

# Evaluating Corporate Capability

## by Applying Fuzzy Theory (PART I)

— The Concept and the Decision Process —

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### Contents

- I. Introduction
- II. The Concept of Evaluation of Corporate Capability
  - A) A Historical Look at Corporate Evaluation
  - B) The Authors' Concept of Corporate Evaluation
    - 1. The Evaluating Agency
    - 2. The Objectives of Evaluation
    - 3. What is Evaluated
    - 4. Evaluation of the Business Environment
    - 5. Evaluation of Business Systems using the Management Resources Approach
- III. The Measurement Process for Evaluation of Corporate Capability

## I. Introduction

Vital tasks for any company are ascertaining how their company system functions, identifying problem areas and areas where they have a comparative advantage, and then instituting reforms. The measurement of comparative advantages and disadvantages are what we usually refer to as evaluation. In this paper we discuss corporate capability evaluation, a way of evaluating company systems.

A great deal of theoretical and practical research has been carried out over the years with the aim of optimising methodology for evaluating corporate capability. There are already established definitive theories on business analysis, but the same cannot be said of company diagnosis, it is still at the developmental stage. One of the main reasons for this is that as the conditions facing companies change, the methodology – objectives, and what is actually evaluated, must change too, if evaluation is to continue to be appropriate. Another reason is that it is meaningless to attempt to set, 'absolutes' (factors which will apply anywhere and at any given time) for evaluation, because it will always be relative.

By applying fuzzy theory to this thorny problem we believe we have produced a way of designing corporate capability evaluation methods which can be applied universally. In this paper we present the theoretical framework we have evolved, and an algorithm for evaluation, which we must point out is still at a preparatory stage.

## II. The Concept of Evaluation of Corporate Capability

### A) A Historical Look at Corporate Capability Evaluation

What is actually meant by corporate capability is tied up with corporate evaluation systems. We can assume that corporate capability evaluation is carried out from the time a company is founded, in the following ways.

The owner of a company will try to ascertain the profitability of his company, and whether the company has the ability to pay the wages of its employees. Once transactions based on credit commence, deliverers of products to a company will obtain data on its credit situation and make judgements based on that data.

Organised, scientific corporate capability evaluation, however, does not have a long history . We consider that the credit analysis carried out by American banks at the start of this century, in order to make decisions on loans, constitutes its beginnings. Prior to this, loan decisions were based on the close relationships between the bankers and owners of companies. As the size of companies increased, and relations between their owners and bankers grew more distant because of the separation of capital from management, it became impossible to make judgements in the old ways. In 1898 it was decided that when companies applied to members of the New York State Bankers' Association for a loan, a report on their assets and liabilities, in a stipulated format, should be demanded, and that the decision should be made only after an analysis of this report<sup>1</sup>. At the same time modernisation of the banking system meant that the feudal, violent means of securing repayment of loans and interest on them were no longer acceptable.<sup>2</sup>

These changes resulted in the development of techniques for making judgements on companies' ability to repay loans, by examining various financial statements, especially balance sheets. A common tool used was the current ratio, based upon the relationship between current liabilities and current assets. Then in 1913 the Federal Reserve Act was passed. It stated that if member banks asked the Federal Reserve Bank for permission to rediscount bills they would be required to provide written evidence that financial statements had been presented regarding those bills. This of course encouraged the production of financial statements and the practice of analysing them. Analytical methods devised at this time were the standard ratio method by Bliss<sup>3</sup>, the trend method by Gilman<sup>4</sup> who was critical of ratio analysis, and the index method by Wall.<sup>5</sup> In the 1920s evaluation of company accounts progressed to such an extent that it is called the era of scientific business analysis.<sup>6</sup>

Because these accounting evaluation methods did not simply depend on ratios it was possible to carry out an overall evaluation of a company's capability by editing the data from financial statements in an organised, systematic fashion. A typical early example of this was a joint study by Wall and Duning. Using seven ratios, one of which was the current ratio, and a weighting given based on experience, they produced overall indicators. Then for each item they calculated the arithmetic mean of the values obtained from the financial statements of many companies, then the mode and median, from the arithmetical mean of which they produced the standard ratio. They then took actual ratios of particular companies, divided them by the standard ratio, and multiplied them by the weighting to obtain the scores. The overall score for a company is given by the total of the scores for all the items.<sup>7</sup>

Because the objective of this exercise was credit analysis it did not really constitute an overall evaluation of the company. However it used four measures of turnover (including sales – receivables turnover) with a weighting of 35%, and data on three factors which influenced the credit situation (financial, personal, and cyclical factors – they indicated that the respective ratios of these three factors were 40%, 40%, and 20 %)<sup>8</sup>. Hence, although it was an analysis only of credit, it gave some indication of the capability of the company at that time because it added a dynamic ratio to the static ratios of the past, and because it was more than just financial analysis,

Credit analyses came to cover profit and loss statements as well as balance sheets, then after the disastrous events of 1929, improvements were made to accounting systems in order to protect investors. This led to progress in analysis of the profitability of companies, using profit and loss statements. Then as the awareness of companies' role in society increased, the analysis of productivity came to be regarded as an important area for study.

