Research on the impact mechanism of user satisfaction with Software as a Service

Shuwen Li1,2,a
1Hohai University, 210098, Nanjing, Jiangsu, P.R. China
2Jiangsu University of Science and Technology, 212003, Zhenjiang, Jiangsu, P.R. China

Abstract. Software as a Service (SaaS) has become a mainstream way for enterprises and governments to promote informatization. However, it is very easy for users to change their SaaS supplier due to low implementation costs. Improving user satisfaction with SaaS products and ensuring their continued usage by users present practical challenges that SaaS suppliers cannot ignore. The traditional information system success model only pays attention to the quality of products which is known as internal quality. This paper combines the internal quality features of SaaS with the suppliers’ quality and environmental quality. These two qualities constitute external quality, which also affect user satisfaction. The study comprehensively explores the impact mechanism of SaaS user satisfaction based on the integrated perspective of internal quality and external quality. We use SPSS23.0 and SmartPLS to examine the hypothesis with data from 212 valid questionnaires. The study finds that system, information, service, supplier, and environmental quality have a significant effect on user satisfaction, and the influence of service quality is the greatest.

1 Introduction

With the emergence of cloud computing technology and the rapid spread of service-oriented thought, software as a service (SaaS) provides a new service mode. This is one of the most widely used applications in cloud computing. SaaS has become a mainstream way for enterprises and governments to promote informatization, but the future of SaaS suppliers’ enterprise development is not promising. Many SaaS suppliers’ companies such as Yunio and Fleetmatics have either closed down or been acquired. The reason for this is that compared with traditional authorization software, SaaS no longer needs the infrastructure construction and maintenance operation software, users use a very flexible payment model for SaaS services, the start-up costs are very low, and the SaaS deployment cycle is short; hence, it is convenient for users to replace their SaaS provider. SaaS suppliers should therefore understand how to gain a competitive advantage in the fierce market, make users willing to adopt SaaS services that suppliers provide, and understand the factors influencing user satisfaction with SaaS products.

The information system success model, proposed by Delone and McLean, has been widely used in the field of information management. This model aims to create a comprehensive classification basis to evaluate the success of information systems, including service quality, information quality, and system quality, which are together referred to as internal quality, which affects consumers’ intention to use a system, their usage behavior, and satisfaction. However, compared with the traditional information system, the implementation cost of SaaS is very low, thus users can change SaaS suppliers easily. If suppliers want to let users continue to use their SaaS product, only considering internal quality of their SaaS products is not enough, they also need to consider the quality of the SaaS supplier, and environmental quality, which together constitute external quality. The SaaS users, when facing a new SaaS services, will not be familiar with the new SaaS, then the supplier’s quality and the environmental quality will directly affect consumers' satisfaction with SaaS.

This article is based on the information system success model considering the internal quality of products, the external supplier quality, and the influence of environment quality on SaaS satisfaction. The employees of three manufacturing companies who use the SaaS service serve as the research subjects. A questionnaire survey was used to collect data, and a partial least squares structural equation model was used to analyze the data. Through the above work, we expect to understand the influencing mechanism of user satisfaction with SaaS, provide corresponding countermeasures for SaaS suppliers, and promote the development of social informatization.

2 Research model and hypothesis

Combining internal quality with external quality, the theoretical model of users’ satisfaction with SaaS is
2.1 Internal quality

System quality refers to the characteristics or the expected performance of information systems, including three indexes: functionality, ease of use, and flexibility[1]. Functionality means the ability for a user to use SaaS to complete tasks, and it is the most basic requirement of SaaS. Ease of use is a vital quality of SaaS software. SaaS is an innovative product for users in the early implementation stage. Easy to use software allows users to quickly master the method of utilizing the software, and improves the work performance. Flexibility embodies the users’ personalized configuration requirements of SaaS, how SaaS can fit in with work tasks and users’ habits. Thus, the well-designed SaaS systems with high quality are not only simple and practical, but also satisfy users’ demand, and are bound to promote users’ satisfaction with SaaS. Therefore, we propose the following hypothesis:

H1: System quality has a positive impact on users’ satisfaction with SaaS.

Information quality refers to the output of a quality information system[1], which includes three dimensions, they are accuracy, completeness, and timeliness[2]. Specific to SaaS information quality, accurate and complete information can improve users’ trust of a system, and users are willing to continue to use the system. Timeliness means the SaaS system can respond to the demands of users in a timely manner. If SaaS systems cannot provide persuasive, high quality information to meet the needs of users, the latter will be dissatisfied with the system. Therefore, we suggest the following hypothesis:

H2: Information quality has a positive impact on users’ satisfaction with SaaS.

