

Research of Corporate ERP Performance Evaluation Model Based on System Dynamics

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Abstract -With the rapid development of the global information technology and the widespread application, enterprises put higher forward requirements on the implementation of ERP performance management. In order to solve the problem that majority of enterprises performance evaluation system of ERP attach importance to financial index system, light the future value creation, pay attention to performance of tangible assets, light intangible assets value of light, think highly of result, light process and other issues, this paper absorb and digest theoretical research about the Balanced Scorecard combined with system dynamics. In view of these, this paper aims to provide a dynamic balanced scorecard based on the performance evaluation model of ERP implementation. Then, for enterprises implemented ERP as an example, this paper establishes the dynamic model of ERP performance evaluation, which uses Vensim software and combines the status of enterprises. Also, this thesis mainly put this dynamic model into empirical analysis. Finally, according to the empirical analysis, we can draw the conclusion that the system dynamics not only can effectively make up for the lack of balance score card, such as the time lag and lack of system feedback, but also can prove the effectiveness of information dynamic evaluation model, which can provide support and reference for decision-making and performance management, avoiding subjective thinking defect of managers.

Index Terms - System dynamics, dynamic balanced scorecard, performance management evaluation, ERP implementation, Soft of VENSIM

1. Introduction

The implementation of ERP exerts growing importance on the enterprise, as the application of information technology in the field of management goes further and the information system becomes perfect and mature. Performance appraisal of ERP implementation is the very factor that decides whether the ERP implementation of enterprises is successful or not. However, in our country, the ERP management and evaluation system in the enterprises is far from perfect at the moment. Most enterprises continue to use the "value return on investment" evaluation method and have not built scientific performance appraisal system^[1]. Recently, the study of ERP implementation performance appraisal mainly focuses on the following aspects. The American scholars Delone and Mclean presented 6 main indexes of evaluating IS success: system quality, information quality, system use, customer satisfaction, personal influence and organization impact^[2]. Whereas, the D&M model mixed up the concept of implementation process and the concept of implementation result. The ABCD testing table method presented by Oliver Wight gives each question an answer by "yes" or "no". This method aims to find the difference of the standard in the table and formulates rectification plans and optimization measures.

But evaluation items are complicated in this method, which has a strong subjectivity and difficult operation. Zhu Zongqian and Ji Hao build a mining model for ERP risk external evaluation information. However, the model is limited to the prediction of ERP implementation effect. The fuzzy comprehensive evaluation method adopted by Zhang Xuejun eliminated the influence by human actor in the implement process. But its indicators are too quantitative and lack the model flexibility. Besides, there are the EVA theory by Xue Fei, the neural network model by Zhu Zongqian, the comprehensive COBIT model by Dong Yumei and so on. But these models have the following shortages: the practicality is not strong, the results are not straightforward enough and the evaluation results can't provide the simulation for the improvement of ERP implementation.

Kaplan and Norton first put forward the ERP implementation performance evaluation index system based on BSC. However, BSC pays much attention to the static performance measurement and neglects the dynamic monitoring of the measuring the execution result. Thus, it can't reflect the cause and effect feedback and nonlinear relationship, which also has time dilation. Sloper put forward the thought of system dynamics to make the complicated relationship between performance indicators clear. The performance evaluation method based on DBSC masterly makes up the characteristics of insufficient dynamics, time dilation, poor feedback of BSC by using the principle of system dynamics. System dynamics theory was first put forward by Professor Jay W. Forrester at Massachusetts Institute of Technology in the United States of America. This theory can effectively explain the effects, which is brought by the factors that dynamically changed with time in political, economic and medicine^[3]. And Coyle^[4] think that system dynamics is a feed backing and controlling model that describes and designs information with quantitative and qualitative method. Another expert Sterman said, a complex dynamic system needs technology tools to create a mathematical model for support^[5], as to be verified by computer programs, to grasp the dynamics influencing between factors, to understand the advantages of system dynamics.

Combining the system dynamics perspective and balance score card forms the dynamic balanced scorecard ideas. Dynamic balance score card uses the idea of system, takes the 4 aspects of BSC as the basis of research, applies the principle of system dynamics and performs modelling with simulation analysis according to the background and characteristics of the enterprise. BSC makes up the lacks of insufficient

dynamics and simple causality for BSC^[6]. It can gain the comparison of strategic performance improvement between different tactics by the computer simulation. And it also provides support for policymakers to choose the most reasonable strategy^[7].