Evaluation carried out by interested parties outside the company such as Wall and others is known as external analysis; evaluation carried out by management for the purpose of managing the company is known as internal analysis. With the increase in the size of companies and the separation of capital from management referred to earlier, came the rise of the professional manager and a variety of new management techniques. Two in particular, standard costing (which applied the concept of a scientific management method devised by an industrial engineer named Taylor and which consisted of analysing the actual manufacturing plant), and budget variance analysis, which covered the whole company, came to be used widely by companies in the 1930s. Variance analysis consists of comparing

actual results with a standard, and identifying the causes of any variance, so that it was basically a results evaluation system.

Later, with the concept of direct costs, came breakeven analysis, and the introduction of profit planning. The Dupont Company had already created a ratio system for return on investments (ROI) in the 1910s, and using it in the management of the company.

Today's, mainly external, analysis of financial statements could be described as a direct continuation of the activities described above, although evaluation factors and methods have become more diverse, more complex, more data – oriented from the 1960s onwards, with improved information technology, and more interdisciplinary research. It is now believed that aspects of company activities which cannot be expressed in terms of figures from accounts, in other words qualitative factors, ought to be included in the evaluation, and that when figures from accounts are processed it should be done not by simple arithmetic (simple addition, subtraction, multiplication, and division) but by more advanced mathematical techniques. Okuno and Yamada, for example, pointed out that the latest methods of preparing data and computer technology should be introduced in management science.<sup>9</sup> These developments have had a considerable effect on business analysis.

A typical example of corporate evaluation carried out in the early stages (1960s) of modern development was known as PIMS (Profit Impact of Marketing Strategy). It began as an internal company project within General Electric in 1960, but is now continued by the Strategic Planning Institute. They send out questionnaires (with about 100 questions covering strategy, competition, the situation within the industry, company results) to 2,000 workplaces of 200 companies, in order to identify ways of forecasting and explaining company results.

They use two financial indicators, / criterion variables for company results, ROI and cash flow. They then carry out simple regression analysis, using these financial indicators and the individual contributions of the other factors/explanatory variables.<sup>10</sup>

In Japan, MITI's 'Corporate Management Capability Committee', under the guidance of Prof. Ryuei Shimizu, carried out two surveys (using questionnaires), on the business environment, management strategy, decision – making mechanisms, organisational factors, and financial factors in the manufacturing sector and the retailing sector. The results were published in a publication entitled 'SOGO KEIEIRYOKU SHIHYO' (Overall Business Capability Indicators).<sup>11</sup> The first step in interpreting them was a simple aggregational analysis of all the management factors. The second step was to carry out D value analysis of each factor, to calculate how much each contributed. The third stage consisted of using dummy variables for multiple regression analysis. The main advantage of this method was that it enabled quantitative analysis to be carried out for qualitative factors.

Since 1979 the Nihon Keizai Shinbunsha (publisher of a daily economics newspaper) has, produced an annual ranking list of Japanese companies from data on questionnaires filled in by journalists in the economics field, using NEEDS/CASMA. To do this they use factor analysis and multiple regression analysis.<sup>12</sup> Meanwhile, the Corporate Evaluation Research Group, set up by the Nikkei Research Institute of Industry and Markets, came to the conclusion that it is difficult to forecast the future of companies using only data (mainly financial) on the past. This, they said, allowed them to evaluate only the current status of companies, whereas they felt it would be much of much more use if they could make an evaluation of the situation 5 years hence. To this end they formed, in 1987, four

sub – sections, each of which was to speciallize on one aspect of corporate capability, the four aspects being research and development capability , production capability , sales capability , and corporate vitality.<sup>13</sup>

To summarise recent trends in corporate evaluation, we can say that there has been a movement away from concentrating on financial analysis, that a more mathematical approach has been adopted which incorporates qualitative factors, and that the emphasis has changed from simply evaluating the current sataus to attempting evaluate the future status of companies.

## B) The Authors' Concept of Corporate Evaluation

In order to define this concept we must look at the three aspects of it, mamely, the evaluating agency, the objectives of evaluation, and what is evaluated.

### 1. The Evaluating Agency

Evaluating agencies can be divided into two types, internal evaluators and external evaluators, according to their objectives in carrying out the evaluation.

Internal evaluation is self – evaluation by the managers of a company in order to make a management decision or improve the company's performance.

The evaluation may for example be used as data for decisions on investment in new equipment or whether to move into a new field of business. It may be used to improve daily production or sales methods, to achieve cost reductions (rationalization) or better budget control. In the case of internal evaluation the evaluating agency is itself also the object of the evaluation.



External evaluation can have various objectives. It may be carried out by a financial institution in order to ascertain the repayment capability of a company it is considering giving a loan to. It may be done by investors or securities companies in order to obtain evaluation criteria for investment in debentures or shares. In recent years the main objective has frequently been to provide data for decisions on mergers or takeovers. Also newspapers, publishers, and research institutes have carried out large – scale on – going evaluation of companies, incorporating their own unique evaluation factors, with the objective of providing data for their readers, clients. The evaluating agency for external evaluation is not also the object of the evaluation.

## 2. The Objectives of Evaluation

The objectives of corporate capability evaluation will differ according to what is needed at a particular time, and as a result the emphasis of the evaluation will shift. If the purpose is an audit of the operation of the company, an analysis of the past condition of the company will be the main focus, whereas if it is with a view to a merger or takeover the emphasis will be on the current value of assets and anticipated future capability. Before we define our approach to evaluation we must point out that in this paper we will limit ourselves to evaluations with the objective of ascertaining future capability. Hence we are concerned with the assessment of the potential or anticipated capability of a company rather than its past results.