Service quality is defined as the difference in degree between the standardization of service that customers expect and users’ perception of service performance. This article selects responsiveness and reliability as SaaS service quality indicators. Responsiveness means the ability of suppliers to ensure a timely response in providing service support[3]. A SaaS service can have multi-tenant architecture; however, if the users’ scale is large, the service will possibly be delayed. This results in a decrease of SaaS responsiveness, which affects the service quality. In addition, the users’ data is stored at a data center in a SaaS system, which means that the users can not control their data directly. Thus, the users’ concern about the SaaS reliability will be higher than traditional licensed software. Therefore, we put forward the following hypothesis:

H3: Service quality has a positive impact on users’ satisfaction with SaaS.

2.2 External quality

Supplier quality of SaaS, includes reliability, brand awareness, advertising, etc. SaaS as a commercial product, also has brand awareness, degree of advertising, and other external properties. In fact, as a result of SaaS belonging to the category of information products, users can not determine its quality before consumption, so users tend to use external attributes to determine the value of the products; a higher reliability, brand awareness, and advertising of a SaaS supplier, means a higher supplier quality. Thus, the users’ confidence in the supplier will also increase. Users would choose the SaaS products which are provided by trusted suppliers[4-6]. Therefore, we put forward the following hypothesis:

H4: Supplier quality has a positive impact on users’ satisfaction with SaaS.

Environmental quality is also a key external quality that will affect users’ satisfaction with SaaS. Environmental quality includes network performance, environmental security, and the social effect[7,8]. SaaS services need a higher requirement of network performance. A bad network performance will affect the users’ experience of SaaS. In addition, SaaS is an innovative service mode; therefore, for more conservative masses, the safety of the environment has a direct influence on whether they are willing to use SaaS. Finally, users’ consumption behavior will also be impacted by other users’ consumption behaviors in...
society; Ajzen defines this impact as a social factor[8]. An increase in the SaaS social effect will promote the users’ identification with identity of SaaS. Therefore, we put forward the following hypothesis:

H5: Environmental quality has a positive impact on users’ satisfaction with SaaS.

3 Research methods

3.1 The questionnaire design

According to research models, we designed the questionnaires to contain six constructs: system quality(SyQ), information quality(IQ), service quality(SeQ), supplier quality(SuQ), environmental quality(EQ), and SaaS satisfaction(SS). The latent variables and their measurement items are shown in table 1. These items mainly stem from existing literature. Each item is measured on a seven-point Likert scale: 1 represents “strongly disagree” and 7 represents “strongly agree”.

Table 1. Variables and measuring items

| Construct | Item | Reference |
|-----------|------|-----------|
| SyQ       | ①SaaS operation stability | [1] |
|           | ② I can use the functions of SaaS easily | |
|           | ③ SaaS can flexibly adjust to cope with my diverse needs | |
| IQ        | ① SaaS can provide accurate information for me | [2] |
|           | ② SaaS can provide complete comprehensive information | |
|           | ③ The information I need can be obtained from SaaS at any time | |
| SeQ       | ① SaaS can provide rapid service | [3,9] |
|           | ② SaaS can be relied on | |
| SuQ       | ① My SaaS service provider can be relied on | [4-6] |
|           | ② My SaaS service provider is a big brand | |
|           | ③ I can often see the SaaS service provider’s ads | |
| EQ        | ① My network environment can implement SaaS smoothly | [7] |
|           | ② Existing regulations of SaaS can protect my interest | |
|           | ③ The people around me are willing to use SaaS | |
| SS        | ① I feel satisfied about the SaaS | [10,11] |
|           | ② SaaS satisfies my needs | |
|           | ③ I would be happy to use SaaS | |

3.2 Data collection

We collected the data from three enterprises which implemented SaaS services. They served as the research subjects. With the help of the human resource management unit of the company, we selected 300 employees and managers who use SaaS to complete the survey questionnaires. A total of 264 complete responses were obtained. We then used SPSS23.0 to delete outliers, and finally obtained a total of 212 valid questionnaires. Basic investigation statistics of this study show that male users accounted for 64.28%, while female users accounted for 35.72%. Additionally, 86.42% of users were aged under 30 while the remaining 13.58% were aged over 30.

