

# PATTERN CLASSIFICATION ANALYSIS OF CORPORATE QUALITY IN IT INDUSTRY

**Shinya Imai**

*Waseda University, Japan*

[shinyaimai@ruri.waseda.jp](mailto:shinyaimai@ruri.waseda.jp)

**Junzo Watada**

*Waseda University, Japan*

[junzow@osb.att.ne.jp](mailto:junzow@osb.att.ne.jp)

## ABSTRACT

Quality is an attribute which is not important only for products, but also related to management and a company itself. The development and promotion of personnel resources are indispensable in improving the quality of the management and a company. The management quality relates deeply to a corporate culture and a social sense of responsibility. Therefore, companies should emphasize on personnel resource development and training for employees.

In this paper, engineers of a regional IT company were inquired through questionnaires and observed talents were analyzed. Through the questionnaires, this research is to evaluate the values which should be promoted in a company. An attempt was made to clarify the relation between QWL (Quality of Working Life) and personnel training. The paper illustrates that the management quality and CSR (Corporate Social Responsibility) of regional companies relate deeply to the improvement of their individual growth and the quality of their own.

**Keywords:** quality of management, quality of a company, quality of an individual

## I. INTRODUCTION

Nowadays, in an IT industry, the important business policies or strategies are to promote business collaboration and strengthen skills of employees. The objective of this collaboration is to mutually compensate the weakness and strength of their companies, and to realize the co-prosperity or win-win relation with other companies. These companies intend to increase their coexistence value under the slogan of "win-win business collaborations" or "a chain of business collaborations."

IT companies are now switching their focus from hardware provider to service businesses of computers. The IT industry are (1) education of IT technical experts, (2) high qualities of products and services, (3) improvement of business relations, (4)

strengthening of maintenance services and so on. The most important issue and crucial theme is as their important issues in business activities to improve their business ability and competitiveness while increasing the customer satisfaction.

As mentioned above, executive members of a company enhance their organizational ability and cultivate their human resources in order to increase company sales volume and profits, and expand their achievements in service business.

The marketing staffs (sales and marketing, systems engineering) of a company play a central role in business planning. The marketing staffs are required to understand sales products in applying strategies to markets. Therefore, in fostering personal resources it is important to understand how marketing staff evaluate their own IT skills, career achievement, and what they expect from their own company.

In this paper, questionnaires are used to measure employees' satisfaction to their company. We randomly selected 167 employees who involved in front marketing out of five regional business partner companies of the foreign IT company A. We requested each company to gather their answers of questionnaires.

We will clarify the issues of company A facing, analyze how employees can grow optimum, and illustrate a latent structure for improving corporate quality and individual quality.

## II. PATTERN CLASSIFICATION

The objective of Pattern Classification is to build a linear model for classifying data as patterns. Similar methods are developed independently in various countries, and known in different names such as correspondence analysis, pattern classification, quantification type 3, etc., which are described in detail in Hayashi [1], Tenenhaus and Young [2], Watada et al. [3,4,5,6,7,8], Lebart et al. [9] and Terano et al. [10].

When samples are taken from *young people*, it is natural we think of these samples as being elements of fuzzy set  $B_{\text{young people}}$  (Notation  $B$  is used for a general expression below), and attempt quantitatively to classify each sample  $\varpi$  and category by considering the membership values of fuzzy set  $B$  denoted as  $\mu_B(\varpi)$ ,  $\varpi = 1, \dots, n$  [14,15]. In this case, the response to each feature or attribute is given a degree of attribute, not on  $\{0,1\}$  but on  $[0,1]$ , and we determine whether the response pattern for each sample differs. When the response to the attributes are given by  $[0,1]$  and denoted as  $\mu_i(\varpi)$ ,  $i = 1, \dots, K$ ,  $\varpi = 1, \dots, n$ , we can take the frequency of the patterns for the degree of attribute.