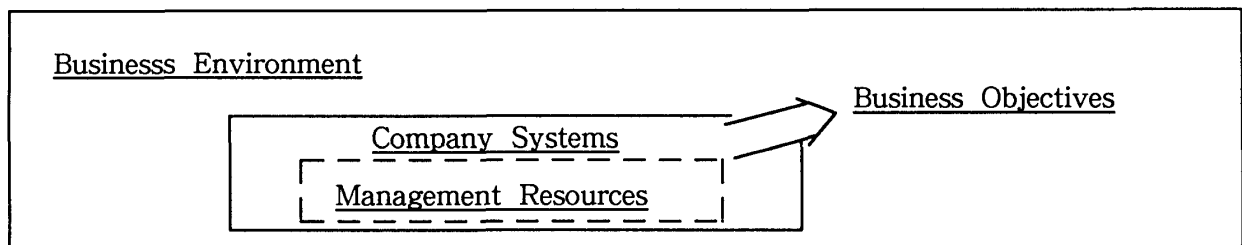
## 3. What is Evaluated

The object of corporate capability evaluation is companies

(businesses). We need to understand the business systems of the company we are evaluating.

To understand a company in terms of systems<sup>14</sup>, we need to consider the relationship between management resources, company systems, and the business environment. Figure 1 below shows this relationship in diagrammatic form.

Fig. 1 Business Environment, Company Systems, and Management Resources



The business environment, represented by the outer margin in the diagram is, in relation to the company systems, an external factor. In this paper we will refer to it as the external environment.

The relationship between company systems and business objectives is a vector, as indicated by the arrow in the diagram. Management resources, indicated by a dotted line in the diagram are constituents of the company system ; each aspect of management resources is a constituent part of the management sub – systems which combine to form the company system.

We believe that in order to evaluate future corporate capability, evaluation should be divided into two segments, that of the business environment, and that of the company system. The evaluation of the company system can be seen in terms of evaluating management resources, the constituent elements of the company system.

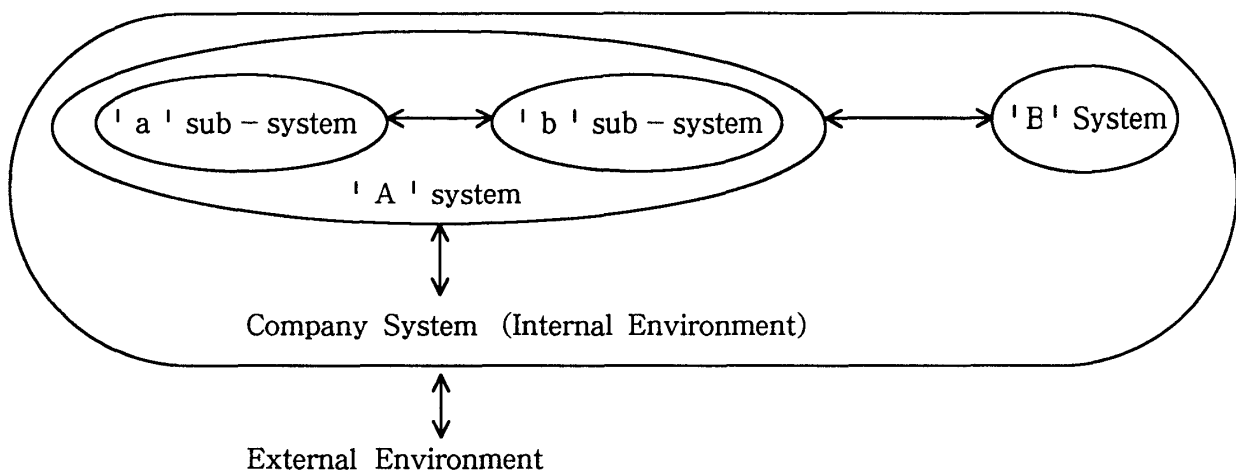
#### 4. Evaluation of the Business Environment

The business environment is generally said to be the 'external world' which surrounds a company. It can be defined in the following way :

In order to clearly identify a system, we must identify its objectives, the system itself, and the system which surrounds it. The latter system is the business environment.

We can also refer to another environment, the one within the company system, in which management functions interact in order to activate the management resources which have been invested. Thus the environment which surrounds the company system may be referred to as the external environment. This relationship is shown in diagrammatic form in Figure 2 :

