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Study on the IT Service Evaluation System in ITIL-based Small and Medium-sized Commercial Banks

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Abstract

With the application of ITIL in IT services of small and medium-sized commercial banks, whether the improvement of IT service has been fulfilled is the key to successful introduction of ITIL. However, the mature IT services index evaluation system and methods for the small and medium-sized commercial banks have not been established. This research aims to establish the stakeholders' satisfaction evaluation system of ITIL project based on KPI of ITIL management, which has strong pertinence and operability. The author has utilized the BP network based on GA optimization to conduct evaluation because the types of indicators are numerous and some of them are difficult to be quantized. Firstly, the author gains the precious model by means of the selected indicators and results of evaluation within 10 small and medium-sized commercial banks and GA-BP model. Afterwards, the indicator evaluation results of four of them are tested. The results of evaluation perfectly fit the expert evaluation results and the precision and convergence speed of the model are higher than that of the random BP, therefore, it is applicable to obtain stakeholder satisfaction of ITIL projects via GA-BP model and commendably satisfy the demands for evaluation of ITIL on basis of IT service level of small and medium-sized commercial banks.

Keywords: *IT service management; Satisfaction; Genetic algorithm (GA); BP neural network*

1. Introduction

Relying on introduction and application of information technology infrastructure library (ITIL), the management level and quality of IT services are able to be improved, which has been recognized in the industry. Although some theoretical models in the international standard systems such as TQM, CMMI, ISO9000, ISO20000, COPC and COBIT have been used in quality optimization and process improvement, the unified method for evaluation of IT service quality has never been implemented. In addition, there are few literatures related to evaluation of IT services, and the typical methods such as SERVQUAL (tangibility, reliability, responsiveness, assurance and empathy) model adopted by Potgieter *et al.* (2005) aiming to evaluate the operational performance of ITSM Implementation Organization, which is a relatively representative and correlative research [1]. Wang Jianjun, Yang Deli *et al*. (2006) used quantitative evaluation method to research IT outsourcing schemes [2]; Spremic (2008) developed process-based key performance indicators (KPIs) to evaluate the processes performance of ITSM [3]; McNaughton *et al.* (2010) designed a complete set of framework to assess the organization and process performance based on four perspectives including management, technology, IT users and IT workers [4]; Wu M S *et al.* (2011) measured the performance of organizations in IT service implementation from four perspectives including finance, customer, internal business processes as well as learning and development on account of the balanced score card [5]. Some scholars conducted quantitative

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and evaluation research concerning IT service management level from the perspectives of specific ITIL process and tools. For example, Hochstein, Tamm (2005) launched research in raising the failure response speed and shortening the incident processing time of the knowledge base. He pointed out that the front desk staff managed to promptly deal with the incidents in the first time by way of searching and using knowledge base or submitted the unsolved problems to the other staffs. It has improved the fault response speed and incident processing efficiency [6]. Larisa, Naga and Melissa *et al.* (2007) analyzed the influencing factors of IT service management from the perspective of service support [7]. Cater-Steel, Tan and Toleman (2009) pointed out that statistical analysis of the data generated in daily management contributed to help IT service providers identify potential problems, reduce failure rate, improve the availability and continuity of network and system so as to improve the quality of IT services [8].

Xia Xiping and Long Chaoyang (2009) believed that the knowledge base enables operation managers to conduct comprehensive analysis, evaluation and make appropriate processing for the purpose of improving the operational efficiency [9]. Lu Yue, Liu Jian (2011) state briefly that ITIL enables high-shared software and hardware resource information and various kinds of knowledge. It facilitates to stimulate work efficiency through the configuration management module, business measurement and the assessment of IT employees workload [10]. Lv Yinjie (2011), in the stage of improving the problem management, proposed the improvement suggestions to deal with the part that need to be ameliorated in the process of problem management via the method of hypothesis testing. Meanwhile, it also intends to evaluate the risk of the improved schemes and efficiently control of the high-risk items by means of FMEA and other 6σ tools [11].