3.3 The reliability and validity analysis

The SmartPLS software was used to analyze the collected data. The reliability test results are shown in table 2. All the multi-item factor loadings were greater than 0.7. The structure of Cronbach’s alpha and component reliability (CR) are greater than 0.7; this shows that the reliability of scale is good.

Table 2. Confirmatory factor analysis results

| Construct | Item | Factor loading | T Value | CR | Cronbach's alpha | AVE |
|-----------|------|----------------|---------|----|------------------|-----|

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In addition, the structures of the Average Variance Extracted (AVE) were greater than 0.5, which means that the scale has good convergent validity (see table 2). Each structure was greater than the square root of AVE values below it, when compared with other structure correlation coefficients. This shows the discriminant validity of the scale (see table 3) is good.

Table 3. Discriminant validity analysis

| Construct | SyQ  | IQ   | SeQ  | SuQ  | EQ   | SS   |
|-----------|------|------|------|------|------|------|
| SyQ       | 0.791|      |      |      |      |      |
| IQ        | 0.553| 0.775|      |      |      |      |
| SeQ       | 0.358| 0.534| 0.775|      |      |      |
| SuQ       | 0.570| 0.659| 0.547| 0.805|      |      |
| EQ        | 0.339| 0.600| 0.616| 0.534| 0.811|      |
| SS        | 0.602| 0.669| 0.691| 0.723| 0.694| 0.837|

3.4 Structure model analysis

We used the Bootstrap algorithm (N = 1000) to calculate the value of multiple correlation square values ($R^2$); this estimates the path coefficient of the structural equation and the significance test. The results of this model are shown in figure 2. The results show that this model has a good explanation power ($R^2 = 0.756$), and all the path coefficients between latent variables are effective. The results show that:
The correlation coefficient between system quality and SaaS satisfaction is significant; therefore, hypothesis H1 was supported; The correlation coefficient between information quality and SaaS satisfaction is significant; therefore, hypothesis H2 was supported; The correlation coefficient between service quality and SaaS satisfaction is significant; therefore, hypothesis H3 was supported; The correlation coefficient between supplier quality and SaaS satisfaction is significant; therefore, hypothesis H4 was supported; The correlation coefficient between environmental quality and SaaS satisfaction is significant; therefore hypothesis H5 was supported.

4 Conclusion and discussion

Our results show that the proposed five hypotheses of this model are supported, and SaaS service quality is the main factor which influences satisfaction (path coefficient = 0.216); this is because when compared to traditional authorized software, the SaaS mode is delivered over the network, and the multi-tenant feature of SaaS makes it more prone to congestion. Thus for SaaS users, service quality is an important factor that affects their satisfaction. In addition, as SaaS is essentially a software product, users need to use specific functions of SaaS to realize the real true utility of SaaS, therefore, information quality and software quality are also important factors that influence satisfaction. Moreover, supplier quality will also affect users’ satisfaction with SaaS. Supplier quality indirectly influences users’ perceived quality of SaaS products provided by the respective supplier, and users will choose products sold by well established brands, which they trust. Additionally, the better the external environment for users using SaaS, the higher the user satisfaction with SaaS.

This paper innovatively integrates internal quality and external quality into a whole framework, and explores the mechanism of influencing user satisfaction with SaaS from a comprehensive perspective. According to the results of this study, the implications for management practice are as follows: (1) SaaS providers should pay great attention to service quality, information quality, and software quality of SaaS. SaaS suppliers should meet the needs of users, develop SaaS products that have practical value, and at the same time, pay attention to construct infrastructure with the corresponding quality of service, to ensure that users can enjoy uninterrupted and timely service, and use fluent software. (2) SaaS suppliers need to pay attention to their publicity as well as that of their SaaS products. On the one hand, fully publicizing their ability can improve the perceived quality of suppliers, while on the other hand, enterprises need to take measures to improve the users’ security awareness of SaaS, so that users can fully accept SaaS products, and thus improve the quality of the environment.

In this paper, there are a few limitations, which can be addressed in future research. First, we did not distinguish the differences during the whole SaaS life cycle. In fact, in the market at present, most SaaS providers have adopted a strategy of free trial. The life cycle of a user flows through the following stages: watching, trial, buy, use and continued use, so the factors that influence users’ satisfaction may have somewhat changed, and future research can focus on the dynamic change of users’ satisfaction. Secondly, this paper has not yet considered other external factors such as government support, and how government policy will affect users’ adoption of SaaS products, so future research can be integrated with external government policy support to establish a more realistic model.

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