Figure 2 Environments

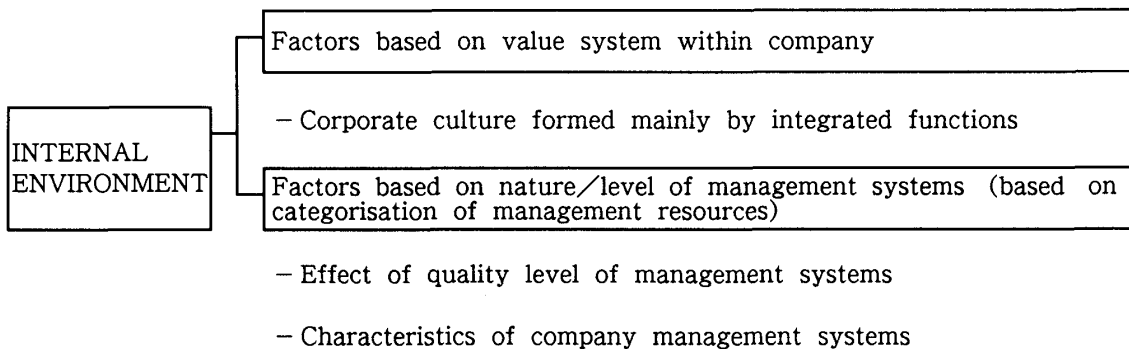


##### a) The Internal Environment

We suspect that the general conception is that the company system and the internal environment are one and the same thing.<sup>15</sup> Why is it then, you may ask, that we do not use the general conception

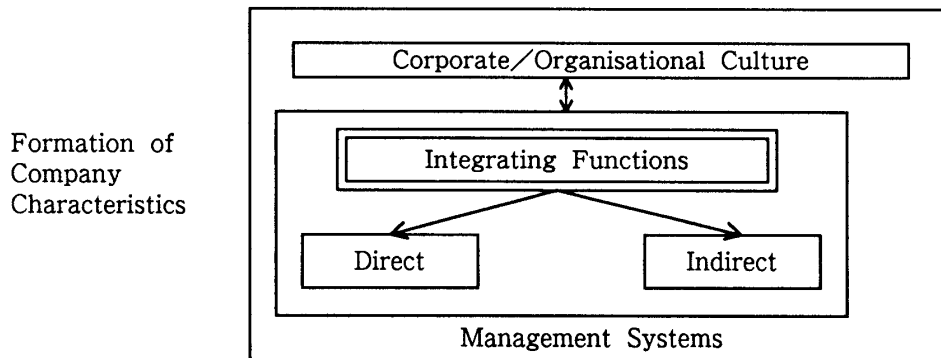
in this case. It is because when we come to measure the degree of future vitality of a company, we feel it is appropriate to refer to the effect that the current condition of the company system will have on future vitality as the internal environment (it could also be described as the internal atmosphere or condition). This internal environment will be affected by the external environment, but it will in turn actively affect its external environment, so that we should look upon these two factors as influencing each other. The constituent elements of the internal environment can be categorised as follows :<sup>16</sup>

Figure 3 Constituent Elements of Internal Environment



The value system of a company is a part of its corporate and organisational culture. Values within the company are formed mainly by its integrating functions – management policy, strategy, organisation, planning – and the effect of the external environment. This is shown diagrammatically in Figure 4 below.

Figure 4 Company Characteristics



Below we list some questions which would be answered in order to evaluate corporate culture.

(i) Company Concepts

Are efforts being made to establish concepts of company philosophy , corporate culture , corporate identity , and social responsibility ?

(ii) Management Strategy

Is the strategical decision – making system appropriate for its present environment ; can a management structure be formed which will be capable of carrying out long and middle term planning, diversification, and multinationalisation ?

(iii) Relations with the External Environment

Are the opinions of the members of the external environment – shareholders, the local community, consumers – with regard to the company’s activities in terms of its social responsibilities (eg. not to pollute the environment), being correctly evaluated ?

(iv) Organisation

Are appropriate combinations of staff and tasks being used to carry out corporate activities? Is the organisation appropriate for the prevailing situation? Is the organisation sufficiently flexible,

and is it being improved, developed?

(v) Top Management

Are there any problems with the top management decision – making system for corporate strategy, relations with the external environment, and organisation?

b) The External Environment

One of the objectives of MITI's (Questionnaire) Survey on Companies' Behaviour – their response to changes in their internal /external environment' was to obtain data on changes in the business environment in the 1990s and companies' long – term strategy, on changes in the distribution of economic wealth in response to the changing attitudes among individuals and society as a whole, and on how companies were tackling the problem of international harmony in the course of their activities, transactions.<sup>17</sup> This is suggestive of the close relationship between businesses and their external environment.

Today the importance of the external environment is increasing because of the following factors :

(i) The accelerated pace of changes in the environment :

The increasing speed of technological progress, the shortening of product life cycles, the increased speed of data communication / processing etc.

(ii) Diversification of the direction and nature of changes in the environment :

Changes such as internationalisation, globalisation, diversification of values, diversification of the principles / rules which govern society etc.

(iii) 'Breaks in continuity within the environment :

When, for example, companies in industries with a long stable history of good results suddenly find themselves struggling as a result of dramatic changes in the external environment, which are outside their previous range of experience.

(iv) The linking – up of previously separate sectors of the environment :

The creation of networks, and coordinated, systems etc.

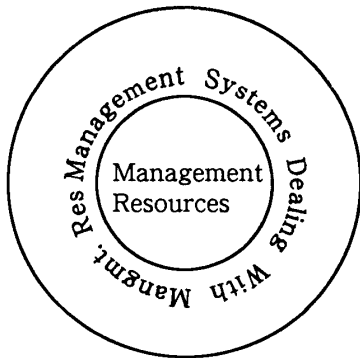
The nature of the above changes is such that it is simply impossible for companies to ignore them. When we evaluate the internal environment we have to select factors for evaluation which reflect changes in the external environment and decide what scores to give for them.

