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# Setting Organizational Key Performance Indicators in the Precision Machine Industry

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The aim of this research is to define (or set) organizational key performance indicators (KPIs) in the precision machine industry using the concept of core competence and the supply chain operations reference (SCOR) model. The research is conducted in three steps. In the first step, a benchmarking study is conducted to collect major items of core competence and to group them into main categories in order to form a foundation for the research. In the second step, a case company questionnaire and interviews are conducted to identify the key factors of core competence in the precision machine industry. The analysis is conducted based on four dimensions and hence several analysis rounds are completed. Questionnaire data is analyzed with grey relational analysis (GRA) and resulted in 5–6 key factors in each dimension or sub-dimension. Based on the conducted interviews, 13 of these identified key factors are separated into one organization objective, five key factors of core competence and seven key factors of core ability. In the final step, organizational KPIs are defined (or set) for the five identified key factors of core competence. The most competitive core abilities for each of the five key factors are established. After that, organizational KPIs are set based on the core abilities within 3 main categories of KPIs (departmental, office grade and hierarchal) for each key factor. The developed KPI system based on organizational objectives, core competences, and core abilities allow enterprises to handle dynamic market demand and business environments, as well as changes in overall corporate objectives.

*Keywords:* core competence, core ability, SCOR model, key performance indicators, grey relational analysis

## Introduction

The precision machinery industry is highly valued and generally acknowledged as one of the basic industries of nations. In Taiwan, the precision ma-

chinery industry has started to face major challenges, which will continue in the coming years. Traditionally, the Taiwan machine industry focuses on machine assembly and maintenance, and employees work in dark workplaces, which are usually warm, oily, and dirty. Such an environment makes building a good and sustainable system difficult. Thus, the traditional machine industry has started to transform itself into the modern precision machine industry in response to globalization and customization (Wu, 2011). In this process of transformation, building a rational mechanism is important in finding out the key factors of core competence, which can be used to train the enterprise talents, to promote the competitiveness of the enterprise, and to encourage the professional accomplishment of employees.

In recent years, the business environment has become more competitive and volatile. Therefore, enterprises need to focus on technological abilities, the soft abilities and management of manpower. The knowledge technology of an enterprise can lead to competitive advantage and in surmounting the competition. Thus, the concept of core competence becomes an important management tool (Lahti, 1999). Spencer and Spencer (1993b) argue that core competence is a management model based on individual capability, and aims to find out and to confirm the needed capability and behaviors for achieving superior excellence. In this way, an enterprise or an individual can enhance working performance, which makes the application of core competence a necessity for the strategic management of an enterprise.

The purpose of this research is to define (or set) organizational key performance indicators (KPIs) in the precision machine industry by using the concept of core competence and the supply chain operations reference (SCOR) model. In competitive and volatile business environments, an enterprise must follow its unique culture and determine its core competence and appropriate KPIs. Focusing on the core competence is the key to achieving outstanding performance (Shih, 2000). Prahalad and Hamel (1990) argued that the most important task of the leader of an enterprise is to discover how to operate the enterprise sustainably and to find out the key factors how to achieve this goal (i.e., the core competence of the enterprise). Thus, the development of the core competence is the best way for enterprises to measure their pursuit of excellence, as well as the key factor for enterprises to run sustainable operations. When the core competence of enterprises is built, the goal of growth must be established to obtain the best advantages of the core competence.

The current research follows three steps. In the first step, we conducted a bench-marking study to collect major items of core competence and to group them into main categories, which will result in the formation of the foundation for the research. In the second step, a case company is analyzed and interviews are conducted to identify the key factors of core competence

in the precision machine industry. The analysis is conducted based on four dimensions (comprehensive, department, management level, and years of experience), and hence, several analysis rounds are completed. Questionnaire data are analyzed with GRA to identify the key factors of core competence (Deng 1989), and complemented with a case company interview to extract the most significant ones. In the final step, organizational KPIs are defined (or set) for the most essential key factors of core competence. In the setting of KPIs, the SCOR model is used as a reference to improve the efficiency of supply chain management for enterprises, suppliers, and customers (Huan, Sheoran, & Wang, 2004).

The remainder of this paper is structured as follows: literature review on the concept of core competence, the concept of core ability, organizational KPIs, and the SCOR model is presented in the second section. The third section presents the research approach, while the fourth section discusses the research results. Finally, the research is concluded in the fifth section.

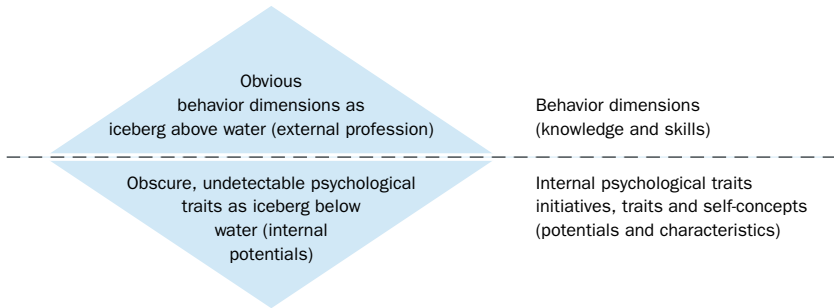
### Literature Review

This section introduces the development of both core competence and KPI and viewpoints of domestic and foreign scholars. In the literature review, the core competence is divided into external profession and internal potential, while the KPI of the organization is combined with the objectives of the organization, such that its vision can be achieved and the competitiveness is enhanced to cope with highly changeable situations.

### Core Competence and Ability

McLagan (1997) defines competence as the potential characteristics, knowledge, conception, and behavior of individuals. Boyatzis (1982) explains that competence consists of the fundamental traits that make one achieve excellence in work, and these traits include external and internal dimensions, such as motivation, qualities, self-concept, attitudes, knowledge, skills, and abilities. Chiang (2002) argues that ability refers to potential traits, which have become an effective referential standard related to high work performance in thinking and behavior. Spencer and Spencer (1993b) compare competence to an iceberg (Figure 1), in which the obvious behavior dimensions (such as the profession and skills) are above the water, and the obscure and undetectable psychological traits (such as potentials, characteristics, and self-concepts) are below.

According to the above, competence is the basic key characteristic of achievement and can affect work performance. Maurer and Weiss (2010) assume that competence at continuous learning is a key part of successful work. An organization or an individual may have several competences. Spencer and Spencer (1993a) use the work competence assess-



**Figure 1** Competence Iceberg Model

ment method to determine the competences that enable high levels of performance among workers. Later, Spencer and Spencer (1993b) propose the concept of the core competence based on these ideas. Core competence emphasizes the connection among individual working behavioral features, efficiency, and performance (Boyatzis 1982; Prahalad and Hamel 1990; Prahalad 1993; Chen 1997; Huang 2001). Prahalad and Hamel (1990) further argue that organizational core competence is the unique intelligence, process, or product related with market competition, which best reflects the content and orientation of an individual, event, and organization. Thus, core competence refers to the competence of an organization or individual that is essential or central to high performance.

In the course of long-term management, an inclusive ability can be composed of the accumulation of core competence and the relevant resources. Ability is a kind of unique characteristics of an enterprise that distinguishes the firm from competitors (the core ability). Cravan (2002) shows that core ability can create a unique value for the customer. Prahalad and Hamel (1990) point out that core ability is the source and basis of continual competition among enterprises. Thus, core ability is the key to sustain an enterprise and to achieve a leading position in enterprise development and strategy.