As illustrated above, Pattern Classification deals with  $n$  samples characterized by  $K$  attributes  $\mu_i(\varpi)$ ,  $i = 1, \dots, K$ ,  $\varpi = 1, \dots, n$ . Each sample  $\varpi$  belongs to fuzzy set  $B$  with  $\mu_B(\varpi)$ ,  $\varpi = 1, \dots, n$ . The objective of Pattern Classification is to give a mutually close numerical value to each of samples that have resembling reactions, when real numerical values  $v_\varpi$  and  $u_i$  are assigned to samples  $\varpi$  and to the various categories  $i$ , respectively, and at the same time to give a close numerical value to resembling categories. In order to do this, the correlation coefficient of the category is used as an indicator.

The size of reactions for all categories for sample  $\varpi$  is defined as

$$m_\varpi = \sum_{j=1}^K \mu_j(\varpi)$$

Samples with a large membership value to fuzzy set  $B$  are evaluated highly in this

analysis, but those with low ones are not given much consideration. As a result, the reaction for all of the data is defined as the product of the membership values to fuzzy set  $B$  and the above equation:

$$T = \sum_{\varpi=2}^n m_{\varpi} \mu_B(\varpi)$$

Means  $\bar{u}$  and  $\bar{v}$ , variances  $\sigma_u^2$  and  $\sigma_v^2$ , and covariance  $\sigma_{uv}$  for numerical values  $u_i$  and  $v_{\varpi}$ , based on fuzzy event  $B$ , come out as follows:

$$\bar{u} = \frac{1}{T} \left\{ \sum_{\varpi=1}^n \sum_{i=1}^K \mu_i(\varpi) \mu_B(\varpi) u_i \right\}$$

$$\bar{v} = \frac{1}{T} \left\{ \sum_{\varpi=1}^n m_{\varpi} \mu_B(\varpi) v_{\varpi} \right\}$$

$$\sigma_u^2 = \frac{1}{T} \left\{ \sum_{\varpi=1}^n \sum_{i=1}^K \mu_i(\varpi) \mu_B(\varpi) u_i^2 \right\} - \bar{u}^2$$

$$\sigma_v^2 = \frac{1}{T} \left\{ \sum_{\varpi=1}^n m_{\varpi} \mu_B(\varpi) v_{\varpi}^2 \right\} - \bar{v}^2$$

$$\sigma_{uv} = \frac{1}{T} \left\{ \sum_{\varpi=1}^n \sum_{i=1}^K \mu_i(\varpi) \mu_B(\varpi) u_i v_{\varpi} \right\} - \bar{u} \bar{v}$$

Based on the conditions that  $\bar{u} = 0$  and  $\bar{v} = 0$ , the problem here is to determine the  $u_i$  and  $v_{\varpi}$  that maximize correlation coefficient

$$\rho = \frac{\sigma_{uv}}{\sqrt{\sigma_u^2 \sigma_v^2}}$$

A partial differentiation of the correlation coefficient by  $u_k$  and  $v_{\tau}$  gives us

$$\frac{\partial \rho}{\partial u_k} = 0; \quad k = 1, \dots, K$$

$$\frac{\partial \rho}{\partial v_{\tau}} = 0; \quad \tau = 1, \dots, n$$

From these we get the following:

$$\sum_{\varpi=1}^n \mu_k(\varpi) \mu_B(\varpi) v_{\varpi} = \rho \frac{\sigma_v}{\sigma_u} \sum_{\varpi=1}^n \sum_{i=1}^K \mu_i(\varpi) \mu_B(\varpi) u_i$$

$$\sum_{i=1}^K \mu_i(\tau) \mu_B(\tau) u_i = \rho \frac{\sigma_u}{\sigma_v} m_{\tau} \mu_B(\tau) v_{\tau}$$