## 5. Evaluation of Business Systems using the Management Resources Approach

Management resources are the input a business receives. and a major task for management is how to utilise these resources in the most efficient way possible. Hence companies create control systems to organise and manage them in such a way that they match the companies' objectives.

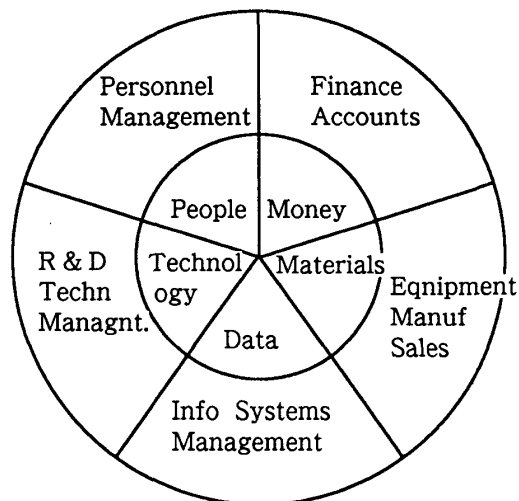
When considering company system function. We divide management resources into five categories, human resources, materials, money, information, and technology. An overview of the relationship between management resources and company system functions is show in Figure 5 below.

Figure 5



It can also be expressed as in Figure 6 below.

Figure 6



In this paper, in order to discuss corporate capability evaluation, we divide them, into three categories, (i) financial aspects, (ii), human resources, and (iii), information, technology, and equipment/facilities. (three of the segments in figure 6 being combined to form a single category).



### III. The Measurement Process for Evaluation of Corporate Capability

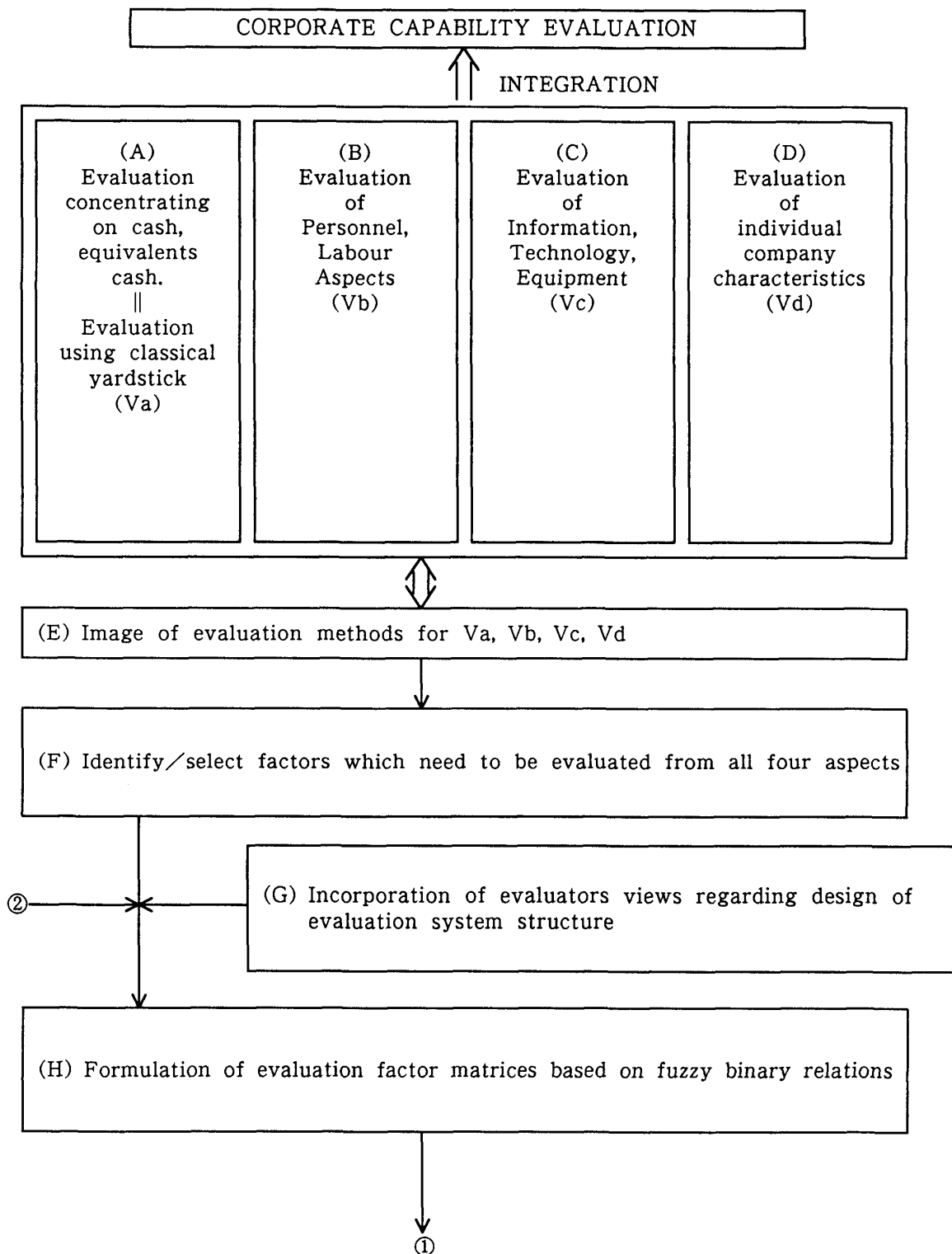
#### A) Designing a System Structure for Corporate Capability Evaluation

