BPM Software Adoption in Enterprises based on TOE Framework and IS Success Model

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Abstract

With rapid advance of enterprise management informatization, traditional methods of business process management gradually fail to meet the demand of current enterprise development. Business Process Manager (BMP), one business process management software, has become the new favourite of enormous enterprises due to the huge profit and more efficient business process it creates. The work explored BPM software adoption in enterprises with innovative combination of TOE framework and IS success model in order to provide the real-time software demand for BPM software manufacturers. This work focused on the reasonable integration of the two models above. With analysis on all aspects that influenced adoption decision and long-term acceptance in the two models, the main influence factors of BPM software adoption in enterprises were finally determined. In this work, the correlation among all influence factors of BPM software adoption was obtained by questionnaire survey and data analysis. The completed research can provide effective and reasonable adoption suggestions for enterprises as well as BPM software manufacturers.

Keywords: Enterprise; TOE Framework; IS success model; BPM softwar

1 Introduction

With the popularity of economic globalization, enterprises have realized that uncorresponded management software for strategy and business will cause "cask effect" and prevent the enterprise development.

Revealed by market survey, BPM software is regarded as the most appropriate solution in today's business-process-oriented trend. Suitable BPM software can create generous profits for enterprises. However, the scale and complexity of software system correspondingly increase software defects and system vulnerabilities. And these software bugs and failures will bring negative influences and even huge loss to people's work and life. Therefore, the reliability of BPM software determines the software adoption for an enterprise.

Faced with flourishing BPM market, it is important for decision makers of enterprises to choose BPM software with high applicability and reliability. However, the lack of related theory and technical support makes it difficult for rational and correct evaluation of BPM software and for BPM software adoption.

Currently, there are mainly three evaluation ways of BPM software: evaluation based on function, evaluation based on reliability and evaluation based on flexibility. They have their own particular scientificity and reference value. Unfortunately, there is still no evaluation way from the enterprise perspective. Considering the final purpose of BPM manufacturers – selling software to customers, it is necessary to have an evaluation on BPM software in the perspective of enterprise.

Most methods mentioned in researches conduct modelling analysis on BPM software adoption based on TAM/TOE model. And it has become the main method in current enterprises. In this work, a new research method was proposed for BPM software adoption in enterprises based on TOE framework and IS success model. With few reported literatures special for BPM software adoption, the method has certain innovation in this field.

2 TOE Model and IS Success Model

2.1 TOE MODEL

With extension of innovation diffusion model, Tornatzky and Fleischer believed that the adoption of innovative technology in organizations was influenced by technology (T), organization (O) and environment (E) (See Fig. 1). In TOE model, technology refers to internal-external technology of enterprises including those existing technology and unintroduced technology; organization refers to the scale of enterprises, management structures and human resource; environment, sometimes called institution, refers to trade behaviors among cooperators, opponents and governments in related business. TOE model have strong systematicness due to its systemic integration of internal-external factors in enterprises and technology characteristics. It has been widely applied in factor analysis of technology adoption in organizations of different information system fields.

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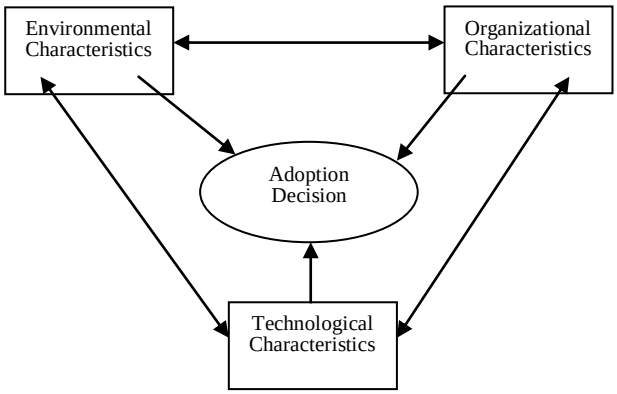

FIGURE 1 TOE Model

Meanwhile, TOE model is also widely used in researches on information technology diffusion field, including EDI technology, network service technology, internet technology and CRM system. It provides a perfect theoretical perspective for those researches on influence factors and functions of innovative technology diffusion. For example, Iacovou et al. (1995) studied influence factors of EDI technology diffusion in small firms based on TOE model. They found three determinants of EDI technology diffusion – organization preparation, external pressure and expected profit. Among these, organization preparation is included in organizational factor of TOE model, while external pressure is included in environmental factor. And expected profit refers to comparative advantages that EDI technology creates for potential adopting enterprises, included in technical factor in TOE model.

