

AN APPROACH TO APPRAISING, DIAGNOSING AND DESIGNING
THE STRUCTURE AND FUNCTION OF A CORPORATE *

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ABSTRACT

Based on system dynamics, this paper creates an approach of combining qualitative and quantitative analyses, systems thinking, systems analysis, synthesis and deduction with a set of models. First, We build up a generic model set with various economic indexes. About several dozen modern management methods have been applied to the different subsystems implied by their parameters and feedback structures.

INTRODUCTION

More and more entrepreneurs are getting to realize the keen competition both at home and abroad, the life expectancy of the enterprises is no more than 7 years, and less than 40 for the largest one. The way of getting rid of this predicament is to advocate management innovation, new management ideology, strengthen the new management style, and adopt new management methods. The questions of how to evaluate the enterprise performance effectively, how to analyze the influences of the competition and diagnose the problems existed in the enterprises and how to design the structure of the enterprise according to changes in inner and external conditions are drawing more and more attention to the people.

The existed analysis of the enterprises has some disadvantages: 1) it fails to diagnose the causes of enterprises with poor functions. 2) it is hard to give a quantitative analysis in the contribution of efficiency of promotion through the comprehensive use of the multi-management methods. 3) it fails to judge the pros and cons of enterprises' dynamic structure. 4) it lacks an approach of quantitative and qualitative connected methods with generic function to a specific enterprise.

Based on system dynamics, this paper creates an approach of combining qualitative and quantitative analyses, systems thinking, system analysis, synthesis and deduction with a set of models. First, we divide a typical enterprise into some generic substructures according to its characteristics. We build up a generic model set with various economic indexes. About several dozen modern management methods have been applied to the different subsystems reflected by

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their parameters and feedback structures. Second, when it is applied to a concrete enterprise, we will fit and tailor the general model into specific model. The software package has been facilitated by man-computer interface to provide better utilization. The proposed approach has been welcomed by the users with relatively satisfying results. It will be further developed in the future.

MODELING

1. The guide to evaluation and its methods
How to appraise the application of management means and methods to an enterprise? We argue that it's necessary to emphasize systemic thought and view and emphasize comprehensive application of various methods. Whether management methods are helpful to bring about an enterprise goal within a period must be determined by the enterprise's basic structure and its inner relations. The only way to find a effective and proper management method for an enterprise is based on three factors: the enterprise's running mechanism, its dynamic variation and its tendency of long term development. Here, we adopt an appraising approach which combines Qualitative and Quantitative analysis. The method is used to diagnose the management methods that have been applied to an enterprise for the improvement on its productivity. The approach is that, qualitative analysis acts as a guide with a support by Quantitative analysis, and solving problems progresses gradually. Not only does qualitative analysis offer a judgment and act as a guide for the whole approach, but also it is the only substitute for quantitative analysis when some parts of enterprise systems are impossible or very difficult to be quantified. Apparently, qualitative analysis is not enough for our study, and we need the support from quantitative analysis so as to have our analytic results within a reasonable requirement in accuracy, to offer a solid foundation to further study, and to make our analyses profound.

2. The basis for the creation of an enterprise model
The model should both be generic for enterprises and be convenient for its quantification. We consider that the typical substructures of an enterprise are production, marketing, finance, personnel, R & D and so on. Each enterprise has the same or similar subsystems, so the model can be used widely in many enterprise. Another important considerable issue is that a quantitative model is based on the concrete structure of an enterprise system which can't be independant of man's factor which is a well-known puzzle to deal with. For the purpose of study, we always need some assumption and approximation in our model. We suppose that the less the assumption or approximation is, the better the model is. Main functions of the model are: (1) Diagnoses the completeness of an

enterprise's structure and the coordinateness its basic functions. (2) Appraises whether the system's dynamic structure is superior or not. (3) Analyzes the main problems existing in an enterprise and digs out their underlying causes. (4) Judges the effects of the application of management means and methods to an enterprise, and puts forward the plans of comprehensively implementing the management ways and methods according to practice.

THE ANALYSIS OF THE MODEL

To expound the appraising approach set up by us, firstly, we analyze the structure and functions of an enterprise, and advance the concepts of the structure completeness and coordinateness of an enterprise. The aim of structure-function analysis is to judge the completeness and coordinateness through analyzing the structure and functions of an enterprise so as to understand its future development tendency, the keys of the analysis are: Whether (a) the structure is complete and (b) the functions are coordination.