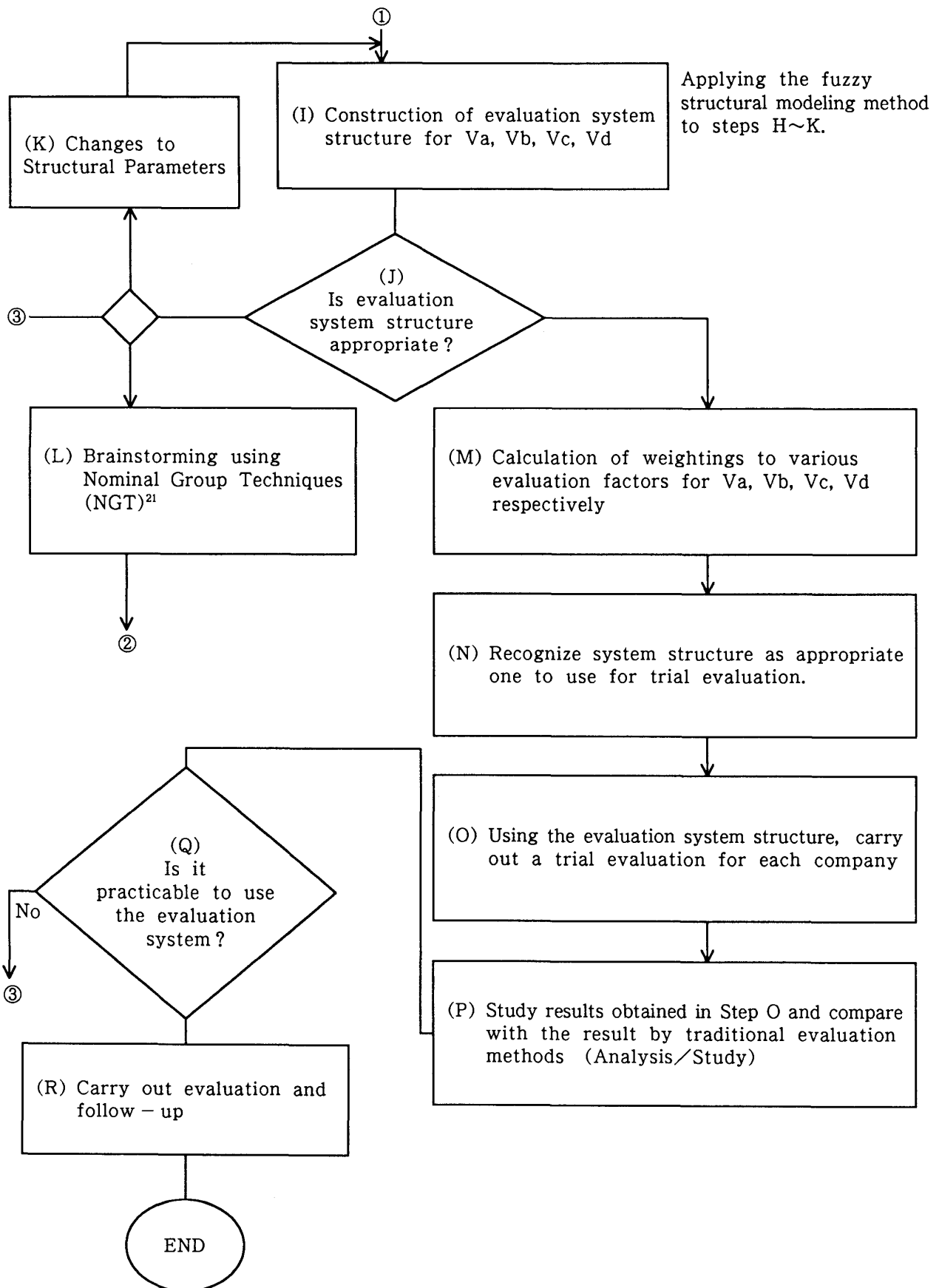
We regard corporate capability evaluation as a system, and so we must identify the objectives, factors to be evaluated/relationships between them, of that system. We must decide what the objectives are, what business the companies we will evaluate are engaged in, from which aspects we are going to analyse the results (funds, human resources, and/or equipment and data resources, and whether we are looking at the long or short term, and then carry out an evaluation in line with our objectives.

In other words we must clarify the system structure, the evaluation factors and how they interrelate. Selection of these factors is, however, extremely difficult, and entails much equivocacy (fuzziness). Here, therefore, we treat the evaluation factors as fuzzy sets<sup>18</sup>, and the relationships between them as fuzzy binary relationships.<sup>19</sup> We apply Fuzzy Structural Modelling (FSM)<sup>20</sup>, developed from fuzzy theory, to design corporate capability evaluation systems.