Eliminating  $v_{\tau}$ , we get

$$\sum_{\varpi=1}^n \sum_{i=1}^K \frac{\mu_B(\varpi)}{m_{\varpi}} \mu_k(\varpi) \mu_i(\varpi) u_i = \rho^2 \sum_{\tau=1}^n \mu_k(\tau) \mu_B(\tau) u_k; \quad k = 1, \dots, K$$

In order to consolidate the above, we introduce the following notation:

$$b_k = \sum_{\varpi=1}^n \mu_k(\varpi) \mu_B(\varpi); \quad k = 1, \dots, K$$

$$z_k = \sqrt{b_k} u_k; \quad k = 1, \dots, K$$

$$c_{ki} = \frac{1}{\sqrt{b_k b_i}} \sum_{\varpi=1}^n \frac{\mu_B(\varpi)}{m_{\varpi}} \mu_k(\varpi) \mu_i(\varpi);$$

$$k, i = 1, \dots, K$$

$$\mathbf{C} = [c_{ki}]$$

$$\mathbf{z}' = [z_1, \dots, z_k]$$

Using these notations, an eigenvalue problem is obtained as in the following:

$$\mathbf{Cz} = \rho^2 \mathbf{z}$$

In other words, under the conditions  $\bar{u} = 0$  and  $\bar{v} = 0$ , all we have to do is to find  $u_i$  for the maximum eigen value of the eigenvalue equation. In addition, if we solve  $v_{\tau}$

based on the condition  $\frac{1}{\rho} \frac{\mu_u}{\mu_v} = 1$ , we get

$$v_{\tau} = \frac{1}{m_{\tau}} \left\{ \sum_{i=1}^K \mu_i(\tau) u_i \right\}$$

### III. BUSINESS QUALITY IN IT INDUSTRY

#### A. Present State of Business Activities

IT companies activate technologies and fields for new businesses in order to diversify their business. They try to establish new business collaboration on the basis of their own technology in the field of software package development where they have their own strong technologies. On the other hand, computer makers restructure the organization of a special division and reallocate responsible personnel in order to promote such a change of emphasis from on hardware to on software. Furthermore, computer makers provide seminars separately for each IT company and for each product brand. Nevertheless, we cannot help observe the difference of their intentions between IT companies and computer makers, even if the objective is to promote the business of IT companies and find a way of surviving.

It should be emphasized that nowadays the IT industry faces an era to provide total solutions and businesses are changed to a proposing typed one by applying various skills from a system development typed one. Such skills are classified into three groups: 1) technical skill, 2) their relationship skill and 3) management skill. Computer makers have responsibility to promote such a business direction to a proposing type business.

#### B. Issues of companies

If manufacturers do not consider consumers preferences and needs it is not possible to fulfill customers' satisfaction by means of their products. Therefore, the decision making on products has changed from such past ways where makers decide the functions, design, performance, and quality of products one-sidedly depending on their own judgment or standard. It is important to understand the needs of customers'

commercialize products and service faster than their competitors, and identify the target markets and customers appropriately. For example, when a manufacturer announces a new product, it should arrange its advertisement and promotion simultaneously and instantaneously. A corporation emphasizes increasing customers' satisfaction rate by means of improving the usage of a product and clear understanding of its instruction, providing a section to deal with inquiries and complaints, improving the response rate, and providing better customer services after purchasing.

An integrated power evaluation of a company requires "corporate quality" to realize customers' satisfaction. One of the important issues confronting a company is how to cultivate and educate employees to become leader. A company has to increase the number of training days for employees in annually. All employees should have a nature to be a leader. Therefore, every company should have its responsibility to abstract and extract such talents from each employee. They do not emphasize only on job sites and factory floors but also provide a sufficient education system for employees and the strategy of personnel training and education in a company. This research on behavioral features of managers illustrates important issues for corporate quality that are discussed from the survey of employees.

### **C. Issues of an individual employee**

"A corporation can not develop without the development of individuals" from T.J. Watson Sr. the founder of IBM. This means that the aggregation of individual abilities should be the most powerful support for their company and the company can develop when individual employees do by brushing their ability. On the other hand, the development of a company promises the growth of individuals. That is, the goal of individual employees should be realized, as well as that of the company.