### ***Organizational KPI and the SCOR Model***

Generally, reaching anticipative operational goals can enhance the competitiveness of an enterprise. To evaluate the performance of operational goals, a complete performance evaluation (or management) system is needed. This system can be used to evaluate whether a goal is reachable or not, and to manage an organization in the right direction. The selection of KPIs heavily influences the future performance of an organization (Yeh 2001). Therefore, business managers should strive to find the balance between financial and operational indicators to enhance the future performance of the

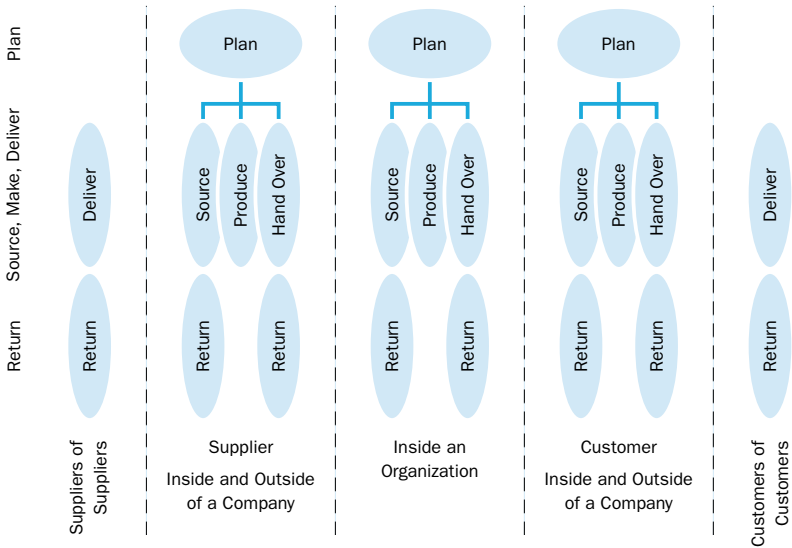
enterprise. KPIs are objective-oriented quantitative assessment indicators, which are regarded as a classification of key ingredients in the operations of the enterprise. KPIs are obtained by sampling, collecting, calculating, and analyzing input data from the internal processes of the organization. The key to establishing an effective performance management system in an enterprise lies in the setting of clear and workable KPIs. Chuang (2011) argues that if there are no assessment tools, there will be no performance; if there is no performance, there will be no management. This logic implies that performance management is one part of the management system. In recent years, financial-oriented assessment has been expanded to include non-financial-oriented assessment (e.g., employee rationale, productivity, quality, quit rate, and attraction to professionals).

One of the major changes in modern management is that individual organizations no longer compete as autonomous entities, but rather they compete as supply chains. Instead of manufacturer versus manufacturer, or supplier versus supplier, the current situation calls for supply chains versus supply chains. A supply chain refers to an integrated network of autonomous organizations, which are involved in the different processes and activities that produce value in form of products and services (Christopher 1998). This relationship implies that enterprises cannot simply focus on the internal process. Instead, companies must have a complete set of KPIs that could measure the whole supply chain network, which includes all activities connected with sourcing, manufacturing, and distribution from suppliers to customers. Therefore, the SCOR model (Figure 2) can be helpful when developing a performance management system for an enterprise (Huan et al., 2004).

In the SCOR model, the supply chain consists of several supply chain members (Figure 2). The supply chain process within each supply chain member is separated into five main processes, which are plan, source, make, deliver, and return (Pau & Chang, 2009). To develop and to improve the supply chain and its performance within these five main processes, the SCOR model includes 131 KPIs covering issues, such as customer service, cost control, risk management, and relationship with customers and suppliers (Supply Chain Council, 2010).

### Research Approach

The purpose of this research is to define (or set) organizational KPIs in the precision machine industry based on core competence and the SCOR model. A component manufacturer in the machine industry was invited to serve as the case study. The case company was established in Taiwan in 1990. This company has more than 1000 employees, the turnover has already reached NTD 5 billion and is increasing continuously. The supply



**Figure 2** Five Procedures of SCOR

chain operations include sourcing, manufacturing, and distribution. As for machine industry, the demand for talents usually adopts the disciplines of apprenticeship to train the talents. The loss of talents may occur because of the lack of systematic planning, designing, and carrying out the cost of training. The company hopes to transform itself from a traditional machine company that focuses on machine assembly and maintenance into a modern company that centers on manufacturing servitization. In this process of transformation, it is important to build a rational mechanism in order to find out the key factors of core competence, which can be used to train the enterprise talents, to promote the competitiveness of the enterprise and to encourage the professional accomplishment of employees. The research approach in this research was conducted in three steps, which are described below in detail.

**Collection of Major Items of Core Competence**

In the first step of the research, a bench-marking study was conducted to collect major items of core competence. These items are grouped into main categories to build the foundation for the investigation of core competences within the precision machine industry in general and the selected case company in particular. The process of selecting bench-marking enterprises and collecting major items of core competence included the following:

1. Select enterprises in Taiwan that have won gold or silver Taiwan Train Quality System (TTQS) medals via the Internet.

**Table 1** Item and Classification of Core Competence from 17 Benchmarking Enterprises

| (1) | (2)                                      | (3)   | (4) | (5)                | (6) |
|-----|--|---|-----|--------------------|-----|
| 1   | Research Innovation                      | SPIL  | 11  | R&D and Innovation | 1   |
| 2   | Innovative Ability                       | Hiwin Technology Corp.  |     |                    |     |
| 3   | Innovative Development                   | Fair Friend Ent. Group  |     |                    |     |
| 4   | Continual Innovation                     | Kao   |     |                    |     |
| 5   | Innovation                               | CMC Motor<br>TOYOTA<br>TSMC<br>Wowprime<br>Compal Electronics, Inc. |     |                    |     |
| 6   | Innovation and Desire for Changes        | 3M  |     |                    |     |
| 7   | Reforms and Innovation                   | Telephone Company Ltd   |     |                    |     |
| 8   | Cooperation                              | D-Link<br>Fair Friend Ent. Group<br>Hiwin Technology Corp.          | 10  | Group Cooperation  | 2   |
| 9   | Group Orientation                        | Telephone Company Ltd   |     |                    |     |
| 10  | Group Success                            | Kao   |     |                    |     |
| 11  | Group Work                               | Wowprime  |     |                    |     |
| 12  | Relationship with Customers and Partners | TSMC  |     |                    |     |
| 13  | Harmony                                  | Compal Electronics, Inc.<br>Lianchi Group<br>CMC Motor              |     |                    |     |
| 14  | Customer First                           | D-Link  | 6   | Customer Oriented  | 3   |
| 15  | Customer First                           | Fair Friend Ent. Group  |     |                    |     |
| 16  | Customer Oriented                        | Kao<br>Hiwin Technology Corp.                                       |     |                    |     |
| 17  | Serve Customers                          | Wal-Mart Stores, Inc.   |     |                    |     |
| 18  | Services                                 | Lianchi Group   |     |                    |     |

*Continued on the next page*

2. Select foreign enterprises with similar viewpoints on core competence via the Internet.
3. Collect items of core competence from the websites of the selected enterprises.

The sample included enterprises from traditional industries and from modern industries, such as services, technology, logistics, and expendable supply manufacturers. In total, 17 enterprises were involved in this benchmarking study, and from these selected enterprises, 59 items of core competence were collected and grouped into 21 main categories (Table 1).



**Table 1** *Continued from the previous page*

| (1) | (2)                       | (3)                                | (4) | (5)                       | (6) |
|-----|---------------------------|------------------------------------|-----|---------------------------|-----|
| 19  | Honesty and Integrity     | P&G<br>3M<br>Kao                   | 6   | Honesty and Integrity     | 4   |
| 20  | Honesty and Integrity     | TSMC                               |     |                           |     |
| 21  | Sincerity                 | DEPO                               |     |                           |     |
| 22  | Fairness                  | Telephone Company Ltd              |     |                           |     |
| 23  | Transcendence             | Compal Electronics, Inc.<br>TOYOTA | 5   | Transcendence             | 5   |
| 24  | Desire for Success        | P&G                                |     |                           |     |
| 25  | Excellence                | CMC Motor                          |     |                           |     |
| 26  | Pursuit of Excellence     | Wal-Mart Stores, Inc.              |     |                           |     |
| 27  | Continual Learning        | D-Link                             | 4   | Continual Learning        | 6   |
| 28  | Continual Learning        | Fair Friend Ent. Group             |     |                           |     |
| 29  | Group Learning            | SPIL                               |     |                           |     |
| 30  | Initiative                | Lianchi Group                      |     |                           |     |
| 31  | Loyalty                   | Lianchi Group                      | 4   | Observation of Discipline | 7   |
| 32  | Trust                     | P&G                                |     |                           |     |
| 33  | Commitment                | TSMC                               |     |                           |     |
| 34  | Observation of Discipline | D-Link                             |     |                           |     |
| 35  | High Motivation           | Kao                                | 4   | High Motivation           | 8   |
| 36  | Active and Initiative     | 3M<br>Hiwin Technology Corp.       |     |                           |     |
| 37  | Working Hard              | Lianchi Group                      |     |                           |     |
| 38  | Quality Control           | Fair Friend Ent. Group             | 3   | Quality Control           | 9   |
| 39  | Professional Quality      | SPIL                               |     |                           |     |
| 40  | Profession                | TOYOTA                             |     |                           |     |
| 41  | Responsibility            | D-Link                             | 3   | Responsibility            | 10  |
| 42  | Responsibility            | Jointown Pharm. Group              |     |                           |     |
| 43  | Honesty and Responsib.    | Telephone Company Ltd              |     |                           |     |