1. Structure-function analysis. Whether an enterprise structure is complete means whether the constituents of an enterprise have any defects according to modern theory of business organization and management. In other words, it means whether the basic structure of an enterprise possesses the five basic functions stated above. For example, R & D is a prerequisite for a long-term development of an enterprise, and it is one of the five basic functions. Certainly the enterprises that have no R & D function will suffer from this flaw in their future development, regardless of what causes these results. That is an example of structure incompleteness. Having little investigation into their market, some enterprises draw up their production plans by simply adding a growth rate to last year's production. It is always too late to adjust their product structure and bring about new products when demand has changed, which makes the enterprise suffer a serious situation. The weakness of marketing study function also is the problem of structure incompleteness. We have divided the structure completeness into five levels:

Levels of Structure Completeness	Norms of Judgement
poor	at least one basic structure is lack of
rather poor	at least three functions are weak
good	no more than two functions are weak
better	no or at most one function is weak
best	no any function is weak

The level of structure completeness is diagnosed mainly by qualitative methods. Most of the typical enterprises

investigated by us are in good or rather poor level in their structure completeness in China.

2. The coordinateness of the functions of an enterprise. The soundness of single basic function is not enough for an enterprise and how to coordinate these basic functions is more important for an enterprise. Therefore, the coordination level of the function is a key factor. In an entire enterprise structure, there are many feedback loops among which there are some loops will become the dominant factors, and the enterprise's behavior will be influenced by those factors. The coordination between dominant and undominant parts will reflect the coordination level between structures and functions. The judgement of coordination level is mainly dependent on the model simulation.

3. The relations between management means and methods, and function and structures. Single management method's application to enterprise's one function or several functions, or several methods cooperatively being used in an enterprise at the same time, may change the relations among functions, or even change the structure itself. Speaking in a certain sense, management method's application can change the poor or unreasonable structure. Regardless of direct or undirect change, and its purpose is to make the function work better. We can comprehensively analyze each aspect of a problem, so as to seek after the links to which management methods may be applied. After finding the links and simulating these management methods' application to them, we can know every methods' effect on it and dig out a scientific and quantitative basis for an enterprise to choose its desirable methods. The process mentioned above illustrates that we must consider the fact that an enterprise is a system and it is very important to emphasize the coordination among the methods in real practice.

STEPS AND PROCESS OF EVALUATING APPROACH

1. Main steps. There are five steps: (1) According to requirement, tailor a generic model and make it suitable to a enterprise and then check its validity. (2) Analyze structure-function, and identify its structure completeness and coordination level of its functions. (3) Find problems through simulation and analyze their causes and factors. (4) Apply selected management methods to the structure to which main loops lie in order to solve problems. (5) Judge the suitability of the applied methods according to their effects on solving problems.

2. The realization of appraising process

(1) Classification of management means and methods

The model can be used in appraising the application results of management methods. First of all, methods should be classified according to certain criteria so

that it will be effective to appraise their validation. Since the model's frame is based on the same way. There are five kinds of methods which are used in related functional organization respectively.

Categories of methods are listed:

Marketing: analysis of consumer's behavior; Marketing investigation: Analysis of product life expectancy; Selling forecasting: Analysis of new product's trial selling; Analysis of cost and profit production: TQC, TPM, ABC analysis, QC, EOQ, PERT.

Finance: decision making analysis, Cost control

R & D: CPM, Objective management, Systems analysis

Personnel: Motivation to staffs, Staffs' training

(2) Structure and parameters of the model in accordance with management means and methods.

The first step to appraise management means and methods by the way of modeling is how to exactly show whether a management method is suitable for an enterprise. To show that objectively, we firstly should analyze the changes in performances of an enterprise when a method is used.

Application of a management may cause two changes: one is the change directly related to that method. Parameter change belongs to a direct change owing to the method's application. The other change will be caused through various loops, which conduct changes resulted from methods' application to the enterprise's other parts and cause the system behavior changed. We only discuss the case of parameter and structure changes caused directly by a method's application. For example, QC may have impact on product quality and reject product rate in the process of production, but TQC may have effect in other parts such as product design, technology, purchase of raw materials, of course also including manufacture, quality of selling service and so on, and it (TQC) involved in more parameters. The effectiveness of a method's application can be showed through system behavior changes caused by parameter changes. Model parameters may be influenced by a management method, and, in fact, parameter value should be given carefully in appraising the method's application in a specific enterprise.

(3) Appraising indices of management ways and methods

According to the principles of our appraising approach, the effectiveness of management method is judged by the behavior change caused by system structure and parameter, but what indices should we use to exactly show that effectiveness. We think that, every management method has its specific purpose and meaning and the degree of its solving related problems is a important factor. The other point we also consider is that we should not deviate our analysis from labor productivity, the most important index debated by us. Therefore, indices should include productivity. Here, we list some indices existing in our model.