Generally speaking, with various theories and methods, scholars have explored influence factors of BPM software adoption and diffusion in enterprises from different prospective, with some research achievements. However, there are still two deficiencies existing. Firstly, when utilizing TOE model, scholars usually focus on the influence factors of external diffusion between enterprises (technology adoption), while they ignore the influence factors of internal diffusion in organizations (technology integration). Based on the judgment by Gartner, there are six stages of BPM maturity in enterprises. Most enterprises, in the first stage, can rise to the second stage. Only few enterprises can come to the third or higher stage. Secondly, TOE model only analyses those influence factors before BPM software adoption in enterprises, lacking the analysis of influence factors for long-term acceptance after software adoption.

2.2 IS SUCCESS MODEL

William H.Delone & Ephraim R.Mclean proposed six main indexes of IS success: system quality, information quality, information utilization, customer satisfaction, individual influence and organizational influence, all of which compose the IS success model. In the relation of indexes, system quality refers to the self-evaluation of information process system; information quality to the evaluation of information system; information utilization to users' acceptability of information system; customer satisfaction to users' feedback in the utilization of information system; individual influence to the influence of information on user behaviors; organizational influence to the influence of information on organizational performance.

In 2003, Delone & Mclean proposed an improved IS success model after rethinking numerous theories of IS success model (See Fig. 2). It includes seven influence factors: information quality, system quality, service quality, intention to use, operation, customer satisfaction and net earning. Among these factors, new service quality refers to the evaluation of support for final users, and net earning to the sum of information influence on individuals and organizations.

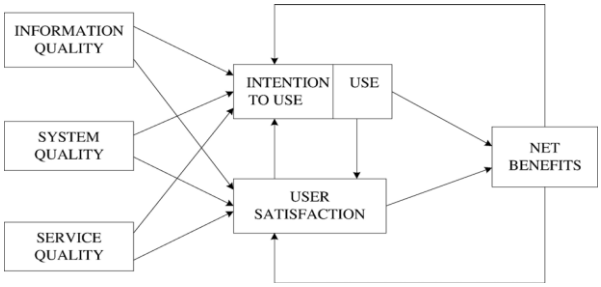

FIGURE 2 Improved IS Success Model

Different from adoption model studying the influence factors before adoption behavior, IS model evaluates the success of adoption behavior after adoption. Both of the two models focus on adoption behavior though choosing

different timing. The success of adoption behavior in IS model evaluation essentially evaluates the influence factors of adoption behavior. Those influence factors before adoption actually determine the success of adoption behavior. Therefore, there is certain reference value of IS model for the research on influence factors of BPM software adoption in enterprises.

It is revealed that TOE model has strong analysis on influence factors of BPM software adoption in enterprises. However, an appropriate adoption usually takes those influence factors before adoption as well as long-term acceptance condition after adoption into consideration. Therefore, an improved IS success model was proposed as a complement to TOE model. The combination of TOE model and IS success model can provide a loop-locked optimum analysis with feedback mechanism for BPM software adoption in enterprises, ensuring its higher scientificity and feasibility.

3 Modeling and Related Hypothesis

3.1 MODELING

Based on innovation-adoption-related theory, TOE framework divides influence factors of an organization on innovation adoption into three aspects: technical factor, organizational factor and environmental factor. In our model, technical factor includes technical complexity, compatibility and comparative advantage; organizational factor includes executive support, cost budgeting and organizing ability; environmental factor includes present business regulation, government policy and unavoidable pressure from compulsion, bandwagon and competition. In the process of modeling, we comprehensively relate the three factors with TOE framework in order to complete innovation adoption of BPM software in enterprises.

The integration of organization and external factors as well as technology characteristics brings strong systematicness for TOE framework. It possesses both of clear structure and flexibility. TOE framework combined with IS success model can be used for analysis on influence factors of innovation adoption.

Based on the dynamic integration of TOE framework and IS success model, BPM software adoption in enterprise was treated as organizational innovation behaviors. And we studied specific influence factors of BPM software adoption from external aspects of technical factor, organizational factor, environmental factor and long-term acceptance.

Finally, we proposed a BPM software adoption model in enterprises based on TOE framework and IS success model (See Fig. 3).