*Continued on the next page*

**Identification of Key Factors of Core Competence**

In the second step of the research, we conducted a case company survey to identify the key factors of core competence in the precision machine industry. A questionnaire composed by 4 demographic items (comprehensive, department, management level, and years of experience) and 21 core competence items (derived from the main categories identified in the benchmarking study) was used for data collection. To analyze the key factors of core competence, the respondents were asked to grade a statement for each of the competence items individually on a Likert scale from 1 to 5 (1

**Table 1** Continued from the previous page

| (1) | (2)                           | (3)                       | (4) | (5)                           | (6) |
|-----|-------------------------------|---------------------------|-----|-------------------------------|-----|
| 44  | Problem Analyzing and Solving | Kao                       | 2   | Problem Analyzing and Solving | 11  |
| 45  | Analytic Thinking             | Hiwin Technology Corp.    |     |                               |     |
| 46  | Executive Ability             | Jointown Pharm. Group     | 2   | Executive Ability             | 12  |
| 47  | Doctrine of Knowing and Doing | Telephone Company Limited |     |                               |     |
| 48  | Positive Thinking             | Hiwin Technology Corp.    | 2   | Positive Thinking             | 13  |
| 49  | Enthusiasm                    | Lianchi Group             |     |                               |     |
| 50  | Spirit of Master              | P&G                       | 2   | Respect for Individual        | 14  |
| 51  | Respect for Individual        | Wal-Mart Stores, Inc.     |     |                               |     |
| 52  | Crisis Awareness              | Jointown Pharm. Group     | 2   | Quick Response                | 15  |
| 53  | Quick Response                | SPIL                      |     |                               |     |
| 54  | Adaptability                  | Kao                       | 1   | Adaptability                  | 16  |
| 55  | Leadership                    | P&G                       | 1   | Leadership                    | 17  |
| 56  | International Perspective     | Kao                       | 1   | International Perspective     | 18  |
| 57  | Satisfaction                  | Wowprime                  | 1   | 360 Degree Satisfaction       | 19  |
| 58  | Reflection                    | Hiwin Technology Corp.    | 1   | Reflection                    | 20  |
| 59  | Cost Consciousness            | D-Link                    | 1   | Cost Consciousness            | 21  |

**Notes** Column headings are as follows: (1) number, (2) core competence item, (3) sources, (4) number of enterprises, (5) classification of core competence, (6) priority.

– strongly disagree, 2 – disagree, 3 – neutral, 4 – agree, and 5 – strongly agree). Higher scores indicated that more emphasis was placed on the particular competence item. Questionnaires were sent to department managers (e.g., business, administration, production, and R&D), middle managers (e.g., director and deputy manager), and top managers (e.g., CEO and vice president) within the case company. The questionnaires were sent to 42 managers and 42 valid answers were received (response rate of 100%).

The collected questionnaire data were analyzed using GRA to extract the key factors of core competence. There are three steps in implement the GRA. The first step is the calculation of the grey relational coefficient. The calculation of the grey relational coefficient is shown in Equation (1) (Deng 1989). In this equation,  $\zeta$  is the distinguishing coefficient. When the value lies between 0 and 1, it shows the difference between two parts. Generally, an average (0.5) is used as value of the distinguishing coefficient, which can be adjusted based on actual conditions. In this research, 0.5 was used as the value of the distinguishing coefficient.

$$r(x_i(k), x_j(k)) = \frac{\min_i \min_k |x_0(k) - x_i(k)| + \zeta \max_i \max_k |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \zeta \max_i \max_k |x_0(k) - x_i(k)|} \quad (1)$$

The second step is the calculation of the grey relational degree. After

the grey relational coefficients are calculated, the grey relational degree is computed and is equal to the arithmetic mean of the grey relational coefficients. The grey relational degree represents the relationship between two sequences. If the changes in two factors have the same trend, this finding indicates that the extent of synchronous change is high, as well as the extent of the correlation (Deng 1997). The calculation of the grey relational degree is shown in Equation (2).

$$r(x_i, x_j) = \frac{1}{n} \sum_{k=1}^n r(x_i(k), x_j(k)). \quad (2)$$

The third step is the determination of the grey relational sequence. This step requires the arrangement of the obtained grey relational degrees from the biggest to the smallest. The final order is the grey relational sequence. Finally, items with similar grey relational degrees are classified (or organized) into the same group.

In this particular study, the collected questionnaire data are processed according to the three steps described above. Firstly, the questionnaire items are analyzed with GRA to get the grey relational coefficient and degree. Thereafter, a linear graph is drawn based on the grey relational degrees, and the items are arranged from big to small (right to left). The items with similar values are then classified into the same group. The linear graph is used to investigate the key factors of core competence that the managers emphasized the most. An item with a high grey relational degree signifies that the managers paid more attention to it than an item with a low degree. Finally, the key factors of core competence are selected from the classified groups in the linear graph one by one by following the recommendation of Daniel (1961) that an enterprise requires three to six key factors to succeed. The analysis is conducted based on four dimensions (comprehensive, department, management level, and years of experience), which require the completion of several rounds of analysis.

In addition, managers of the case company were interviewed since it was difficult to establish the key factors of core competence solely based on GRA results. The issue was that the repeatability of the factors in the different dimensions was low, which led to several key factors exceeding the principle of Daniel (1961). Thus, the most essential key factors of core competence are extracted through interviews based on GRA result. The interviews are designed such that repetition of key factors could be avoided. This step was critical since the analyzed dimensions to some extent included the same key factors of core competence. To cover most of the identified key factors without too much repetition, the interview questions (derived based on GRA result) are used. Interviewees were invited from the involved departments. The managers in each department are organized into

groups of five and one manager is selected from each group. Departments that had less than five managers are excluded. In total, five managers were interviewed, who were four managers from the production department and one manager from the administration department.

### **Definition of Organizational Key Performance Indicators**

In the third step of the research, organizational KPIs are defined (or set) based on the identified key factors of core competence. This study used 131 KPIs included in the SCOR model and 12 internal KPIs related to the career development of the internal staff and the safety in the workplace from the case study as the reference for setting organizational KPI for the identified key factors of core competence (Table 2). To differentiate the KPIs belonging to the SCOR model and the case organization, each KPI was coded (SCOR = 1-131, Internal A01-A-12). The reason why these KPIs were used as the starting point is due to the importance of the supply chain in the global and competitive market environments. Enterprises cannot simply focus on top management and internal process anymore. Firms should have a complete set of KPIs that measure the whole supply chain network and consider all activities connected with sourcing, manufacturing, and distribution from suppliers to customers.

To simplify the setting of KPIs for the identified key factors of core competence, each key factor was handled separately. To begin with, the most competitive core abilities for the identified key factors are established based on the interviews with the five company managers. Then, organizational KPIs are set according to the core abilities within the three main categories of the KPIs:

1. Departmental KPI: Different departments (e.g., production, business, human resources, finance, and IT) in an organization have various duties and responsibilities, and the performance is tracked based on different organizational KPI.
2. Office grade KPI: Different office grades might influence the fulfillment of organizational KPI, as well as the need for common and professional competence that are aimed to achieve organizational KPI.
3. Hierarchical KPI: Each hierarchy in an organization has its responsibility levels, which are vertically and horizontally connected with the power needed to achieve organizational KPI.

### **Results and Analysis**

To begin with, the key factors of core competence in the precision machine industry are extracted. After that, organizational KPIs are set for the identified key factors of core competence.