The quality of working life of each employee can be summarized in the followings:

- (1) Job satisfaction;
- (2) The successful application of their ability and their own development;
- (3) Taking responsibility and authority
- (4) Appraisal of their tasks by other people;
- (5) The evaluation responding to their achievement; [11]

Therefore, each employee expects the return to the achievement of their own targets, and the proper treatment corresponding to their function and responsibility. It is said that experiences give people knowledge and their responsibility at their jobs makes people grows. On the other hand, the most important is said to be their own consciousness and spirit and enthusiasm toward their job. It is necessary to develop their own ability in the framework of personnel management strategy in a company and improving their own skills along their own career plan. There are many cases in the past where employees developed their own skills on a job training (OJT; on-the-job-training) within or without their company. In the IT industry that has competition of technologies, the OJT is one of the easiest methods to make each employee understand a flexible treatment, as well as problem solving methods. After learning and obtaining experiences from OJT, it is necessary that education hours are provided for employees to learn theories. It is the responsibility of employees themselves to ensure steady knowledge acquisition and direct their passion and enthusiasm in the educational process.

## **IV. QUALITY OF CORPORATE AND INDIVIDUAL EMPLOYEE IN IT INDUSTRY**

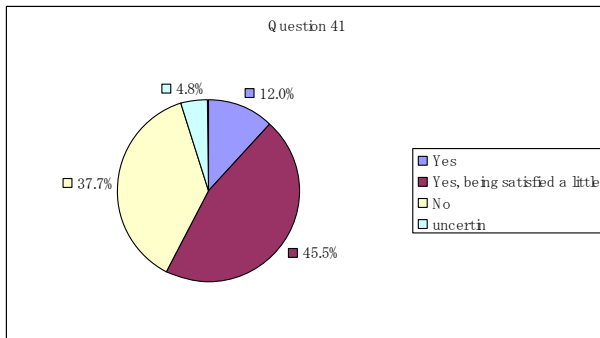
## **A. Corporate Quality**

Quality control starts from the detection of problems and deficits. Effective quality control requires employees to be eager and enthusiastic in trouble-shooting. The most important in finding defects in a system is to start from facts. Therefore, the quality control is said to be a method depending on facts. All activities of the quality control begin from recording facts and interpreting them as they are.

“The remedy to cure illness of Nissan should be found within the company” from Mr. Carlos Ghosn who led Nissan to recover. He committed himself talked to his employees thoughtfully and thoroughly after being appointed as the CEO [12]. Let us relate this to our own and organization with the following questions. Did your company change from the past? Did your company successfully respond to the change of markets, competitive structures and customer’s needs? Innovation should provide survival actions for companies corresponding to the changes of their environment. The V curve of recovering of Nissan came from the leadership of Ghosn’s and it was emphasized. But on the other hand, we should not forget the role of experts from middle lines and a numerous number of general employees who embodied the direction of rebuilding Nissan led by Ghosn [12].