The implement of ITIL requires abundant human, financial and material resources, and harsh work. Most of the implement organizations are the big IT service organizations, for example, IT departments of large state-owned commercial banks have universally carried out the ITIL. Therefore, the study on how to conduct the performance evaluation by the international standard system framework and the above literatures have no regard for the shortness of IT Department of the small and medium-sized commercial banks, such as their late start, small scale, weak technical base and insufficient funds, etc. Although the standard framework and research literatures mentioned above have made beneficial exploration regarding ITIL performance evaluation, the deficiencies existed in performance evaluation for small and medium-sized commercial banks are as follows. Firstly, the literatures focus too much on tangible values like management, financial value brought by ITIL to the service organizations but neglect its intangible values including competitive advantage, employee growth and innovation value, etc.[12] Secondly, it is necessary to establish and improve new mechanism for development and evaluation of intellectual resources and promote agglomeration and optimization of intellectual resources of small and medium-sized banks under the ITIL framework, so as to meet the needs for development of knowledge and market economy [13]. Thirdly, the method for evaluation of ITIL service performance features in conceptual framework, but lack of empirical test and persuasion [12]; Lastly, small and medium-sized commercial banks are short of sufficient technology, capital and manpower support in evaluation, so, the evaluation system should be as simple as possible, which is often ignored by researchers, thus resulting in little application value in small and medium-sized commercial banks.

Artificial neural network is an artificial intelligence method that is used to simulate the structure and function of cranial nerve system. It adopts nonlinear parallel processing method and has a strong ability to learn and adapt, by which the problems of evaluation in social science are able to be effectively solved and automatically adjusted and optimized in order to meet the changing practical demands. For example, Shao Haihong evaluated the customer credit risk of commercial banks with random BP network [14]. Liu Lan evaluated and predicted the risk of credit card consumption with BP network [15]; Liu Guoqing evaluated credit of the listed companies with GA-BP neural network model [16]; Zhengyi evaluated

credit risks of commercial banks with GA-BP [17], and Hou Xiaoxian evaluated risk of Anhui economy with GA-BP neural network [18], which, on the one hand, proves feasibility of BP neural network in bank evaluation and lays a foundation for further research; on the other hand, shows that application of neural network for economic evaluation is less than the traditional analytic hierarchy process and fuzzy evaluation, etc. Moreover, few of researchers conducted evaluation of IT service level of ITIL, therefore, it is feasible to utilize the GA-BP network to evaluate and study IT service level of ITIL, which is of great significance.

2. ITIL-based IT Service Evaluation Model

The implementation of ITIL aims to improve the service level of IT service organizations and meet the different levels and stages needs of customers. In other words, the purpose of it is to effectively transfer customer satisfaction level towards IT services to all departments and employees at all levels based on establishing the service quality-based IT service evaluation mechanism. It is a premise of strengthening staffs' service consciousness and providing the customer-oriented services. Therefore, this research, on the basis of ITIL model, is to establish the primary and secondary KPI index and conduct the evaluation towards the ITIL-based IT services through customer satisfaction evaluation method. This paper constructs the IT service level evaluation system based on ITIL; it is illustrated in the following Figure 1.

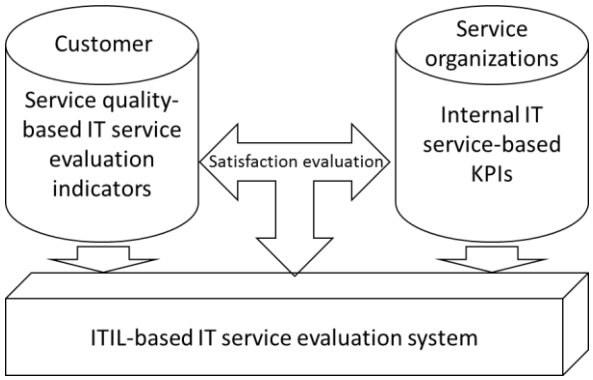

Figure 1. ITIL-based IT Service Evaluation System

2.1. Model of Satisfaction of the ITIL Project Stakeholders

It should be clarified that customer is the only subject in ITIL-based IT service evaluation system. Moreover, the research is aimed at studying the expectations and quality evaluations of the customers before and after receiving IT services so as to get their overall satisfaction toward the IT services. In order to facilitate the evaluation and calculation and build the model of satisfaction concerning the ITIL project stakeholders, (Figure 2) throughout the entire process of project construction and daily service process after the completion, ITIL project stakeholders including board of directors, the management, all branches, business departments, customers of the bank, internal scientific and technical personnel have different demands and perceptions of toward IT service level. When the demands of different interest subjects are not satisfied, the overall service satisfaction will be seriously affected, The reason is that the unilateral incoordination or giving up incoordination caused by the unsatisfied individual stakeholders tended to result in loss of the entire bank; on the contrary, if the demands of the stakeholders are satisfied, it will promote the mutual trust and continuous participation in improving the IT service level.