**Table 2** Key Performance Indicators

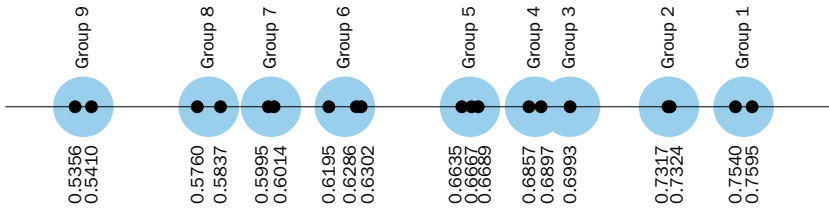
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|      |  |
|------|--|
| 109  | Planning costs for delivering products   |
| 112  | Orders management costs  |
| 113  | Orders delivery costs  |
| 115  | Managers' delivery investment for achieving operational objectives             |
| 116  | Managers' production investment for achieving operational objectives           |
| 117  | Managers' planning investment for achieving operational objectives             |
| 119  | Managers' source investment for achieving operational objectives               |
| 120  | Days of finished goods inventory   |
| 121  | Days of raw materials inventory  |
| 122  | Days of half-finished goods inventory  |
| 123  | Days of calling back materials   |
| 125  | Percentage of excessive stock  |
| 126  | Ratio of the stock that can't serve as maintenance to common stock             |
| 127  | Fixed assets in production of a supply chain                                   |
| 128  | Fixed assets in sourcing of a supply chain                                     |
| 129  | Fixed assets in planning of a supply chain                                     |
| 131  | Fixed assets in sourcing of a supply chain                                     |
| A-01 | Amount of development patent   |
| A-02 | Number of people of internal lecturers   |
| A-03 | Number of people and level of improving language ability                       |
| A-04 | Defect ratio of internal production process                                    |
| A-05 | Amount of improvement proposal in terms of production and management processes |
| A-06 | Employees' satisfaction-dismissal rate   |
| A-07 | Customers' satisfaction level to products and staff's services                 |
| A-08 | Rate of occupational accident  |
| A-09 | Amount of qualified certificates   |
| A-10 | Awards acquired for training   |
| A-11 | Complaints from communities  |
| A-12 | Error rate of packaging products   |

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### **Key Factors of Core Competence**

The collected questionnaire data are analyzed using the GRA to extract the key factors of core competence. The analysis is conducted according to the three steps of GRA. Firstly, the questionnaire items are analyzed to obtain the grey relational coefficient and degree (steps 1 and 2). Thereafter, a linear graph is drawn based on the items grey relational degrees and the items are arranged from big to small (right to left). The items with similar values are then classified into the same group (step 3). Finally, the key factors of core competence are selected from the classified groups one by one according to the principle of Daniel (1961). The analysis is conducted



**Figure 3** Grey Relational Linear Graph for Comprehensive Analysis

based on four dimensions (comprehensive, department, management level, and years of experience), and thus several analysis rounds were completed.

In the 'comprehensive' analysis, the 21 questionnaire items were classified into 9 groups according to the closeness of the grey relational degrees (Figure 3). The key factors of core competence were selected one by one from the groups that had the highest grey relational degrees (from right to left) based on Daniel (1961). In Group 1, 'quality control' (0.7595) and 'R&D and innovation' (0.7540) were selected. In Group 2, 'group cooperation' (0.7324) and 'customer oriented' (0.7317) were selected. In Group 3, 'responsibility' (0.6993) was selected. The selection of key factors stopped since the number of key factors would have exceeded six (Daniel, 1961) if the three factors in Group 4 had been selected. In summary, the 'comprehensive' analysis showed that the key factors of core competence in the precision machine industry included quality control, R&D and innovation, group cooperation, customer orientation, and responsibility.

The GRAs for the other dimensions (department, management level, and years of experience) followed the same procedure, but are not fully reported in this paper. However, the results of these analyses are presented in Table 3. As can be noted, the repeatability of the key factors in the different dimensions is low, which resulted in a number of factors exceeding the principle of Daniel (1961). This finding implies the difficulty in establishing the key factors of core competence solely based on GRA results. Instead, the most essential key factors of core competence are extracted through interviews with the five department managers (one production manager, and four administration managers) within the case company. Two interview questions based on GRA result were used, (1) 'What do you think about the 9 key factors of core competence selected by top managers and managers with over 16 years of experience?' and (2) 'What do you think about the key factors of core competence selected by your department that were not selected by top managers and managers with over 16 years of experience?' Overall, the conducted interviews covered 13 of the identified key factors of core competence (Table 4).

The interviews with the five department managers resulted in 13 key fac-

**Table 3** Key Factors of Core Competence Based on Each Dimension

| Comprehensive             | Quality Control   | R&D and Innovation      | Group Cooperation         | Customer Orientation      | Responsibility                |
|---------------------------|-------------------|-------------------------|---------------------------|---------------------------|-------------------------------|
| Department                |                   |                         |                           |                           |                               |
| R&D                       | Quick Response    | 360 Degree Satisfaction | Continual Learning        | Adaptability              | Self-Reflection Excellence    |
| Business Department       | Quick Response    | 360 Degree Satisfaction | Adaptability              | Self-Reflection           | Cost Consciousness            |
| Administration Department | Quick Response    | Quality Control         | R&D and Innovation        | Continual Learning        | International Perspective     |
| Production Department     | Quality Control   | R&D and Innovation      | Responsibility            | Excellence                | Observation of Discipline     |
| Management level          |                   |                         |                           |                           |                               |
| Top Managers              | Quick Response    | 360 Degree Satisfaction | Customer Orientation      | Adaptability              | International Perspective     |
| Middle Managers           | Quality Control   | Group Cooperation       | R&D and Innovation        | Adaptability              | Executive Ability             |
| First-Line Managers       | Quality Control   | Group Cooperation       | Adaptability              | 360 Degree Satisfaction   | Customer Orientation          |
| Years of experience       |                   |                         |                           |                           |                               |
| 1-5                       | Quality Control   | Group Cooperation       | R&D and Innovation        | Observation of Discipline | Honesty and Integrity         |
| 6-10                      | Group Cooperation | 360 Degree Satisfaction | Customer Orientation      | International Perspective |                               |
| 10-15                     | Quick Response    | Responsibility          | International Perspective | Executive Ability         |                               |
| 16 and above              | Quick Response    | Responsibility          | Continual Learning        | Adaptability              | Excellence                    |
|                           |                   |                         |                           |                           | Problem Analyzing and Solving |
|                           |                   |                         |                           |                           | Problem Analyzing and Solving |
|                           |                   |                         |                           |                           | Continual Learning            |
|                           |                   |                         |                           |                           | Positive Thinking             |

**Table 4** Key Factors of Core Competence in Terms of Different Departments and Views

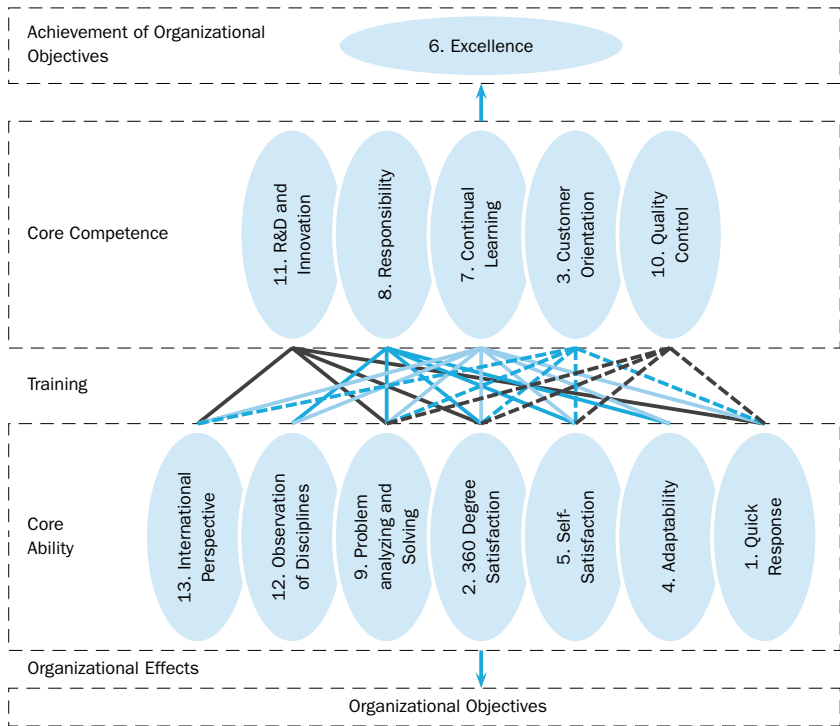
| Top managers*                 | Production departments        | Administration departments |
|-------------------------------|-------------------------------|----------------------------|
| Quick Response (A)            | Quality Control (C)           | Quick Response (A)         |
| 360 Degree Satisfaction       | R&D and Innovation (C)        | Quality Control (C)        |
| Customer Orientation          | Responsibility (B)            | R&D and Innovation (C)     |
| Adaptability                  | Excellence (B)                | Continual Learning (A)     |
| Self-Reflection               | Observation of Discipline     | International Perspective  |
| Excellence (B)                | Problem Anal. and Solving (B) |                            |
| Continual Learning (A)        |                               |                            |
| Responsibility (B)            |                               |                            |
| Problem Anal. and Solving (B) |                               |                            |