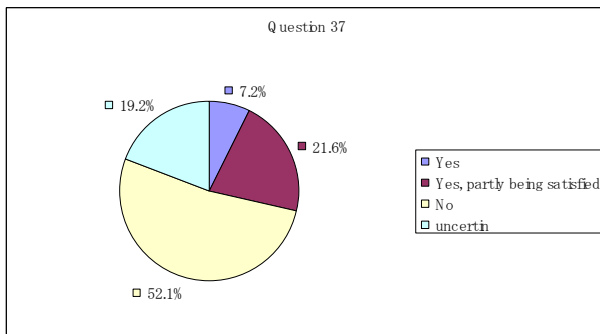
Employees in the organization of a company are classified into a line specialist and staff specialist. The most important final target of the organization is to obtain the maximum interests. It is not possible to keep the profits for the whole company only by sales staff. It is not possible to create the competitive power of a company without the fact that employees in each division must master the details of their techniques and senses of sales. The stance of an organizational sales division is to realize that employees and especially staff specialists take the needs of their customers with sincerity and eagerness. The staff specialists are to support the line employees. Sales divisions have to collaborate with other related divisions in sales activities and attack problems and chances flexibly. It should result in achieving the goals which provides satisfaction for all the people in the company, as well as ones in sales divisions. Corporate quality should be enhanced and the company differentiates from any other competitive companies if we can create at least one employee who can image the satisfaction of a customer in dealing with their job. Required elements in realizing organizational sales are implemented in the behaviors of each employee including skills and know-how. A well organized sales department should properly respond customers’ requests as a team, and take such a responsibility at the end. The most important is to increase the loyalty of employees to the company.

Figure 1 shows the satisfactions of marketing employees with their work stations. Affirmative answers including “yes” and “partly satisfied” were 57.5% out of all the answers obtained from the five companies on Question 41: “Are you satisfied with work environments of your company?” An individual wants to obtain some support from a company to increase the quality of work life and make their daily and future lives rich and enhance individual ability. It is important to increase the satisfaction that employees obtain from a company. As a result, each employee cannot bring their own ability out sufficiently without such a work environment even if education menus are provided for employees to flexibly and speedily treat the requests from customers. The reason is because employees want a safe and sound work environment. The sound work environment is essential in order to bring out their ability sufficiently in a company where they spend a whole day.

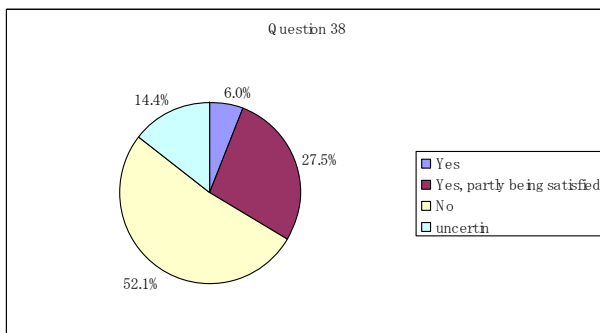


**Figure 1. Question 41: “Are you satisfied of work environments of your company?”**

Then, how do employees consider their royalty and their career-up? Are they satisfied with moral-up and motivation-up as well as education and career development in a company? The results of Question 37 and 38 happen to be similar as shown in the following:



**Figure 2. Question 37: Satisfaction rating of in-house program to improve morality/motivation**



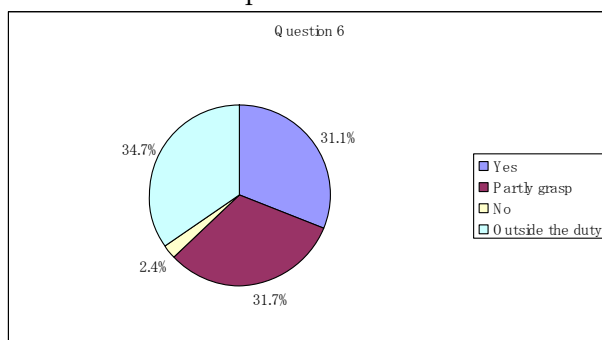
**Figure 3. Question 38: Satisfaction rating for systems and programs of in-house promotion and commendation**

Figures 2 and 3 show the satisfaction of employees has strong correlation with customer satisfaction. If employees worry and are dissatisfied about a work environment and company, they will not take responsibility sufficiently. Therefore, the number of errors increases and work efficiency should decrease. Accordingly, the quality of products and