Although it is possible to design a corporate capability evaluation system using the method described above, there is no guarantee that it will faithfully reflect the intentions of the evaluator or be appropriate for the environment. In order to decide whether an evaluation system is appropriate, data is fed back to the evaluator. Then, if the system is adjudged to be not entirely appropriate, the evaluation factors and the fuzzy relationship between them can be studied again, and the system reconstructed using the same method. In other words, this learning mechanism enables the fuzziness of the interrelationship between the evaluation factors to be learnt and incorporated into the system.

By repeating the above procedure it is possible because of the inbuilt flexibility, to design diverse evaluation systems which reflect differences in the environment and the knowledge and experience of the evaluators. The process is represented in the block diagram (Figure7) below.





The evaluation method we propose here adds, to the traditional method (which concentrates on cash and cash equivalents), evaluation of companies' individual characteristics, personnel / labour, of information / technological resources, and equipment. It constitutes an integrated evaluation of all these aspects [(A), (B), (C), (D) in Figure 7].

Step (E) consists of producing hypothetical images of the respective evaluations from these four aspects. In step (G) the evaluation factors for the images presented in step (E) are identified, selected. Then fuzzy item correlations are given to the evaluation factor and evaluation factor matrices are produced.

In step (I), the respective evaluation system structures are created for the four aspects described above [(A), (B), (C), (D)]. In step (J), we decide whether or not these structures are really appropriate. If the answer is no, either the structure parameters are changed and the system structures are reconstructed, or the factors within the matrices are studied, and inappropriate ones are amended.

In steps (H), (I), (J), and (K), a structure can be constructed using fuzzy structural modelling method.

Unless an appropriate system structure has, by whichever method, been achieved, it is necessary to again identify / select the factors to be evaluated instead (L).

If the answer to question in step (J) is yes, the system structures are already appropriate, what weighting will be given to the various evaluation factors (for each aspect), is calculated.

Steps (M) and (N) consist of recognizing that the system structure determined by the previous steps is one which can be used for a trial. It is then used to evaluate each company and tests are carried out.

In steps (O) and (P) the results of this trial run are studied,

and compared with results of evaluations carried out by traditional methods. in order to determine whether this structure can actually be used.

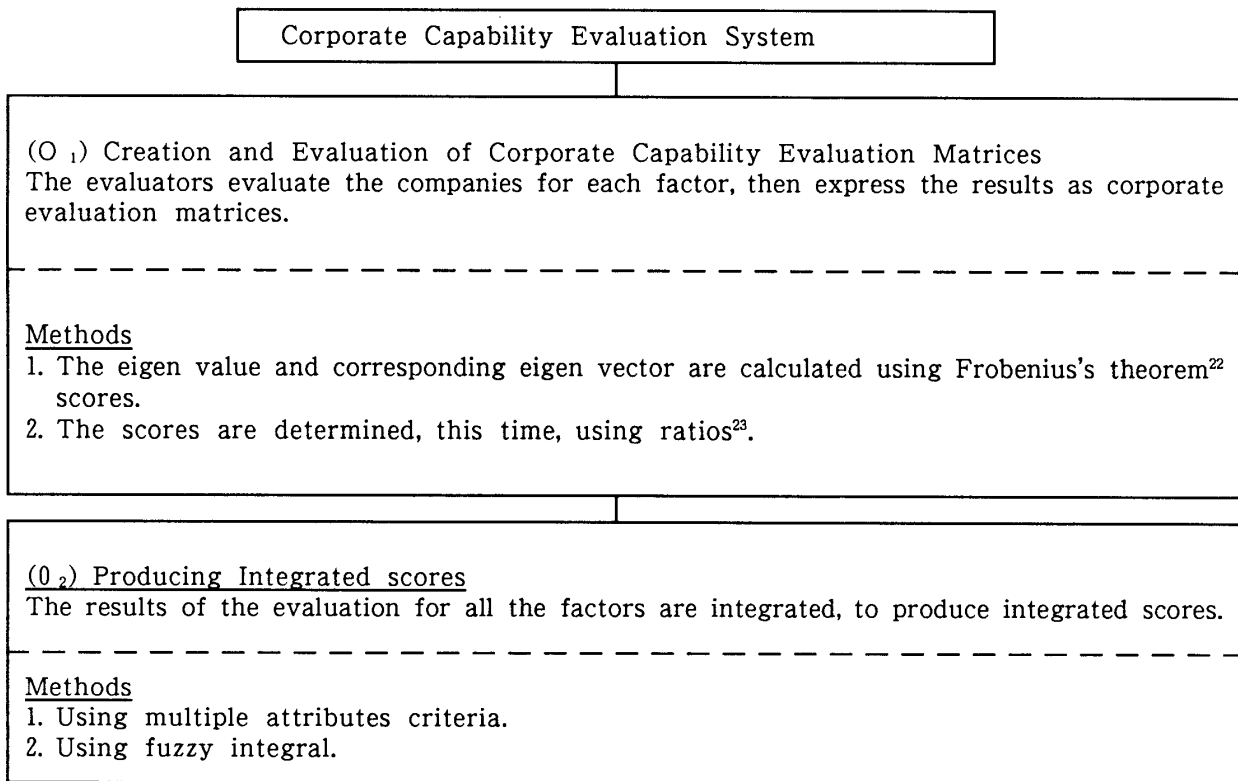
If the answer to the question in step (Q) is yes, they can be used, we can move on the final step (R), carrying out of the survey and the follow – up work. If the answer is no, we again ask ourselves question (J), and depending on the answer, either change the structure parameters or study again the factors within the matrices.