**Notes** Key factors of core competence marked with 'A' means that they are the same ones selected by top managers and managers with over 16 years of service and by managers from administration departments. Key factors of core competence marked with 'B' means that they are the same ones selected by top managers and managers with over 16 years of service and by managers from production departments. Key factors of core competence marked with 'C' means that they are the same ones selected by production and administration departments. \* And managers with over 16 years of service.

tors of core competence that comprised one organization objective, five key factors of core competence, and seven key factors of core ability (Figure 4). The core competence of the enterprise emphasizes the connection among the individual performance, working behavior, working efficiency, and performances, and further reaches the enterprise's objectives, such as creating corporate values, improving competitiveness, and creating corporate cultures. Thus, the key factors of core competence can train the internal staff to have the core ability through education. Training can improve competitiveness, which can result in achieving the overall objective of 'excellence.'

In Figure 4, the five key factors of core competence are in order from left to right, and are connected to five or more items of core ability. First, the core competence 'R&D and innovation' can cultivate the internal staff to get 'international perspectives,' 'problem analyzing and solving,' '360 degree satisfaction,' and 'quick response.' Second, the core competence 'responsibility' can train the internal staff to have 'observation of disciplines,' 'problem analyzing and solving,' '360 degree satisfaction,' 'self-reflection,' and 'adaptability.' Third, the core competence 'continual learning' can teach the internal staff to obtain 'problem analyzing and solving,' '360 degree satisfaction' as well as deep characteristics like 'international perspectives,' 'observation of disciplines,' 'self-reflection,' 'adaptability,' and 'quick response.' Fourth, the core competence 'customer orientation' can nurture the internal staff to acquire 'international perspectives,' 'problem analyzing and solving,' '360 degree satisfaction,' 'self-reflection,' and 'quick response.' Finally, the core competence 'quality control' can educate the inter-





**Figure 4** Key Factors of Core Competence and Organizational Objectives

nal staff to learn ‘problem analyzing and solving,’ ‘360 degree satisfaction,’ ‘self-reflection,’ and ‘quick response.’

**Organizational key Performance Indicators**

This study uses the 131 KPIs included in the SCOR model and 12 internal KPIs related to career development of the internal staff and safety in the workplace from the case study as the reference for setting organizational KPI for the identified key factors of core competence (Table 2). To differentiate the KPIs belonging to the SCOR model and the case organization, each KPI was coded (SCOR = 1-131, Internal A01-A-12). All the internal KPIs and 85 of the KPIs included in the SCOR model satisfied the need of organizational KPIs. Thus, this research considered 97 KPIs.

To simplify the setting of KPIs for the five identified key factors of core competence, each key factor is handled separately. To begin with, the most competitive core abilities for the identified key factors are established. As shown above, this knowledge was gained from the interviews with the five company managers. After that, organizational KPIs are set based on the core abilities within the three main categories of KPIs (departmental, office

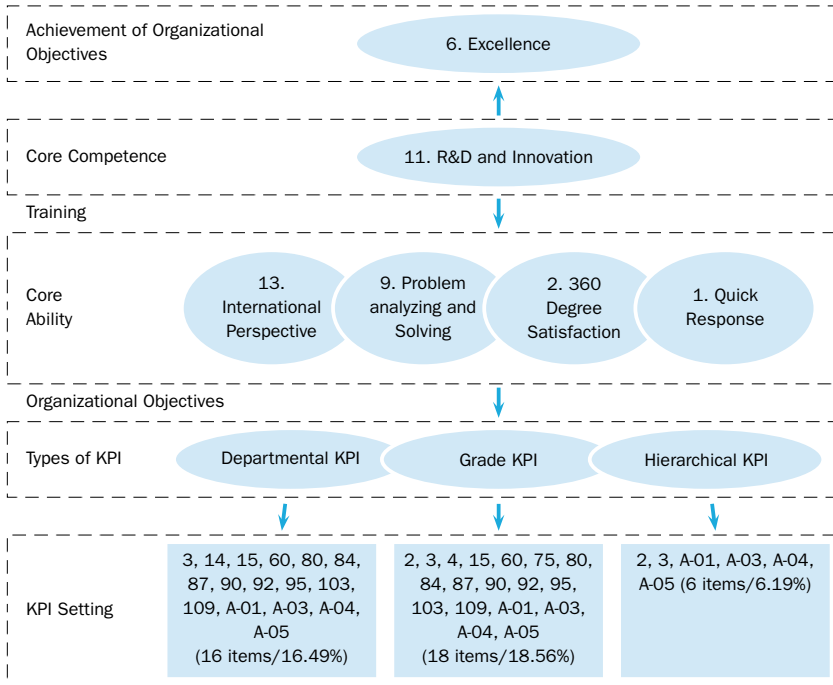


Figure 5 Setting of KPI for Core Competence R&D and Innovation

grade, and hierarchal). Below, each identified key factor is addressed in detail.

The most competitive core abilities for the identified key factor of core competence ‘R&D and innovation’ include ‘international perspectives,’ ‘problem analyzing and solving,’ ‘360 degree satisfaction,’ and ‘quick response’ (Figure 5). After the setting of KPIs (see Table 5) based on the core abilities, the departmental category contained 16 items (16.49% of total KPIs), the office grade category contained 18 items (18.56% of total KPIs), and the hierarchical category contained 6 items (6.19% of total KPIs). Based on the setting of KPIs for the core competence ‘R&D and innovation,’ the result emphasizes the achievement of works and departmental missions. Organizational KPIs include types related to cost, correctness of the documents, and completeness of products. Although, the hierarchical category only contains six items, these items are mostly related to important decisions like cost control, complaints, and patents.

The most competitive core abilities for the identified key factor of core competence ‘responsibility’ are ‘observation of disciplines,’ ‘problem analyzing and solving,’ ‘360 degree satisfaction,’ ‘self-reflection,’ and ‘adaptability’ (Figure 6). After the setting of KPIs (see Table 5) based on the