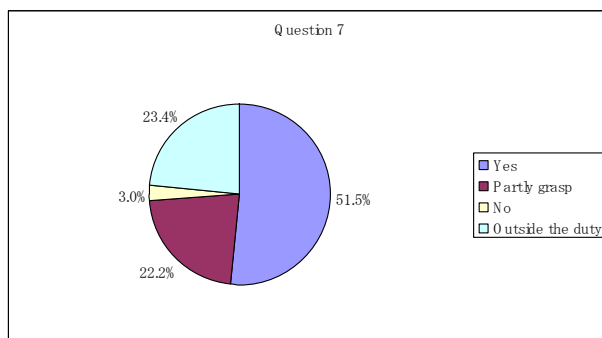
services should be worsened. This invokes the customer' dissatisfaction and makes customers escape from the company. . Therefore, the increasing of employees' satisfaction rate enhances quality and productivity [13]

**B. Individual quality**

Figure 4 show the statistics of answers to the question about “the understanding of a situation of territories and customers in charge” out of Question 6: Skills of sales staff. The total of “Yes” and “Partly grasped” in Figure 4 is up to 62.8%. Such a figure is not sufficient for marketing staff to take care of a front-line. The most disappointed is that Answers: “out of duty” counted up to a large value: 34.7%. The Questionnaires were sent to ask marketing staff answer but application system engineers and maintenance staff answered as out of their duty. 27.1% of the respondents are system engineers and maintenance staff. Operational staff and etc. are 10.2%.



**Figure 4. Question 6: “Do you understand your own targeted sales territory and customers?”**



**Figure 5. Question 7: “Do you understand the setting of the action target and the target sales amount for a year?”**

Question 7 asks “Do you understand the annual target figure/ annual action target.” Figure 5 shows that the answers of “out of duty” are counted up to 23.4%. It is too high in comparison with the total of “Yes” and “partly grasped” is 73.7%. About one fourth of all the employees randomly selected “out of duty” or “no”. This fact should conflict with the employee’s satisfaction. Marketing staff have to work hard for realizing the target figure. Otherwise, the growth of the company cannot realize the target set.

Next we have to discuss about how they can obtain the knowledge of operations as shown in Figure 6. This is the skills and quality required most for marketing staffs. This is the most important answer in this research. Customers most evaluate the total ability of



manufacturers and applied businesses. 50.3% of marketing staff learned such knowledge from their customers. This activity has an important meaning for individual growth and career-up. Marketing staff can grasp and gain the reliability from their customers by increasing the individual quality after the acquisition of new knowledge through lectures and seminars and brushing their skills up by the experiences of implementing.

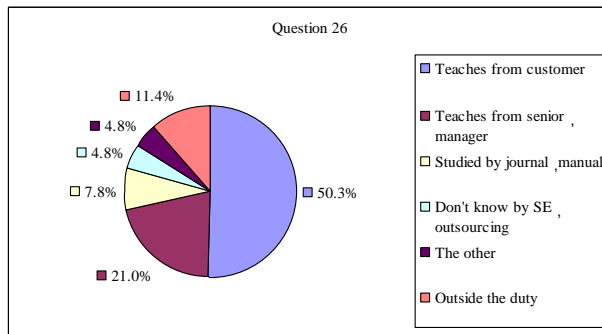


Figure 6. Question 26: "How can they obtain the knowledge of operations?"

"Think" is a motto frequently referred in IBM Sr. It is a word from the founder of IBM, Watson Senior talked. Watson Sr., Senior to employees "People, read books and listen to opinions of other people's, discuss with all and at the end think. "The growth of IBM was realized by means of education and training, that invests 3% of the whole sale volume to the education and training for employees.

## V. ANALYSIS OF QUALITY BY PATTERN CLASSIFICATION

### A. Application of Pattern Classification

The objective of this paper is to clarify the issues in the improvement of individual quality included in personnel development of employees and careering up by means of understanding the present state of employees in an IT industry. The policy making for such issues should be linking with the management quality of a company. Questionnaires are analyzed by a pattern classification model.