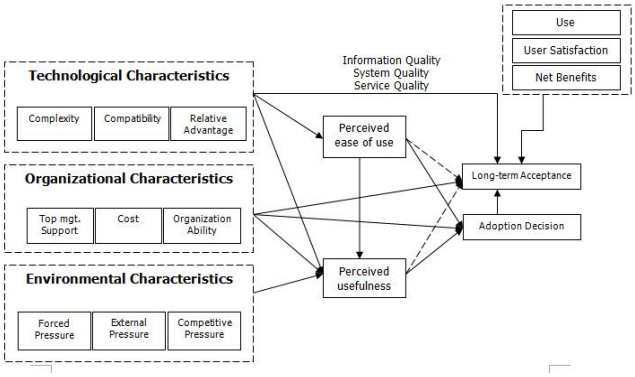

FIGURE 3 BPM Software Adoption Model in Enterprises based on TOE Framework and IS Success Model

3.2 TECHNICAL FACTOR

As one major influence factor of BPM software adoption in enterprises, technical factor includes complexity, compatibility and comparative advantage. For those enterprises using BPM software, complexity in technical factor is inversely proportional to BPM software adoption. The more complexly the software performs, the more difficulties enterprises will have in software adoption, against the operation and diffusion of the software. Compatibility refers to the matching degree of BPM software technology needed and present existing technology in enterprises. The more compatibility, the more likely enterprises will adopt BPM software, beneficial for software adoption. Comparative advantage is proportional to BPM software adoption. The more obvious advantage, the more likely enterprises tend to adopt the technology. Therefore, we proposed the related research hypothesis of technical factor as follows:

H1: Technical factor will influence BPM software adoption in enterprises;

H1a: There is a negative correlation between complexity and BPM software adoption;

H1b: There is a positive correlation between compatibility and BPM software adoption;

H1c: There is a positive correlation between comparative advantage and BPM software adoption.

3.3 ORGANIZATIONAL FACTOR

In the IS success model based on TOE framework, organizational factor mainly includes three aspects: executive support, cost budgeting and organizing ability. Those executives who truly understand BPM can drive employees to complete enterprise tasks and realize own misconception, fundamentally deepening perceived usefulness of BPM software. Therefore, executive support has positive

effect on BPM software adoption in enterprises. Board support from executives is beneficial for BPM software adoption. For profit-making enterprises, cost budgeting has an important role in organizational factor. These enterprises are always cautious about BPM software adoption and cost budgeting in consideration of higher profit and less cost. In present competitive environment, the less enterprises cost, the more likely BPM software will be adopted. Therefore, cost budgeting is inversely proportional to BPM software adoption. Organizing ability, as the third aspect of organizational factor, is the foundation of adoption behavior in enterprises. Adoption decision of enterprises is affected by informationalized level of employees and informatization infrastructure of enterprises. Therefore, organizing ability has positive effect on BPM software adoption. Here, we proposed the related research hypothesis of organizational factor as follows:

H2: Organizational factor will influence BPM software adoption in enterprises;
H2a: There is a positive correlation between executive support and BPM software adoption;
H2b: There is a negative correlation between cost budgeting and BPM software adoption;
H2c: There is a positive correlation between organizing ability and BPM software adoption.

3.4 ENVIRONMENTAL FACTOR

Compulsion pressure of BPM software adoption is from powerful organizations, including existing important clients and strong suppliers. They have a profound effect on the future of enterprises due to those necessary resources for survival and development that they have. Bandwagon pressure can remind enterprises that BPM software widely adopted in current industries. And the advertisement of BPM software by management consultancies, media software manufacturers indicates that BPM software adoption in enterprises has become part of information trend. Bandwagon pressure has a positive effect on BPM software adoption. Meanwhile, BPM software has an important role in competition with peers. Those with BPM software will have more competitive edges. Therefore, competition pressure also has a positive effect on BPM software adoption. Based on this, we proposed the related research hypothesis of environmental factor as follows:

H3: Environmental factor will influence BPM software adoption in enterprises;
H3a: There is a positive correlation between compulsion pressure and BPM software adoption;
H3b: There is a positive correlation between bandwagon pressure and BPM software adoption;
H3c: There is a positive correlation between competition pressure and BPM software adoption.

3.5 INTERMEDIARY VARIABLES

3.5.1 Perceived Ease of Use of BPM software

Perceived ease of use of BPM software refers to the difficulty of operating software for employees, acting as a performance evaluation-related variable of BPM software. The measurement for perceived ease of use of BPM software mainly includes additional workload for software operation and the difficulty of working with this software. Perceived ease of use of BPM software affects perceived usefulness of enterprises and employees as well as directly influences BPM software adoption in enterprises. Therefore, BPM software has to provide both of basic functions and convenient operations for employees. Perceived ease of use of BPM software needs to focus on the difficulty of business process description and business rule setting, the complexity of performance analysis and process monitoring, and the secondary development of BPM software. These keys have a positive effect on BPM software adoption.