**Table 5** Setting of KPIs within 3 Main Categories

| (1) | (2) |     |     | (3) |     |     | (4) |     |     | (5) |     |     | (6) |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|     | (a) | (b) | (c) | (a) | (b) | (c) | (a) | (b) | (c) | (a) | (b) | (c) | (a) | (b) | (c) |
| 2   |     | •   | •   |     | •   | •   |     | •   |     |     |     |     |     |     | •   |
| 3   | •   | •   | •   | •   | •   | •   | •   | •   | •   | •   | •   | •   |     |     | •   |
| 5   |     |     |     |     |     | •   |     |     |     |     |     |     |     |     | •   |
| 6   |     |     |     |     |     | •   |     |     |     |     |     |     |     |     |     |
| 7   |     |     |     | •   | •   | •   |     |     |     | •   | •   | •   |     |     |     |
| 10  |     |     |     | •   | •   | •   |     |     |     |     |     |     |     |     |     |
| 11  |     |     |     | •   | •   |     |     | •   |     | •   | •   |     |     |     | •   |
| 12  |     |     |     | •   | •   |     |     |     |     | •   | •   |     |     |     | •   |
| 13  |     |     |     | •   | •   |     |     |     |     | •   | •   |     |     |     | •   |
| 14  | •   | •   |     | •   | •   |     |     |     |     | •   | •   |     | •   | •   |     |
| 15  | •   | •   |     | •   | •   |     | •   | •   |     | •   | •   |     | •   | •   |     |
| 16  |     |     |     | •   | •   |     | •   | •   |     |     |     |     | •   | •   |     |
| 17  |     |     |     | •   | •   |     |     |     |     |     |     |     | •   | •   |     |
| 18  |     |     |     | •   | •   |     |     |     |     | •   | •   |     |     |     | •   |
| 20  |     |     |     | •   | •   |     |     | •   |     |     |     |     |     |     |     |
| 21  |     |     |     | •   | •   |     |     | •   |     |     |     |     | •   | •   |     |
| 25  |     |     |     | •   | •   |     |     | •   |     |     |     |     |     |     |     |
| 26  |     |     |     | •   | •   |     |     | •   |     |     |     |     | •   | •   |     |
| 35  |     |     |     | •   | •   | •   |     | •   | •   |     |     |     |     |     | •   |
| 37  |     |     |     | •   | •   | •   |     | •   | •   |     |     |     |     |     | •   |
| 39  |     |     |     | •   | •   | •   | •   | •   | •   |     | •   |     |     |     | •   |
| 40  |     |     |     | •   | •   | •   | •   | •   | •   |     | •   |     |     |     | •   |
| 41  |     |     |     | •   | •   | •   | •   | •   | •   |     | •   |     |     |     |     |
| 42  |     |     |     | •   | •   | •   | •   | •   | •   |     | •   |     |     |     |     |
| 44  |     |     |     |     |     | •   |     |     | •   |     |     |     |     |     |     |
| 45  |     |     |     | •   | •   | •   | •   | •   | •   |     | •   |     |     |     |     |
| 46  |     |     |     | •   | •   | •   | •   | •   | •   |     | •   |     |     |     | •   |
| 47  |     |     |     | •   | •   | •   | •   | •   | •   |     | •   |     |     |     |     |
| 48  |     |     |     | •   | •   | •   |     |     |     | •   |     | •   |     |     |     |
| 49  |     |     |     | •   | •   | •   |     |     |     |     | •   |     |     |     | •   |
| 54  |     |     |     | •   | •   | •   |     |     |     |     | •   |     |     |     | •   |
| 55  |     |     |     | •   | •   |     |     |     |     | •   | •   |     |     |     | •   |
| 56  |     |     |     | •   | •   |     |     |     |     | •   | •   |     |     |     | •   |
| 57  |     |     |     | •   | •   |     |     |     |     | •   | •   |     |     |     | •   |
| 58  |     |     |     |     | •   |     |     |     |     | •   | •   |     |     |     | •   |
| 59  |     |     |     | •   | •   |     |     |     |     | •   | •   |     |     |     | •   |
| 60  | •   | •   |     | •   | •   |     | •   | •   |     |     | •   |     |     |     | •   |
| 61  |     |     |     | •   | •   |     |     |     |     | •   | •   |     |     |     | •   |
| 62  |     |     |     | •   | •   |     |     |     |     | •   | •   |     |     |     | •   |

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**Table 5** Continued from the previous page

| (1) | (2) |     |     | (3) |     |     | (4) |     |     | (5) |     |     | (6) |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|     | (a) | (b) | (c) | (a) | (b) | (c) | (a) | (b) | (c) | (a) | (b) | (c) | (a) | (b) | (c) |
| 63  |     |     |     | .   | .   |     |     |     |     | .   | .   |     |     | .   |     |
| 64  |     |     |     | .   | .   |     |     |     |     | .   | .   |     |     | .   |     |
| 65  |     |     |     | .   | .   |     |     |     |     | .   | .   |     |     | .   |     |
| 66  |     |     |     | .   | .   |     |     |     |     | .   | .   |     |     | .   |     |
| 68  |     |     |     | .   |     | .   |     |     |     |     |     |     | .   |     | .   |
| 69  |     |     |     |     | .   |     |     |     |     |     |     |     |     | .   |     |
| 70  |     |     |     |     | .   |     |     |     |     |     |     |     |     |     |     |
| 71  |     |     |     |     | .   |     |     |     |     |     |     |     |     |     |     |
| 72  |     |     |     | .   | .   |     |     |     |     |     |     |     |     |     |     |
| 73  |     |     |     | .   | .   |     |     |     |     |     |     |     |     |     |     |
| 74  |     |     |     | .   | .   |     |     |     |     |     |     |     |     |     |     |
| 75  |     | .   |     | .   | .   |     |     |     |     | .   |     |     |     |     |     |
| 76  |     |     |     | .   | .   |     |     |     |     | .   |     |     |     |     |     |
| 77  |     |     |     |     | .   |     |     |     |     |     |     |     |     | .   |     |
| 78  |     |     |     | .   | .   |     |     |     |     |     |     |     |     | .   |     |
| 79  |     |     |     | .   | .   |     |     |     |     |     |     |     |     |     |     |
| 80  | .   | .   |     | .   | .   |     |     |     |     |     | .   |     |     | .   |     |
| 81  |     |     |     |     | .   |     |     |     |     |     | .   |     |     | .   |     |
| 82  |     |     |     |     | .   |     |     |     |     |     |     |     |     | .   |     |
| 83  |     |     |     |     | .   |     |     | .   |     |     | .   |     |     |     |     |
| 84  | .   | .   |     |     | .   |     |     |     |     |     | .   |     |     | .   |     |
| 87  | .   | .   |     |     | .   |     |     |     |     |     | .   |     |     | .   |     |
| 88  |     |     |     |     | .   |     |     |     |     |     | .   |     |     |     |     |
| 89  |     |     |     |     | .   |     |     |     |     |     | .   |     |     |     |     |
| 90  | .   | .   |     | .   | .   |     |     |     |     |     | .   | .   |     |     |     |
| 92  | .   | .   |     | .   | .   |     |     |     |     |     | .   | .   |     |     |     |
| 95  | .   | .   |     |     | .   |     |     |     |     |     | .   |     |     |     |     |
| 103 | .   | .   |     |     | .   | .   |     |     |     |     | .   | .   |     | .   |     |
| 107 |     |     |     |     |     | .   |     |     |     |     |     |     |     |     |     |
| 109 | .   | .   |     |     | .   |     |     |     |     |     |     |     |     |     |     |
| 112 |     |     |     |     |     |     |     |     |     |     | .   |     |     |     |     |
| 113 |     |     |     |     |     |     |     |     |     |     | .   |     |     |     |     |
| 115 |     |     |     |     |     | .   |     |     |     |     |     |     |     |     | .   |
| 116 |     |     |     |     |     | .   |     |     |     |     |     |     |     |     | .   |
| 117 |     |     |     |     |     | .   |     |     |     |     |     |     |     |     |     |
| 119 |     |     |     |     |     | .   |     |     |     |     |     |     |     |     | .   |
| 120 |     |     |     |     |     | .   |     |     |     |     |     |     |     |     | .   |
| 121 |     |     |     | .   | .   |     |     |     |     |     |     |     |     | .   |     |
| 122 |     |     |     | .   | .   |     |     |     |     |     |     |     |     | .   |     |