1) output, total profit and tax, production, total cost cycling periods of flowing fund, ratio of profit and tax to capital, ratio of profit and tax to cost, ratio of profit and tax to selling. 2) cost per product, energy cost. 3) rate of first class product, rate of high quality product, rate of new product. Other more specific indices which can be composed by variables and parameters in model are not listed here.

3. The usage of the model

The model is written in professional DYNAMO. Including interface disk, there are 3 disks (360k X 3). Implementing steps are: (1) Set up parameters: Changing the generic model into a model that is suitable for a specific enterprise. (2) Analyze the base run of the enterprise model: the base run of the model should be consistent with enterprise behavior by adjusting and changing feedback loops. (3) Amend the parameters which related to the methods used in the enterprise. (4) Run the enterprise model to which management methods has been applied, and identify the difference of its behavior from base run. (5) Find out the difference between before and after using the methods and evaluate what effects and what degree of the effects on productivity will generate after the methods have been used in the enterprise.

CASE STUDY

1. Introduction of the case

A watch factory of Shanghai is one of the biggest key enterprises in watch industry in China. With fixed capital over RMB 50 million and staffs over 5000, it can annually produce more than 6 million watches which are mechanic, quartz, electronic and their fittings and components, and its output value in 1991 amounted to RMB 0.3 billion. In recent years, the factory has created great wealth and supplied lots of consumed goods. Although it has developed greatly, it has many ticklish problems.

Firstly, its products have confronted competitions from both domestic and foreign sides, which greatly reduced its sales. Especially, due to the electric watch's flourishing, ordinary mechanic watch industry declined both in market and price, and its production has to be stopped. Having appeared in the market recently, quartz pointer watch can't immediately occupy most of the market because of its instability of quality, although it has a good prospect. Secondly, enterprises have had heavier loads, owing to the increase in raw materials price, wage and salary, bonus, welfare and in various other heavy shares, the ratio of material cost to product cost has doubled. Lastly, the increasingly poor quality of products is beginning to bother people. The components both bought from other collaborating factory and produced the factory itself have a poorer quality than before. The reasons have two: one is

that production facilities is becoming aged and the investment in the facilities is lacking. The other is that some staffs' morale deteriorated and some skilled worker left.

2. Model conversion

According to the generic model, we can quickly get the enterprise model through parameter setting. All the parameters were from various statistical data of the factory in last five years. We divided all products into three main kinds according to their similarity in processing technology: mechanic watch SS5 and SS7, and electronic watch DSH, on which the following discussion is based. All parameters of five main subsystems have been set for model's conversion.

3. Structure and function analysis

Summarily speaking, the soundness degree of the whole structures and functions of the enterprise is in medium level. Further function analysis will be given through model simulation.

4. Coordination degree among functional blocks in the model. By the simulation of the enterprise, we found there were two main loops that influenced directly the enterprise' whole performance.

The first one is the relation between market study, market sales, and ordinary production arrangement. Since the market study was backward, there was much blindness in productuin arrangement. The delay between production and market information feedback was quite long. The other is arrangements between equipments and facilities scheduling. The period of facilities rescheduling was too long to catch up with the changes in production schedules. Therefore, the contradiction between these two subsystems became sharpened as the market situation changed. From the view of coordination degree, the relations between sales and production and between production and personnel both were undesirable. The whole performances were not harmonious and the production schedules appeared somehow disorderly.

5. What were the main causes of the factory's problems? Discussing with some professionals from the factory, and according to the results of the model simulations, we have found some causes as follows:

(1) The factory have lost many buyers because of the insufficiency of market study and the shortage of selling measures. Among three main watches, mechanic watch was declining and electronic watch was just in initial stage. Although the date-mechanic watch showed its potential in market sales, it happened to other succeeded competitors. Therefore, the factory's effectiveness and labour productivity have been influenced adversely because of its market blindness.

(2) Facilities usage was influenced by the comprehensive management level. The key factor was the full spur and

skill training for workers and technicians, and we should prevent them from outside interference. For example, in production process, there were some quality problems existing in raw materials, especially, in the components produced by other factories and self-made semi-finished parts and components. Those problems mainly caused by the shortcoming of its management system and the inadequacy of personnel's incentives.