Figure 2. The Model of Satisfaction Concerning the ITIL Project Stakeholders

2.2. ITIL-based IT Service Indicator System

The primary evaluation indicators are established on the stakeholders involved in ITIL as the subject, including the board of directors and executives, science and technology department and customers (other departments in the bank). Regarding customer satisfaction, we classified it into five primary indicators referring to the customer satisfaction towards service desk, incident management and problem management, etc. While, the secondary indicators are based on service focus and interest appeal of the project stakeholders. . And the whole index system consist s of 5 primary indicators and 14 secondary indicators, which as shown in Table 1.

Table1. Indicators of ITIL Project Stakeholders' Satisfaction Evaluation

	Primary indicator	Secondary indicator
Satisfaction of project stakeholders C	Satisfaction of the board of directors and executives C_1	Cost control C_{11}
		Schedule control C_{12}
	Satisfaction of employees of science and technology department C_2	Department image promotion C_{21}
		Respect from customers C_{22}
		Enhancement of department power C_{23}
	Customer satisfaction toward service desk C_3	Quick response of the service desk C_{31}
		Quality assurance of the service desk C_{32}
		Fast and accurate dispatching and solution C_{33}
	Customer satisfaction toward incident management C_4	Quality assurance of accident processing services C_{41}
		Incident processing with low cost C_{42}
		No impact of accident on businessC_{43}
	Customer satisfaction toward problem management C_5	Problem solving efficiency C_{51}
		Solving problems effectively C_{52}
		Reducing the cost of problem management C_{53}

Based on related contents of service level agreement (SLA) and specific situation of small and medium-sized commercial banks, the purpose is to specify the target value for the given

service level and formulate the customer satisfaction index according to the target value. The service level indicators and target values are able to be quantified, so, if the actual value and target value of indicators are reflected in the satisfaction questionnaire in specific evaluation, the KPI index can be successfully converted into customer satisfaction indicators. Specific indicators and KPIs are shown as follows:

Table 2. Customer Satisfaction Indicators and KPI

Primary indicators	Secondary indicators	KPIs
Customer satisfaction toward the service desk	Quick response of the service desk	Average time of the service desk in the first line, accuracy of incident classification and incident management of the service desk.
	Quality assurance of the service desk	Number of service requests, one-for-all successful resolution rate, service requests conforming to SLA requirements, given up service requests of the service desk.
	Fast and accurate dispatching and solution	Number of service requests refused, average time for settlement of the service requests, number of repeat service requests and permission error percentage in regular audits.
Customer satisfaction toward incident management	Quality assurance of accident processing services	Number of incidents within a certain time period (week, month), proportion of incidents within agreed SLA solution, number of incidents forwardly discovered.
	Incident processing with low cost	Average rate of incident solution and cost, closed incidents, percentage of requiring repeat treatment (open the closed) for the dissatisfied ones.
	No impact of accident on business	The maximum duration and average time of service interruption caused by accident happened within a certain time period, number of incidents causing serious effects on business.
Customer satisfaction toward problem management	Problem solving efficiency	Average time of problem opening and solution, number and ratio of problems converting to continuous error, ratio of error elimination.
	Solving problems effectively	Number of problems raised forwardly, number of problems reduced through problem management, number of changing during the process of problem management.
	Reducing the cost of problem management	Problem management reduce the cost compared with each time to solve incident, number of incidents that adopt problem management upon repeat occurrence and never happen again, number of problems in knowledge base (number added).

3. Evaluation Methods and Indicator Evaluation

Satisfaction refers to the psychological and emotional feelings or cognition of stakeholders after comparing the actual service level with their expectations, and is determined by stakeholders through certain comparative analysis. Although we provided the respondents (Table 2) with the evaluation index system mentioned above (Table 1) evaluation index reflected in the satisfaction survey is highly fuzzy and thoughts of experts in the process of evaluation are nonlinearly emanative. Therefore, this research has used the BP network based on GA optimization in evaluation so as to make up the inadequacy of previous linear evaluations.

3.1. Determination of Evaluation Indicators

The primary level evaluation index set determined by Table 1 is C= {c1, c2, c3, c4, c5} among which each indicator subset is denoted by ci (i=1, 2… 5). So, the experts evaluate them as worse, poor, medium, good and excellent based on the number of. Through training by the scores of indicators obtained in evaluation, the accurate model is able to be required.

3.2. Determination of Comments Collection

Five kinds of evaluation standards are determined by practical needs of the evaluation. In other words, represents poor (very dissatisfied); represents worse (unsatisfied); represents medium (basically satisfied); represents good (satisfied), and represent excellent (very satisfied).