### B. Scatter graphs of attributes

#### 1) Axis 1 in Figure 7

In a scatter graph, evaluations positive of the 5<sup>th</sup> item are plotted in the positive region of Axis 1 (+) but positive. Especially, evaluation A is included in the first quadrant.

Regarding the skill evaluation of four products, both evaluations A and B are in the positive region of Axis 1 (+). Especially, the skill of Product X has high value.

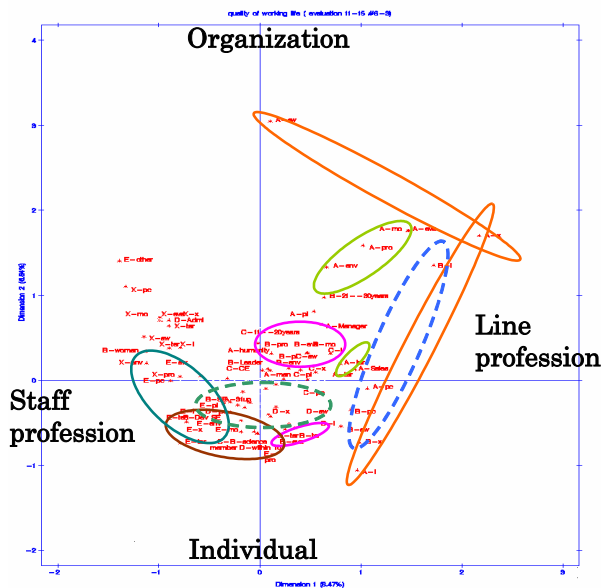


Figure 7. Scatter graphs of attributes

**2) Axis 2 in Figure 7**

In the scatter graph, five items have the strong correlated movement with “the evaluation of increasing skills.” On the Axis 2 of the scatter graph, evaluations A and B of five item attributes are positive. The positive are E-mo and E-pro.

The skill evaluation of four products has negative correlation with Evaluations on the contrary to Axis 1 (+) and the evaluation of four products is minus but E-sw. The employees’ satisfaction for a company is proportional to the proficiency of skills. Even though the scatter graph of variables is minus, changing the management quality of a company strengthens their competitive power more.

**C. Scatter graph of employees**

**1) Axis 1 in Figure 8**

- (1) Satisfied employees:  
Nine out of ten employees who are satisfied or partly satisfied are within the positive region of Axis 1.
- (2) Unsatisfied employees:  
Eighteen out of fifty employees who are unsatisfied are within the positive region of Axis 1.
- (3) Undecided employees:  
Five out of twenty eight sample employees are on the positive region of Axis 1.

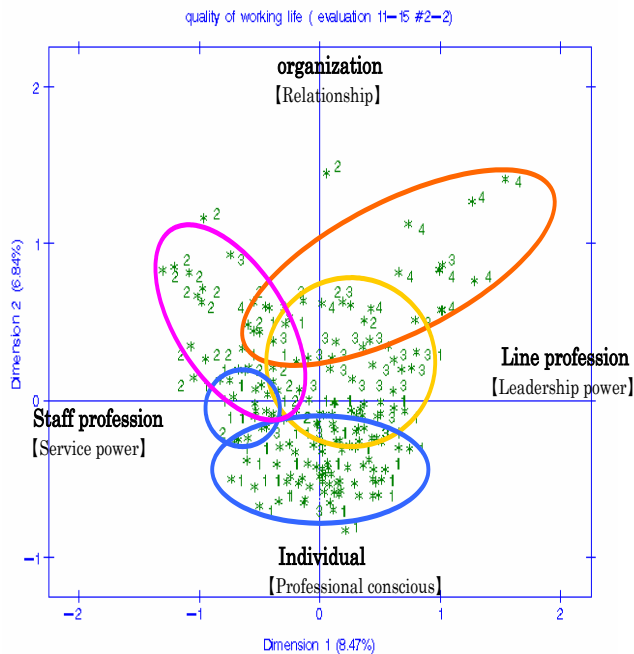
**2) Axis 2 in Figure 8**

- (1) Satisfied employees:  
Ten out of ten employees who are satisfied are within the positive region of Axis 2.
- (2) Partly satisfied employees:  
Twenty two out of twenty eight employees who are partly satisfied are within the positive region of Axis 2.
- (3) Unsatisfied employees:

Eleven out of fifty employees who are unsatisfied are within the positive region of Axis 2.