II. Establishment of system dynamics model of ERP implementation evaluation.

A . Key performance evaluation index based on BSC

In the design of key performance evaluation index system, BSC divides business performance into 4 dimensions: financial perspective, client perspective, procedure perspective, learning and growth perspective, respectively. It can't be studied about all the performance indicators change in the prediction. It should give sufficient consideration to the influence on enterprise brought by informatization implementation and select the decisive index for the performance to perform the simulation predictions. Though each level, can it form the enterprise informationization performance evaluation index system by choosing key performance indicators. Table 1 lists the key performance evaluation index of four dimensions.

TABLE1 performance evaluation index of company

view	index
financial perspective	growth rate of sales
	profit
	return rate of investment
Client perspective	customer satisfaction degree
	client retention
procedure perspective	service quality
	delivery time
	new product development time
learning and growth perspective	Employee productivity
	employee training

B . Causal relationship diagram

According to the modeling procedure of system dynamics, it is necessary to find out the causal feedback of the structure of the system after ensuring system boundary of model. Diagram 1 is the system dynamics causal feedback map of improving customer satisfaction and enterprise profit of company. Diagram 1 shows the four levels of BSC: finance, client, procedure, learning and growth respectively. Differently, the whole system has many positive and negative feedback loops operating alternatively together, which can show feedback relationship and positive-negative relationship rather than the only bottom-up positively related to the causality link like BSC strategic map. For example, enterprise is a nonlinear, high-order, multi-loop, complicated system. Therefore, the solutions are often invalid to the question

caused by the system, making the problem more serious. Besides, time delay exerts immense influence on making decision by decision maker. Profit index will increase rapidly with no regard to the lag between receiving training and quality improvement. However, profit index only increases after a certain period. Thus, it not only add negative feedback loop onto positive feedback loop, but also take time delay into consideration and establish a more complex causal feedback relations.

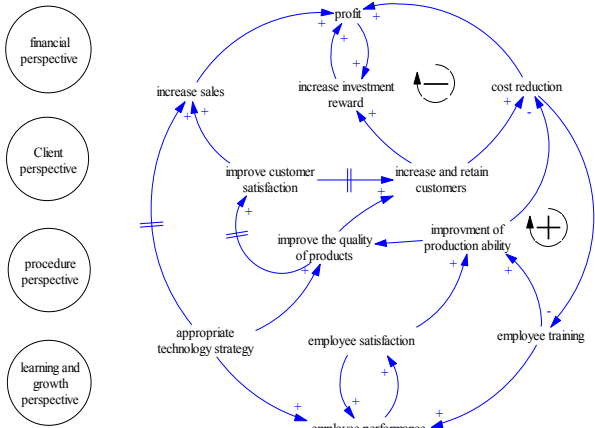


Figure1 causal feedback relationship diagram

C . Establishing system dynamics model

Based on the mentioned system causal loop diagrams above, combining the enterprise BSC key indicators and making the indictors quantitative, this paper establish system dynamics model by using Vensim, software as shown in diagram 2. The model is separated into finance level, client level, procedure level and learning growth level. Each level is a mutual feedback, not just a one-way causal bottom-up connection. When the key performance indicators divide over enterprises' intended target, analyzing and simulating on its management strategy by using system dynamics and obtain results of different design and analysis is the next part, then provide basis for enterprises' strategic adjustment. The equation in model of performance evaluation of enterprise informatization in Figure 2 is shown in table 2.

III . The empirical analysis

A . The introduction of the case company background

The A company is a paper company, registered in 1995. The A company tracks the latest Internet network technology trends constantly in line with the company growing Internet application demand. It established shared access system, which connects the internet with the local area network and ADSL broadband dial-up two ways. The A company also established raw material management information system . Under the condition of double production quota, the staff cuts in half while the time is shortened 2/3. As a consequence, the efficiency improves nearly 30 than manual operation at the same time of improving the accuracy of quotation.