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**Table 5** *Continued from the previous page*

| (1)  | (2) |     |     | (3) |     |     | (4) |     |     | (5) |     |     | (6) |     |     |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|      | (a) | (b) | (c) | (a) | (b) | (c) | (a) | (b) | (c) | (a) | (b) | (c) | (a) | (b) | (c) |
| 123  |     |     |     | .   | .   |     |     |     |     |     |     |     |     |     | .   |
| 125  |     |     |     |     | .   |     |     |     |     |     |     |     |     |     | .   |
| 126  |     |     |     | .   | .   |     |     |     |     |     |     |     |     |     | .   |
| 127  |     |     |     |     |     | .   |     |     |     |     |     |     |     |     |     |
| 128  |     |     |     |     |     | .   |     |     |     |     |     |     |     |     |     |
| 129  |     |     |     |     |     | .   |     |     |     |     |     |     |     |     |     |
| 131  |     |     |     |     |     | .   |     |     |     |     |     |     |     |     |     |
| A-01 | .   | .   | .   |     |     |     |     |     |     | .   | .   | .   |     |     |     |
| A-02 |     |     |     |     |     |     | .   | .   | .   |     |     |     |     |     |     |
| A-03 | .   | .   | .   | .   | .   | .   | .   | .   | .   | .   | .   | .   |     |     |     |
| A-04 | .   | .   | .   | .   | .   | .   | .   | .   |     | .   |     |     | .   | .   | .   |
| A-05 | .   | .   | .   | .   | .   | .   | .   | .   |     | .   |     |     | .   | .   | .   |
| A-06 |     |     |     |     | .   |     | .   | .   | .   |     |     |     |     |     |     |
| A-07 |     |     |     |     |     |     |     | .   |     | .   | .   | .   |     |     |     |
| A-08 |     |     |     | .   | .   | .   | .   | .   | .   |     |     |     |     |     |     |
| A-09 |     |     |     | .   | .   | .   | .   | .   | .   |     |     |     |     |     |     |
| A-10 |     |     |     | .   |     |     | .   | .   | .   |     |     |     |     |     |     |
| A-11 |     |     |     | .   | .   | .   |     |     |     |     |     |     |     |     |     |
| A-12 |     |     |     |     |     |     |     |     |     | .   |     |     |     |     | .   |

**Notes** Column headings are as follows: (1) SCOR KPI coding, (2) R&D and Innovation, (3) Responsibility, (4) Continual Learning, (5) Customer Orientation, (6) Quality Control; (a) Departmental KPI, (b) Office Grade KPI, (c) Hierarchical KPI.

core abilities, the departmental category contained 60 items (61.86% of total KPIs), the office grade category contained 76 items (78.00% of total KPIs), and the hierarchical category contained 36 items (37.11% of total KPIs). Based on the setting of KPIs for the core competence ‘responsibility,’ ‘responsibilities’ account for the highest percentage of KPIs in all the categories. The potential motivation and attitude that involve human behaviors have huge influences on an organization, and the KPI to be achieved includes cost control, reaching rate of delivery, and planning ability.

The most competitive core abilities for the identified key factor of core competence ‘continual learning’ are ‘international perspectives,’ ‘observation of disciplines,’ ‘problem analyzing and solving,’ ‘360 degree satisfaction,’ ‘self-reflection,’ and ‘adaptability’ (Figure 7). After the setting of KPIs (see Table 5) based on the core abilities, the departmental category contained 36 items (37.11% of total KPIs), the office grade category contained 29 items (29.90% of total KPIs), and the hierarchical category contained 17 items (17.53% of total KPIs). Based on the setting of KPI for the core

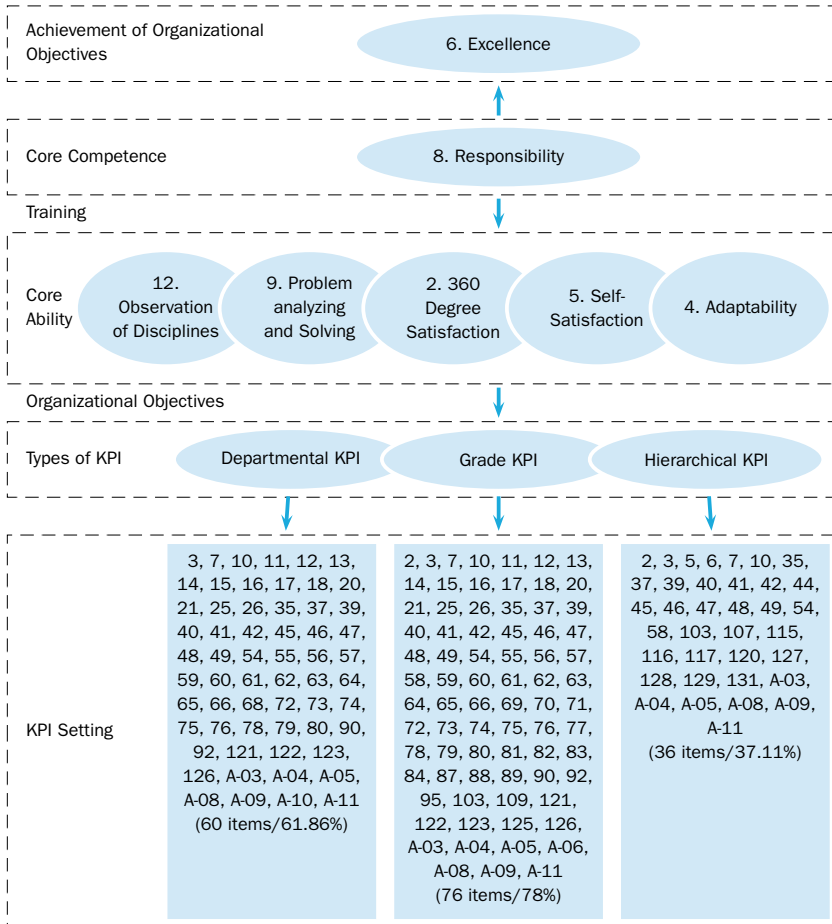


Figure 6 Setting of KPI for Core Competence Responsibility

competence ‘continual learning,’ regardless of the type of department, the spirit of continual learning is required to meet the demands of individual and organizational growth, and the need for learning based on the office grade results in cost control.

The most competitive core abilities for the identified key factor of core competence ‘customer orientation’ are ‘international perspectives,’ ‘problem analyzing and solving,’ ‘360 degree satisfaction,’ ‘self-reflection,’ and ‘quick response’ (Figure 8). After the setting of KPIs (see Table 5) based on the core abilities, the departmental category contained 27 items (27.86% of total KPIs), the office grade category contained 47 items (48.45% of total KPIs), and the hierarchical category contained 7 items (7.22% of total KPIs). Based on the setting of KPI for the core competence ‘quality control,’