3.3. Determination of the Initial Network Values

At present, a lot of methods are used to determine the evaluation index weight, such as experts scoring method, analytic hierarchy process (AHP), Delphi method and link-relative method. As for ITIL project, stakeholders are the subject of satisfaction evaluation, thus the indicator weights should be determined by them. In order to avoid subjectivity of the stakeholders, average weight of several stakeholders is commonly adopted, while subjectivity also could be effectively avoided via the neural network. BP network is the core part of forward network and the essence and the most perfect part of the neural network.

Although BP neural network is the most dominant method in use in artificial neural network algorithm, some defects are visible, such as slow speed of learning convergence, no guarantee to attain the global minimum point of convergence, and uncertain network structure, which is able to be optimized with genetic algorithm (GA) for the purpose of getting the optimized initial weights and thresholds. The basic elements of the genetic algorithm include chromosome coding method, fitness function, genetic operation and operation parameters. In this paper, genetic algorithm toolbox is applied in calculation. The steps are as follows: using binary coding in individual coding, each individual is a binary string, coded by connection weight and system of input layer and hidden layer, all weight values and threshold values are put together to get an individual coding of 10 in length. Afterwards, the14-29-5 network structure is transformed into an individual binary encoding of 5850 in length. On the selection of fitness functions, expert evaluations and norm of error matrix of expectations are taken as the output of objective functions.

Regarding fitness distribution function of fitness function selection sort, selection operator used random operator; crossover operator adopted single-point operator and variation is produced though stochastic method so as to get GA operating parameters:

Table 3. GA Operating Parameters

Population size	Maximum genetic algebra	Binary digits of variables	Crossover probability	Mutation probability	Generation gap
40	50	10	0.7	0.01	0.95

3.4. BP Network Structure Algorithm

BP network is a kind of multilayer forward neural network, and BP algorithm was put forward by RumelhaH *et al.* in 1986. In the network construction accomplished by BP algorithm, three layer networks is a good way to solve the problem of pattern recognition.
S-shaped tangent function is taken as transfer function of hidden layer neurons of neural network, while S-shaped logarithmic function is taken as transfer function of the output layer of the neural network. This option is due to because the fact that the output mode is 0-1 just, which just meets output requirements of the network. Network training is a process of

constant correction of weights and thresholds by which the output error of the network is becoming smaller and smaller. In this paper, Levenberg-Marquardt algorithm is adopted in training for 1000 times, with target of 0.01 and learning rate of 0.1.

4. Case Analyses

4.1. Determination of Input and Output Matrix

This paper is based on ITIL projects of 14 city commercial banks in Sichuan, indicator weights of the projects are determined by the method of experts scoring. Interest subjects of each bank established their own evaluation team (20 customers who signed with SLA were chose to compose the evaluation group; 10 personnel assessment team came from the Department of Science and Technology; the board of directors and the executives compose the evaluation team) to conduct the comprehensive score. Evaluation results of 10 small and medium-sized commercial banks selected by experts are incorporated into the training matrix, and the other four ones into the test matrix. Indicator evaluation matrix is obtained based on the results of evaluation, as shown in Table 4 (input sample source of BP algorithm), and evaluation results table is formed according to the opinions of experts. Finally, the comprehensive evaluation table as shown in Table 5 (output training sample sources of BP algorithm) was obtained.

Table 4. Indicator Evaluation Matrix

	1	2	3	4	5	6	7	8	9	10
C_{11}	0.81	0.15	0.83	0.90	0.94	0.76	0.27	0.77	0.17	0.40
C_{12}	0.62	0.13	0.38	0.18	0.79	0.81	0.19	0.19	0.47	0.82
…	…	…	…	…	…	…	…	…	…	…
C_{53}	0.55	0.06	0.22	0.12	0.76	0.87	0.10	0.88	0.62	0.15
Evaluation state	0.70	0.57	0.46	0.62	0.61	0.71	0.50	0.72	0.66	0.60

Table 5. Comprehensive Evaluation Results

	1	2	3	4	5	6	7	8	9	10
1	0	0	0	0	0	0	0	0	0	0
2	1	0	0	1	1	1	0	1	1	1
3	0	1	1	0	0	0	1	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0

4.2. Training Results

Evaluation results of the other four small and medium-sized commercial banks are taken as the test matrix; and table 6 is the source of the test samples of the four banks; and Table 7 is the input matrix used to test precision of the evaluation model.