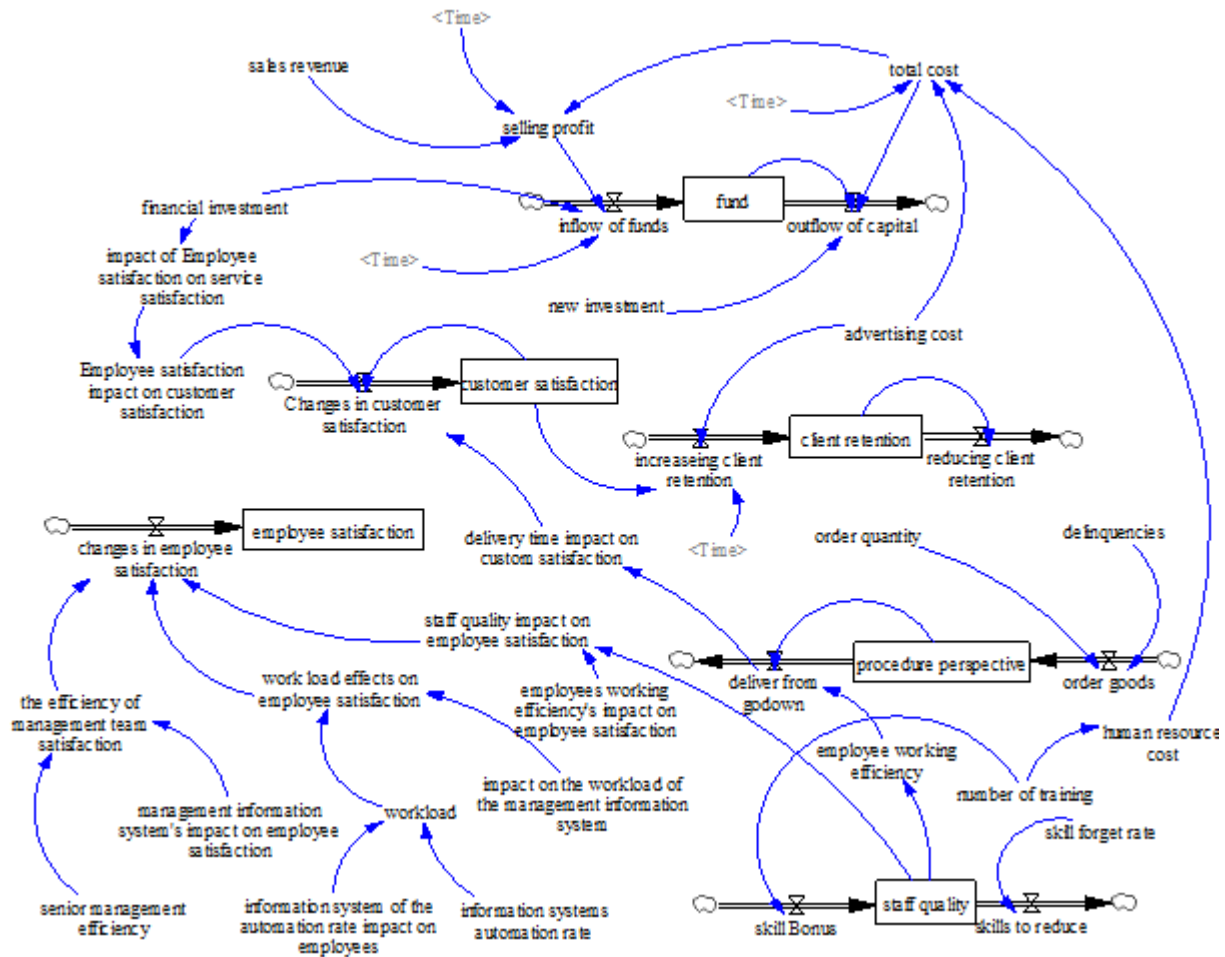


Figure 2 company information performance evaluation mode

B. Simulation run and result analysis

This paper predicts its profits in the recent 10 years based on the implement condition that A company's enterprise information system automation rate is 0.5 . The simulation result is shown in diagram 3-1. As it is seen from the curve in diagram 3-1 that the executive condition of the current strategy is: the profit curve changes in a choppy in the next six years, rises slowly in the seventh year and the profit doesn't have a significant growth in ten years. At the same time, this paper makes prediction for the condition of employee satisfaction which is one of the most important factors that influence the profit. The simulation result is shown in curve 1 in diagam 4-1. We can see from the diagram that employee satisfaction index surges in the first year, while it has a sharp contrast in the second year, and employee satisfaction is tending towards stability from the third year.

This is because, the module of enterprise informatization increase with the enhancement of enterprise informatization rate in the short term, which improves the information processing capability and the degree of integration and provides more accurate and effective decision support for the company's managers. The company's efficient operation supplies convenience for company's internal procedure. The

shorteningof delivery time increases the customer satisfaction, then it comes to the peak value and keep a higher level. With the increase of customer satisfaction, the client retention increases. The increase of client retention brings more sales for the enterprise and the profit gradually improves. The improvement of profit brings more performance salary for the employee and the employee satisfaction begins to rise sharply.