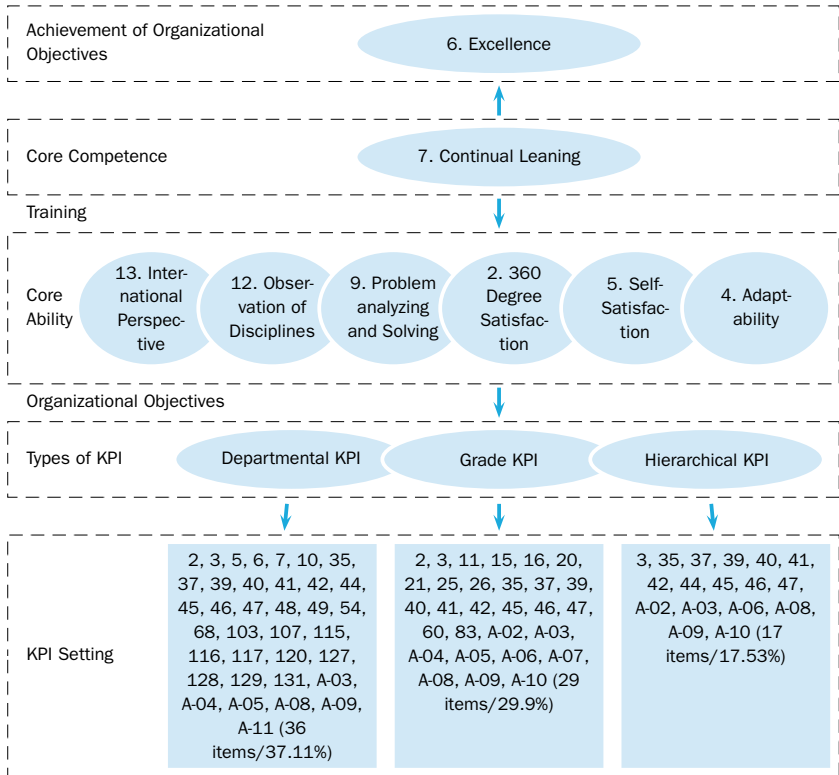
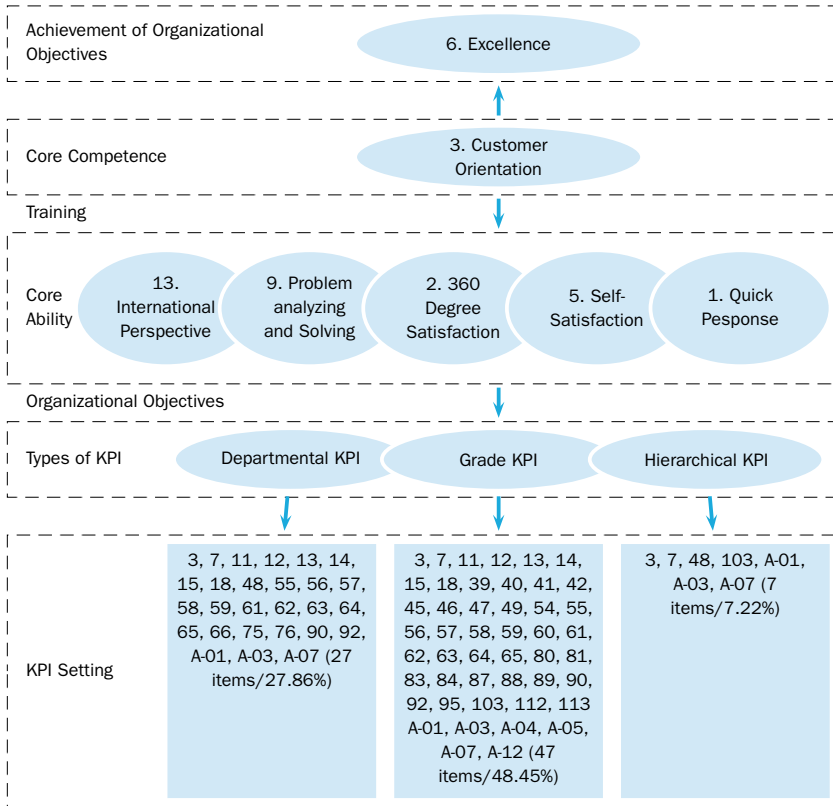


Figure 7 Setting of KPI for Core Competence Continual Learning

the activities involved in the customer orientation emphasizes people's satisfaction of product quality from taking orders to delivery and customer satisfaction of the services. Although there are only seven KPIs in 'hierarchical KPI,' these KPIs are mostly related to the management of costs, funds, and human resources, which show the differences of KPIs between office grades and hierarchies.

The most competitive core abilities for the identified key factor of core competence 'quality control' are 'international perspectives,' 'problem analyzing and solving,' '360 degree satisfaction,' and 'quick response' (Figure 9). After the setting of KPIs (see Table 5) based on the core abilities, the departmental category contained 9 items (9.28% of total KPIs), the office grade category contained 47 items (48.45% of total KPIs), and the hierarchical category contained 9 items (9.28% of total KPIs). Based on the setting of KPIs for 'quality control,' this core competence affects production as well as the supply chain, documents, and data accuracy. This result implies that each of the different office grades should be connected with quality control



**Figure 8** Setting of KPI for Core Competence Customer Orientation

to guarantee the flawlessness of the orders and products throughout the entire supply chain.

**Concluding Remarks**

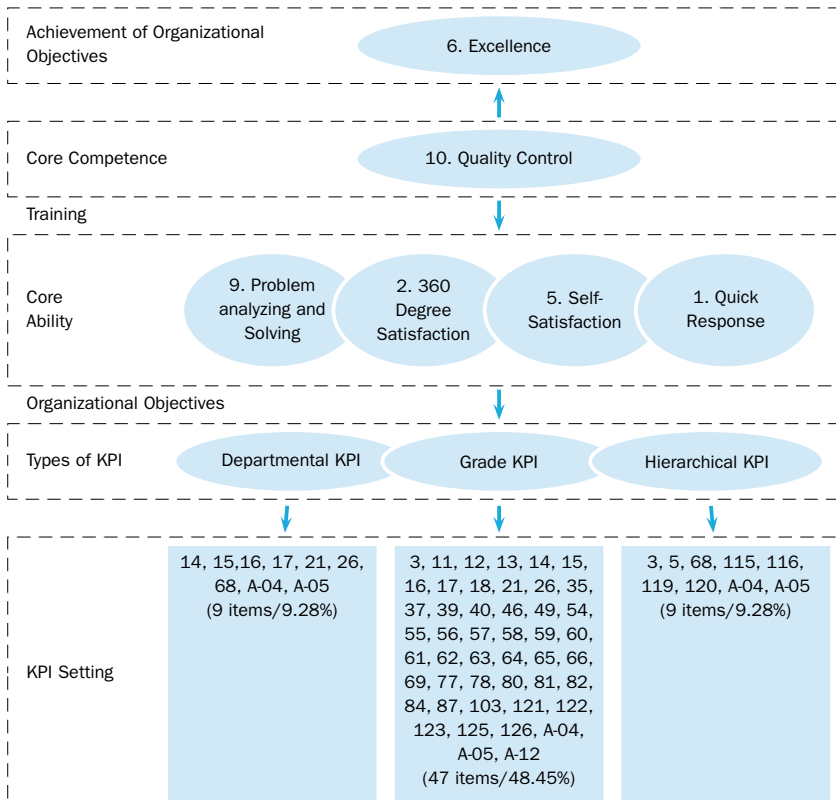
To begin with, the research results are summarized and discussed in this section. After that, some implications of the research, as well as some opportunities for further research are presented.

**Summary**

This research aimed to define (or set) organizational KPIs in the precision machine industry by using the concept of core competence and the SCOR model. A component manufacturer in the machine industry was invited to serve as a case study.

A case company questionnaire composed of 21 core competence items that were derived from the main categories identified in the bench-marking





**Figure 9** Setting of KPI for core Competence Quality Control

study was used for data collection. The collected data were analyzed with GRA to extract the key factors of core competence. The analysis was conducted based on four main dimensions (comprehensive, department, management level, and years of experience), which required the completion of several rounds of analysis. The result identified five to six key factors for each dimension or sub-dimension.

In addition, interviews were conducted with managers inside the case company since it was difficult to establish the key factors of core competence solely based on GRA results. The issue indicated that the repeatability of the factors in the different dimensions was low. Thus, the most essential key factors of core competence were extracted through interviews based on GRA result. The conducted interviews covered 13 of the identified key factors of core competence, which are broken down into organization objective (1), core competence (5), and core ability (7).

Finally, organizational KPIs are defined (or set) for the identified key fac-

tors of core competence. To simplify the setting of KPIs for the five identified key factors of core competence, each key factor was handled separately. Initially, the most competitive core abilities for the identified key factor were established. This knowledge was gained from the interviews with the managers of the case company. Organizational KPIs were set based on the core abilities within the three main categories of KPIs (departmental, office grade, and hierarchical). The developed KPI system, which is based on organizational objectives, core competence, and core abilities, allows enterprises to handle dynamic market demands, business environments, and changes in corporate objectives.

### **Implications and Further Research**

In a competitive and volatile business environment, an enterprise must follow its unique culture and find out its core competence and appropriate KPIs. However, in applying key factors of core competence to reach organizational objectives, the leader has to be decisive enough to set precise and achievable objectives. In addition, employee behaviors and talents should not be neglected. Talents create the competitive advantages for an enterprise. While enterprises can buy machines, lands, and materials with money, people should be connected with the organizational culture such that they will devote themselves voluntarily, create profits, and reach objectives for the enterprise. The most significant objective of an enterprise is to pursue profit maximization and sustainable development for continuous growth and development. Nevertheless, core competence and KPI are the key factors that can bring clear short-, middle-, and long-term direction for an enterprise. Since this study focuses on the precision machine manufacturing industry, the results may only be applicable to similar industries, and not in every type of enterprise. Therefore, future studies could analyze domestic and foreign bench-marking enterprises, set up successful key factors in different industries, and search for progress standards for enterprises. In this manner, literature in this field can be expanded, and more enterprises can pursue outstanding performances and continuous growth.

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