(3) Facilities arrangement and production process couldn't be fitted to change in production schedule. Another factor was the management of parts and components. All of these problems were unclear, which always influenced big business. Recently, the factory couldn't deal with a whole foreign business just because the level of the components inventory was too low. Of course, the model simulation showed other flaws in the factory. Comparing with the problems mentioned above, they were more serious. Generally speaking, their causes were: the insufficiency of market study, slack TQC management, poor training of skilled workers, the less incentives to personnel and poor maintenance for equipments.

6. Results from the application of management methods

Aiming at relieving the problems mentioned above, we adopted the following management ways and methods: ABC, quality control, TPM, personnel incentives, market investigation and product period analysis, etc. Theoretically speaking, all of these ways would have effects, but before we finally knew how much the effect in each way's application or in these ways' coordinated application, we should analyze the simulation result of the model to which these management methods have been applied.

(1). Results of a single way's application. Table 1 shows: The evaluated values of those methods' application are different and market investigation method has the most notable effect among the all ways, and TPM and ABC are next to it. This was in conformity with the practical situation of the factory: market investigation was poor, and it has good potential. Once it has been improved, the factory's efficiency and productivity will increase greatly.

1) ABC management method: This method is simple and practicable, generally it can increase the productivity by 13-15% and 22-25% when its application under the best level.

2) Quality control (QC) method: Observed only from the view of improving productivity, it will increase the productivity by 5-6% and 10-15% when its application under the best level. Apparently, compared with ABC method, the effect of QC is less than the former.

Table 1 Increasing Ranges of Productivity
After using a single management method

	Situation	
	better	best
ABC	12 %	21 %
Q C	6 %	12 %
TPM	21 %	32 %
Market Study	45 %	60 %

3) TPM method: Its application aims at improving facilities arrangement and maintenance. This way normally can increase productivity by about 20% and about 30% when its application under the best level. The effect of TPM is much better than that of QC and ABC.

(4) Market study: It can normally increase productivity by 34%, and about 60% when its application is the best level. Practically the increasing ranges may be lower than that in the table 1 because of the market risk which is difficult to predict. If the mechanic watch had been brought to the market early, the factory's productivity would have been increased by more than 100%, and would have reduced the pile of unsalable goods. From above quantitative analysis, we know that in this case market investigation has most potential effect among all the methods and it may bring about the most benefit. Therefore, we might suppose that market study and TPM are most effective methods in the factory.

(2) Comprehensive application of multi-methods

Is the efficiency higher obviously when comprehensive application of multi-methods are used? The following tests show: a coordinated combination of various management methods will bring about higher productivity. Some tests indicated that the increasing range in productivity was higher than that of each single method's application. (Shown in Table 2). For example, the sum of productivity increasing range of QC and ABC is 18 %, but the increasing range of the two methods' coordinated application (G-B) is more than 20%. Another example, the sum of productivity increasing range of QC and TPM is 27%, which their coordinated application (G-B) has increasing the range of more than 30%. The results tell us that there are some coordinated combinations of multi-methods which have much higher effect than the using of single method use. The best two-method coordinated application is market study and TPM (G-C) as shown in Table 2. When all the

management methods mentioned above are coordinately applied to the model, the efficiency will increase further,

Table 2. The increasing ranges when management methods have been applied coordinately

	Application Situation	
	better	best
G-A: ABC, Market Study	> 60%	>80%
G-b: ABC, QC	> 20%	> 30%
G-C: Market Study, TPM	> 70%	> 90%
G-D: QC, TPM	> 30%	> 50%

but with no big difference from the G-C. Therefore, we should try to find out the key methods and their combination. In this case, we would recommend to apply TPM and Market study method and their combination firstly and then to choose some others to make up if necessary.

Before we involed in this case study, the factory very worried about his trouble, and did not know how to copy with them. Our comprehensive appraising approach has been very helpful to diagnose the problems, appraise and design the structures and functions of the factory quantitatively and effectively solve or relieve the problems. For example, Theoretically apeaking, TQC or QC has excellent effects, but in this case actual TPM is more effective than both of that, which have been verified by our approach. The approach already has made a sound results in several cases. And it also can be used as an organizational learning tool. A software package is available to provide better utilization of the approach. Our approach has been welcomed by the users with satisfying results. It will be futher developed in the future.

REFERENCES

- Forrester, Jay W., 1961. Industrial Dyamics. Cambridge Mass. : The MIT Press.
- Forrester, Jay w., 1975. Collected paper of Jay W, Forrester, Mass.: Wright-Allen Press, Inc.
- Senge, Peter M., 1990. The Fifth Discipline: The Art and Practice of the learing Organizations. Doubleday /Currency
- Wang, Qifan, 1987. Theory and Application of System Dynamics, New Times Press.