However, as the client retention keeps increasing, on one hand the informationization degree of company's product service fails to keep up in time, the compatibility of material flow, capital flow and information flow begins to decrease, on the other hand, the workload of employee increases because the information systems automation rate doesn't improve, while the previous performance salary incentive has been unable to meet the psychological needs of employees, the service quality begins to decline. Thus employee satisfaction decreases and client retention reduces. These variables experience a period of delay rather than presenting ascendant trend all the time in the short term. Some factors accumulate in the beginning and present the trend of oscillation or declination in the following years. In the long term, the information strategy of the A company can't reach the company's performance target and is not conducive to the

long-term development of the company. It should be improved.

C. The suggestion of performance improvement

The enterprise managers of A company need to adjust strategy to change the present situation according to the performance prediction and casual analysis above. They raise the enterprise information automation rate up to 0.7 and raise staff training times each month up to twice. The results are shown in curve 2 in diagram 3 and curve 2 in diagram 4.

It can be seen from the prediction results, the profit curve ascends more quickly than it is in strategy 1 and keeps on a higher level on account of information automation rate raising to 0.7. After the period of oscillation, the profit has far surpassed the profit condition of strategy 2 and presents a rising trend. The employee satisfaction also has a integral improvement than it is in strategy 1.

In that information automation rate raises to 0.7, the employee workload decreases and the employee satisfaction increases. The service quality improves accordingly, thereby the client number increases and the profit promotes. The operating speed of internal procedure promotes and the decision-making efficiency and accuracy of enterprise senior leaders get promoted after the enterprise management information system improves effectively. This lays the foundation of client increasing. This also presents that the enterprise information results have the quality of time delay. The increasing of the number of training not only improves the quality of employees and service quality but also increases the training cost. So the enterprise profit doesn't increase much. But as the client increases, the effect is brought out gradually which gives security for the profit growth.

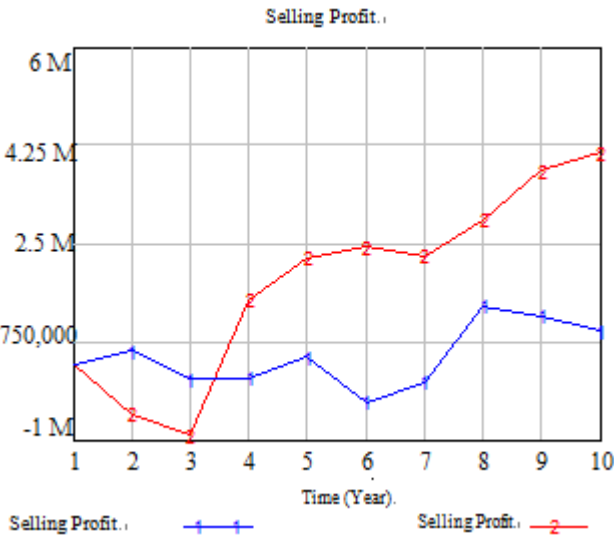


Figure 3 Sales profit trend graph

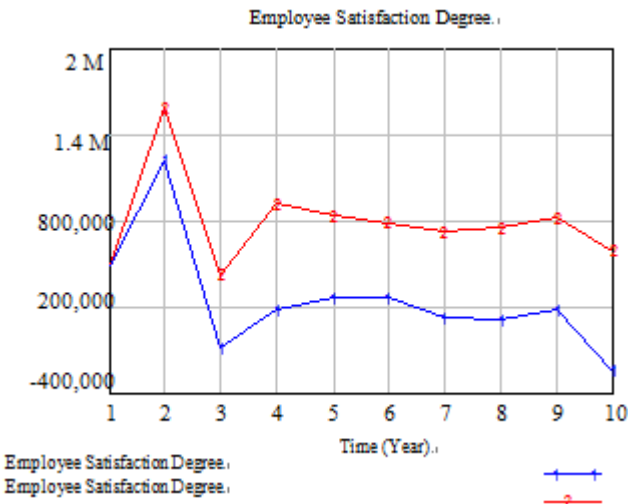


Figure 4 Employee satisfaction degree trend graph

IV. Conclusion

This paper establishes the dynamic model of performance evaluation of company by using vensim software based on the principle of DBSC. The operating result of the simulation of the module reveals the ERP implement effect under the two strategies directly. Thus avoid the subjective defects of thinking of managers. This provides reference for the managers in the company to carry on the strategy and improve policy in practice.

V. Fund Project

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2. Heilongjiang Province in 2013 graduate innovation project

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