3.5.2 Perceived Usefulness of BPM software

Besides perceived ease of use, perceived usefulness of BPM software also directly affects attitude and intention of software users. Namely, the usefulness for work determines the behaviors of employees in enterprises, which finally affects BPM software adoption. Therefore, the usefulness for work has a positive effect on BPM software adoption. The more useful employees feel BPM software for their work, the more likely BPM software will be adopted. So we proposed the related research hypothesis of intermediary variables as follows:

H4: intermediary variables will influence BPM software adoption in enterprises;
H4a: There is a positive correlation between perceived ease of use and BPM software adoption
H4b: There is a positive correlation between perceived usefulness and BPM software adoption.

3.6 SUCCESS FACTORS OF BPM SOFTWARE IN USAGE PHASE

In our closed-loop model, software adoption has to evaluate both of influence factors before adoption and long-term acceptance condition after adoption. Based on the operation and net earning of BPM software, we added an evaluation of success factor for feedback after evaluating system quality, information quality, service quality and customer satisfaction in usage phase. It will help the adoption model of BPM software output more integrated results that are closer to the actual.

3.6.1 System Quality

In usage phase of BPM software, there is a positive correlation between success of adoption and system quality. Success of BPM software during use can be increased by its simple operation in line with employees' operating habit and its easy user interface or instruction, both of which provide appropriate feedback before adoption. Therefore, there is a positive correlation between excellent system quality and BPM software adoption.

3.6.2 Information Quality

Information quality refers to several aspects of designed processing flow: real-time description of actual business activity, comprehensibility, flexible adjustability with busi-

ness requirements, and consistency between process results and expectations. Information quality profoundly affects the success evaluation of BPM software after adoption. Briefly, there is a positive correlation between information quality and BPM software adoption.

3.6.3 Customer Satisfaction, Operation and Net Earning

In addition to system quality and information quality, the evaluation of software success in usage phase also includes three other keys: satisfaction of employees, service condition and net earning.

Success factors of BPM software include satisfaction of employees, adaptation to this software, improvement of job performance and enterprise competitiveness after software adoption, and enterprise profit. These have deeply affected BPM software adoption in enterprises.

4 Research Design and Questionnaire Survey

Questionnaire survey was used for the exploration and research of the model and method mentioned in this work. The objects of survey mainly include information technology enterprises of BPM software and departments of after-sale services and product experience in software manufacturers. After repeatedly modifications by experts, our final questionnaire (the formal questionnaire) totally includes 16 original variables. We used 7-point Likert scale (1 means "quite unimportant", and 7 means "quite important") for the survey of influence factors.

Three domestic leading companies were chosen for our questionnaire survey: ActionSoft, Primeton and Ultimus. We utilized both of paper questionnaires and network questionnaires for data selection. Before formal questionnaire distribution, we conducted feasibility prediction on a small scale, and then some parts were slightly modified. We totally distributed 100 questionnaires and recovered 97 questionnaires, obtaining a recovery rate of 97%. After removing questionnaires with missing items and perfunctory writing, we finally got 96 valid questionnaires, and the valid recovery rate was 96%.

5 Result Analysis

5.1 RELIABILITY ANALYSIS

Cronbach's alpha was used to test the reliability of every variable we measured. With scale KMO value of 0.91, we judged that the result was suitable for factor analysis. Then we used Bartlett test of sphericity for our questionnaire result. The obtained P is less than 0.001, meaning that the questionnaire result passed the test. Meanwhile, the cumulative contribution of variance is 81% and its Cronbach's alpha of whole scale is 0.86. Cronbach's alpha range of 17 influence factors involved in the work is 0.87~0.91, all greater than 0.87. Inverse square correlation coefficient of reliability test is 0.5~0.85. These data indicated that there was high reliability of the scale and acceptable correctness of variable structure.

5.2 VALIDITY ANALYSIS

Our content validity of questionnaire was ensured to meet experimental requirements by a series of measures including pre-distribution, detailed modification and reference to expert opinions. It was obtained that standardized load range of every index of the 17 influence factors was 0.72~0.99, all greater than 0.5. Every influence factor passed T test (t >2) with AVE values of 0.62~0.70. These sufficiently revealed the reliable convergent validity of the scale. Meanwhile, by comparison, we found that the square root of AVE value of latent variables was greater than the correlation coefficient between latent variables, both greater that 0.5. Therefore, it was concluded that there was good discriminant validity of the scale.