(4) Undecided employees:

Twenty three out of twenty eight employees are on the positive region of Axis 2.



**Figure 8. Scatter graph of total evaluation**

The quality of working life, their life in everyday and future and the improvement of their ability that employees look for are important factors to enhance the satisfaction of employees. In the scatter graph, even though many samples pull Axes 1 and 2 out to the positive direction, there are still many employees in the negative region. That expresses there are many employees are daily disgruntled.

**D. Scatter graph of corporation awards / award system**

**1) Axis 1 in Figure 9**

(1) Satisfied employees:

Six out of nine employees who are satisfied or partly satisfied are within the positive region of Axis 1.

(2) Unsatisfied employees:

Twenty out of thirty nine employees who are unsatisfied are within the positive region of Axis 1. (Totally 29 samples)

(3) Undecided employees:

Three out of twenty employees are on the positive region of Axis 1.

**2) Axis 2 in Figure 9**

(1) Satisfied employees:

Eight out of nine employees who are satisfied are within the positive region of Axis 2.

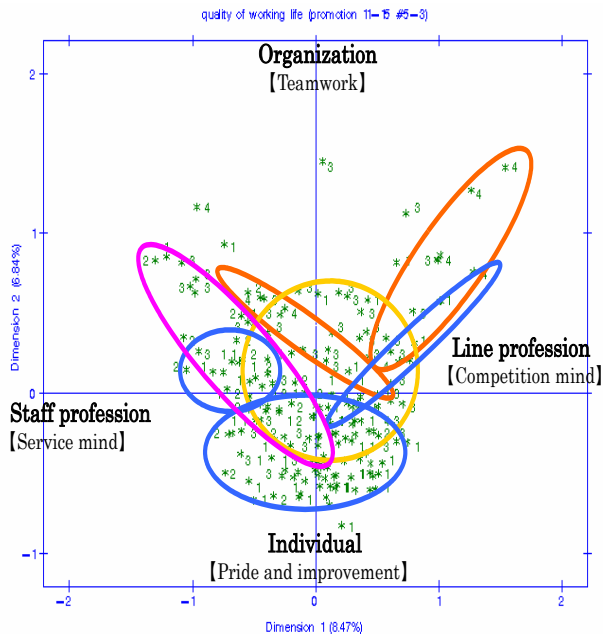
(2) Partly Unsatisfied employees:

Twenty nine out of thirty nine employees who are partly satisfied are within the positive region of Axis 2.

(3) Unsatisfied employees:

Twenty out of forty six employees who are unsatisfied are within the positive region of Axis 2.

(4) Undecided employees:



**Figure 9. Scatter graph of corporation awards / award system**

Eleven out of twenty employees are on the positive region of Axis 2. The factors that make employees satisfied totally are gathering on Axis 1 and partly on Axis 2. On the contrary, Employees who are not satisfied are gathering on the minus regions of Axes1 and 2. 38 samples that have dissatisfaction are scattering over the positive region. This is usually formed in a company. Managers have to treat and evaluate employees fairly and impartially according to the fiscal plan. It is possible to change even employees of the negative region into contributable marketing staff if they can be treated properly and cultivated well. The education and training system in a company should be positioned as one of business strategies.

## VI CONCLUDING REMARKS

In this paper, the answers of questionnaires are obtained from 167 employees of IT companies. These data are analyzed by a pattern classification model. The following points should be stressed as remarks. The quality of a company is the most important to make each employee satisfied in companies. Corporate quality should be realized on the basis of the realization of the quality of individual employees.

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