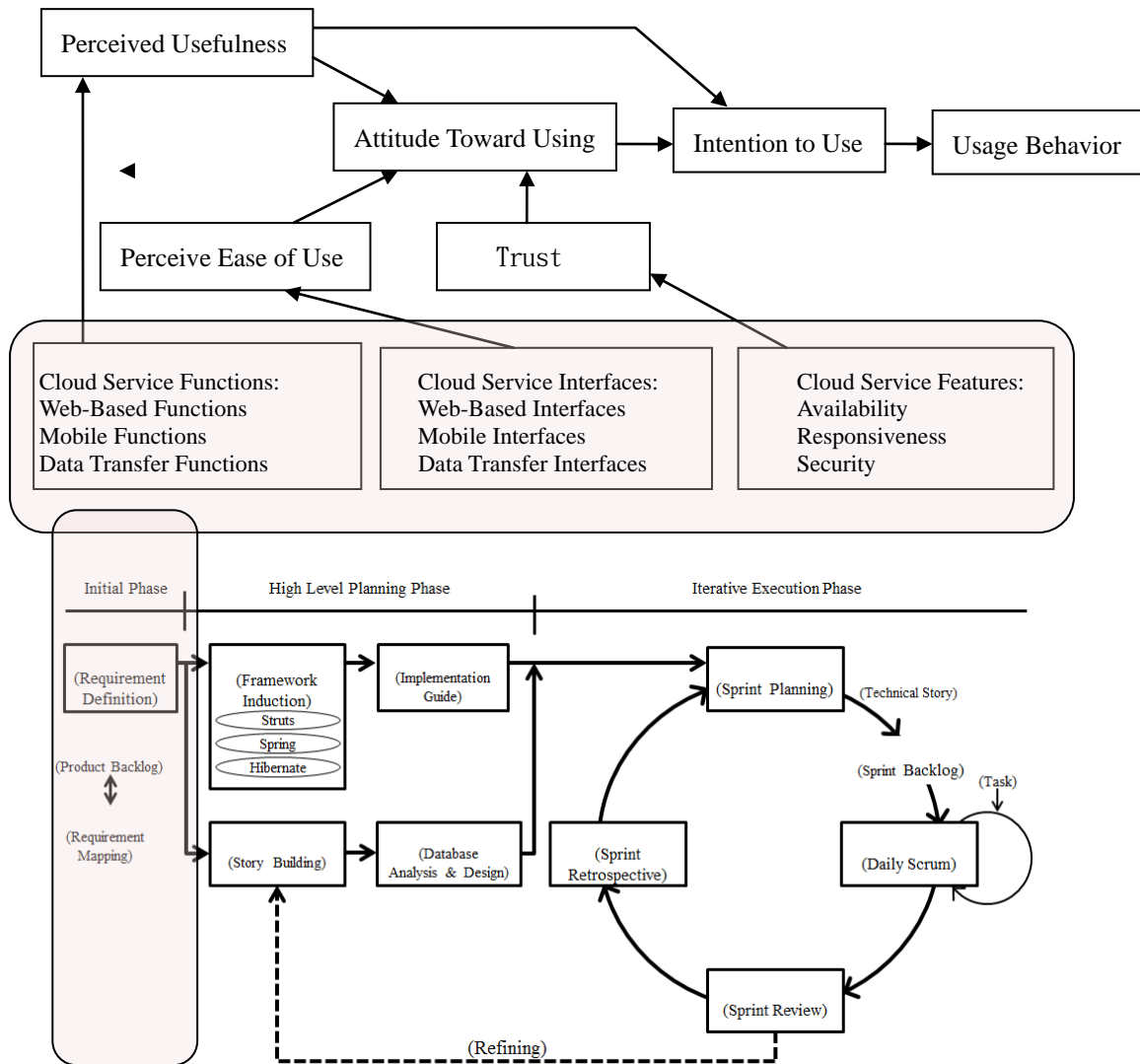


Figure 5. Investigating Technology Acceptance for Cloud Service System Development
Source: this study

4. Research Method

This study adopts the research method of survey using the data collected from a group of potential users of the investigated cloud service. The questionnaire would be reviewed first by a group of representatives to examine the appropriateness of the questionnaire wording and semantics. Questionnaires would be distributed to those participating the cloud service illustration meeting. Each question is measured by 5-point Likert scales from *strongly agree* to *strongly disagree*.

The data analysis would be conducted using software such as SPSS and AMOS. Based on the Structural Equation Modeling (SEM), the exploratory statistics and confirmatory statistics would be generated. The reliability of each indicator, the Composite Reliability (CR), and the Average Variance Extracted (AVE) would be evaluated (Hair, Anderson and

Tatham, 1998). The Squared Multiple Correlations (SMC), Factor Loading, and Cronbach's α would also be calculated (Kline, 1998; Bagozzi and Yi, 1988). The data analysis would be used to test the hypotheses associated with the research framework.

5. Expected Contribution

Empirical research and system development are usually distinct research methods in the academic literature. This study makes a bridge to bring a well-accepted empirical research model into the system development process to make the empirical observation systematically applicable to the cloud service providers. In practice, the systematic understanding of user perceptions during the iterative incremental process of cloud service system development may help the cloud service providers to make faster and better responses in the competitive market.

6. Current Progress

The sample cloud service system development is sponsored by a big company at Taiwan. The system development has been started and expected to finish the first phase in several months. The empirical data would be collected in the illustration meeting called for potential users. Before the questionnaire is developed, the research framework would be further explored or modified to address the functions, interfaces, and features related to the perceptions and behaviors elaborated in the TAM.

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