6 Verification of Model and Hypothesis

6.1 MODEL MODIFICATION

In our research, we utilized MLE method to calculate the fit index of model and the estimated value of each path coefficient. Then the relation between latent variables was obtained. With combination of related theories and test result above, we found that H3b had no significant effect on our model. Hence we removed the latent variable of trend pressure from environmental factor in BPM software adoption. Meanwhile, we re-tested and re-modified the improved IS success model based on TOE framework.

After several modification and corrections, we got that $\chi^2 / df = 1.213$, AGFI = 0.895, RMSEA = 0.021, meeting related requirements. And parameters after modification were obtained: absolute GFI 0.951 (approximate to 1), NFI 0.914, NNFI 0.924, CFI 0.945 and IFI 0.941. It was obvious that parameters above were greater than the acceptable threshold of model 0.9. Therefore, modified IS success model based on TOE framework was scientific, effective and acceptable from an overall perspective. Additionally, we conducted reliability analysis and validity analysis on our modified model, both obtaining eligible results. Generally speaking, our modification of model was successful and acceptable.

6.2 DISCUSSIONS

Firstly, for technical factor, we suppose that H1a, H1b and H1c of H1 are strongly supported by theoretical model. In H1a, enterprises are more likely to adopt BPM software with simple installation and easy operation for process design or process change. In H1b and H1c, BPM software could be more widely adopted by enterprises if it has compatibility with present software and hardware and easier secondary development compared with EPR software.

We believe that software selection of enterprises has become transparent business information due to the popularity of network and simple information exchange between enterprises. On the premise of benefit increase, technical factor becomes one adoption factor with high proportion in enterprises. The possibility of software adoption, for software users, will increase with BPM software's lower complexity, better compatibility and more comparative advantages.

Secondly, for organizational factor, our model has strong support on H2a and H2b, but poor support on H2c.

Executive support and cost budgeting have significant relationship with BPM software adoption of enterprises. Executives who are keys in software adoption can help enterprises better understand of BPM software, and engage employees in the implementation of BPM software. Meanwhile, facing difficulties in software implementation, executives are able to commit more resources for best support and skillfully deal with advantages and disadvantages of software calculations. Nevertheless, due to strict and mature organizational form of present enterprises, organizing ability has no significant effect on BPM software adoption in enterprises.

Finally, for environmental factor, our model has strong support on H3a and H3c, but poor support on H3b. Enterprises who want to adopt BPM software always lay more emphasis on the software influence on profit and pressure from important clients and suppliers. The effect of these two aspects is far beyond that of bandwagon pressure on BPM software adoption. Without seeing implementation effect of BPM software, enterprises can hardly make effective decisions for software adoption only based on blind following the trend.

Influence factors for judgment of IS success have important roles in our IS success model in TOE framework. The research results show that BPM software adoption is significantly influenced by operation, customer satisfaction and net earning. And the three aspects even have close feedback function in software adoption due to their effects on long-term acceptation of BPM software. We innovatively found that, besides several influence factors of TOE framework model, the factors of IS success model also affect BPM software adoption in enterprises. Therefore, the combination of the two models can has more effective and scientific analysis on BPM software adoption.

7 Conclusions

7.1 OPINIONS FOR THE RESEARCH

In enterprises adopting BPM software, executive support and cost budgeting of organizational factors greatly affect BPM software adoption. Compared with foreign enterprises that also aim at maximizing profit, executive support has become a unique influence factor of BPM software adoption in Chinese enterprises. Therefore, for adoption possibility, it is important to make executives actually realize the necessity of BPM software adoption.

For BPM software manufacturers, the complexity, compatibility and comparative advantages are important aspects for the adoption of their BPM software. Considering intense competition and rapid update in software industry, enterprises have severer technical requirements for manufacturers. Therefore, we suggest those manufacturers to reduce software complexity and increase compatibility in order to meet different demands of enterprises for BPM software.

7.2 RESEARCH PROSPECTS

In next stage, we will cautiously change several influence factors and add new factors on the basis both of our established model and implementation characteristics of BPM software. These future modifications are hoped to make up potential defects such as missing influence factors and imperfections in our research. Meanwhile, we are going to make more analysis and discussion for obtained data in order to get more practical research conclusions and further explorations for BPM software adoption in enterprises.

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