Table 6. Test Evaluation Samples

No.	11	12	13	14
C_{11}	0.94	0.02	0.50	0.60
C_{12}	0.06	0.07	0.50	0.41
…	…	…	…	…
C_{53}	0.73	0.62	0.25	0.76
State of evaluation	0.54	0.50	0.56	0.67

Table 7. Test Evaluation Results

	11	12	13	14
1	0	0	0	0
2	0	0	0	1
3	1	1	1	0
4	0	0	0	0
5	0	0	0	0

4.3. Analysis of the Simulation Results

Based on comparison with the random BP evaluation results, it can be seen that BP matrix evaluation results based on GA optimization are improved greatly. According to Figure 3, when the algorithm develops to the 28th generation, function value convergence is completed, and the optimal initialized weights and thresholds are able to be obtained. In the training process, the model was continuously adjusted by BP, in order to make the output results close to the actual result and attained the expected accuracy, with the result of the completed training. Table 8 is produced after training activity, where the first column shows the outcome of expert evaluation; the second column shows the results of GA-BP evaluation; and the third column shows the results of random BP evaluation. The 11th bank is rated as medium level by expert assessment following with the medium result by GA-BP and poor level by random evaluation. Therefore, GA-BP evaluation results are the most favorable one for meeting the needs of experts.

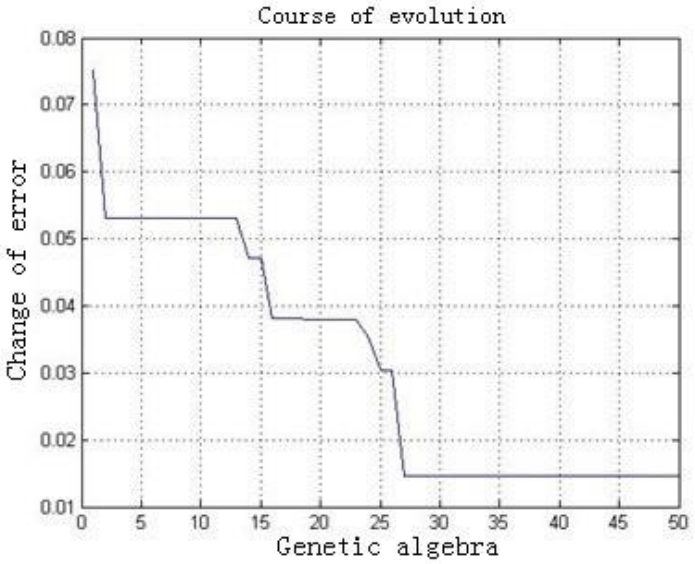

Figure 3. Optimization of the Genetic Algorithm

Table 8. Comparison of Results between Random BP Evaluation and GA-BP Model Evaluation

	Normal evaluation results (unsatisfactory - satisfactory)	GA-BP evaluation results (unsatisfactory - satisfactory)	Random BP evaluation results (unsatisfactory - satisfactory)	GA-BP evaluation error	Random BP evaluation error

11	0	0	1	0	0	0.0001	0.0001	0.8044	0.0001	0.00001	0.0049	1	0.0003	0.0004	0.0001	Simulation error of the test sample: 1.4114 Simulation error of the training sample: 0.02103	Simulation error of the test sample: 2.2942 Simulation error of the training sample: 0.28085
12	0	0	1	0	0	0.0785	0.0785	0.9771	0.3431	0.00785	0.00006	0.082	0.6712	0.0009	0		
13	0	0	1	0	0	0.0165	0.0166	0.9832	0.0166	0.00165	0.00003	1	0.003	0.0023	0		
14	0	1	0	0	0	0.0006	0.9999	0.0023	0.0006	0.00006	0.00003	0.9999	0.0003	0.0041	0.0001		

5. Conclusions

From discussed above, ITIL project implementation has a long run, Not only launching and successful import but daily IT service and continuous improvement demand the corporation, game, coordination, negotiation and communication of multiple stakeholders like the board of directors, the management, each branch, each business department, customers, members of Department of Science and Technology, It aims to form the interests group.. Although interests and expectations of stakeholders, as well as the connotation of satisfaction vary, they reflect IT service levels of the organization from different aspects.

In this paper, based on KPI of ITIL management, stakeholder satisfaction evaluation system of ITIL project stakeholders is established, which is of great pertinence and maneuverability. Because some indicators of the indicator system are difficult to be quantified, so, BP network based on GA optimization was applied in evaluation. Based on simulation analysis, it can be seen that genetic algorithm can effectively improve evaluation process and results of the traditional BP algorithm, achieving faster convergence, higher precision, and better representation of expert knowledge and experience. Moreover, algorithm can be used to train and adjust the model according to the needs of evaluation, thus having higher applicability and intelligence. According to the case analysis, the learning method can effectively gain ITIL project stakeholder satisfaction in order to get the objective evaluation of IT services.

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