By going through the above procedure we can design a system which can be used to measure the capabilities of individual companies.

#### B) Designing a Corporate Capability Evaluation System

The corporate capability evaluation design process, steps (O) and (P) in Figure 7, is shown in Figure 8 below.

Figure 8 The Corporate Capability Evaluation Process (An expansion of step (O) in Figure 7)



Corporate capability is evaluated using the factors which have been decided upon, and weighted as calculated in step (M) in Figure 7. In step (O<sub>1</sub>) the companies are evaluated for these factors, and the results are expressed as matrices.

In step (O<sub>2</sub>) integrated scores are found, incorporating all the factors and their appropriate weightings, using the multiple attributes criteria method<sup>24</sup> and the fuzzy integrals method.<sup>25</sup>

## Sources of Reference

1. J. N. Myer, *Financial Statement Analysis: Principles and Technique*, 2nd Ed. 1939, translation, [J. N. Maiya Zaimu Shohyo Bunseki] by K. Nishino and T. Kaido, 1957, p. 8.
2. A. Moriwaki and T. Sakamoto, II Keiei Bunseki no Taikei, in *Keiei Bunseki Handobukku* 1987, ed. Nihon Keizai Shinbunsha/Nihon Shoken Keizai Kenkyusho, p. 6.
3. J. Bliss, *Financial and Operational Ratio in Management*, 1923.
4. S. Gilman, *Analyzing Financial Statements*, 1925.
5. A. Wall and R. Duning, *Ratio Analysis of Financial Statements*, 1928.
6. K. Hemmi, Chapter 4 Keiei Bunseki no Gendaiteki Mondai, in *Keiei Bunseki* 1990 ed. M. Kurumado, p. 312.
7. A. Wall and R. Duning, *ibid.* pp. 152–161.
8. *Op. cit.* pp. 14–15.
9. C. Okuno and Yamada, *Johoka Jidai no Keiei Bunseki*, 1978, p. 13.
10. M. Shinohara, V Teisei Yoin Bunseki ni Tekiyosareru Shuho, in *Keiei Bunseki Handobukku* 1987, ed. Nihon Keizai Shinbunsha/Nihon Shoken Keizai Kenkyusho, p. 152.
11. *Sogo Keieiryoku Shihyo (Seizogyohen, Kourigyohen)* (Overall Business Capability, Manufacturing/Retail Sectors) 1990, ed. Tsusansho (MITI) Sangyo Seisakukyoku Kigyo Kodoka, pub. 1991.
12. Nikkei Yuryo Kigyo Rankingu 1991, pub. *Nihon Keizai Shinbun*, Aug. 17th 1991.
13. The following reports have been published :  
Kigyo no Kenkyu Kaihatsu Potenshiaru Hyoka, 1989.  
Kigyo no Eigoryoku Hyoka, 1990.  
Kigyo no Kenkyu Kaihatsu Potenshiaru Hyoka, 1990.  
Kigyo no Eigoryoku Hyoka, 1991.



14. By a system here we mean 'something made up of various factors which are interrelated but can distinguished from each other, which carries out a particular function in order to achieve some objective'.
15. R. Shimizu discusses the effect of the company (which we refer to as the internal environment) and its environment on each other in *Kigyo Seicho Ron*, pub. Chuo Keizaisha, pp. 14–18. He says that the cycle, Strategy → Structure → Results → (Strategy) → (Structure), is the basis for their effect on each other, and that the motive force within this process is company strategy (formed by independent decision – making), but emphasises the influence the external environment has on economic strategy.
16. Hanaoka and Maruyama, *Keieigaku Soron*, pub. Hakuto Shobo, 1990, p. 40.
17. Naigai no Keiei Kankyo no Henka ni taisuru Kigyo Kodo, ed. Keizai Kikakucho Chosakyoku, pub. Okurasho (Ministry of Finance) Insatukyoku, May 1991, p. 3.
18. L. A. Zadeh, Fuzzy Sets, *Information and Control*, vol. 8, 1963, pp. 338–353.
19. Amagasa, *Shisutemu Koseiron – Fajii Riron o Kiso to shite*, (Daito Bunka University Institute of Business Research, Kenkyuu Sosho No. 3), pub. Moriyama Shoten, 1986, p. 11.
20. *Ibid.* pp. 7–84.
21. A. L. Debecq et. al. *Group Process for Program Planning*, pub. Scott Foresman and Co. 1975.
22. Onaga and Iri, Kumiawase Ronteki Shisutemu no Moderingu no Kaiseki, in *Shisutemu to Seigyo*, vol. 23 No. 1, 1979.
23. Amagasa and Hanaoka, Fuzzy Riron ni yoru Jinji Hyoka Shien Shisutemu no Sekkei to Kaihatsu (Daito Bunka University Institute

of Business Research, Research Paper No. 12), March 1990.

24. Huang Yoon, *Multiple Attribute Decision Making*, pub, Springer Verlag, Berlin, Heidelberg, New York, 1970, pp. 92–115.
25. Sugano, Fuzzy Sokudo to Fuzzy Sekibun, in *Keisoku Jido Seigyo Gakkai Ronbunshu*, Vol. 8 No. 2, 1972, pp. 218–226.