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A comparative study on motivation for and experience with ISO 9000 and ISO 14000 certification among Far Eastern countries

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Keywords
ISO 9000 series, International standards, Factor analysis, Cluster analysis, Organizational culture

Abstract
The fast evolution of management systems standards ISO 9000 and ISO 14000 worldwide, from unknown entities to well-established management practices, represents a facet of the global marketplace in which many firms operate. Over 400,000 firms in over 150 countries have adopted ISO 9000 since it was introduced in 1986. Its successor, ISO 14000, was introduced in 1996 and has already been adopted by over 30,000 firms in over 100 countries. Reports on the results of an ISO 9000/14000 mail survey, administered in four Far eastern countries including Japan, South Korea, Hong Kong and Taiwan to explore and compare the similarities and differences of motivations, implementations and certification benefits among these countries. Survey data have been analyzed using the multivariate statistical methods and techniques such as factor analysis, cluster analysis, Kruskal-Wallis test, etc. Several conclusions and suggestions are made based on the statistical analysis results.

1. Research background and motivation

Recently, the recognition of environmental issues has become more global, rapidly spreading beyond Europe and North America to the Asia-Pacific region. Since their release in 1986, over 400,000 firms worldwide have received certification to the ISO 9000 quality management systems standard, and over 30,000 firms have received certification to the ISO 14000 environmental management systems standard since their release in 1996 (Corbett and Kirsch, 2001). There is also an increasing number of sector-specific standards, including QS 9000, TL 9000, D1 9000, and others. There have been several studies investigating firms’ motivations for certification, their implementation experiences, and the benefits received; however, somewhat surprisingly for what is inherently an international standard, no study has yet done this on a global scale.

ISO 9000 was initially adopted by firms in Europe and in countries with close ties to the UK, such as Australia and New Zealand and Hong Kong (as ISO 9000 was partly based on an earlier British standard). Firms in the USA followed suit, starting from the early 1990s, with firms in Japan, Korea and Taiwan adopting later. As a consequence of the ISO 9000 experience, ISO 14000 has followed a different path; in particular, firms in Japan were among the first adopters of ISO 14000. In Taiwan, out of 447 ISO 9000 certified firms and 224 ISO 14000 certified firms, the number of firms first registered for ISO certification gradually increased from 1991 to 2000. Similar patterns can be found in Japan, South Korea and Hong Kong. Since 1991 and more firms in these four countries have been pursuing ISO 9000/14000 certification. The diffusions of ISO 9000 and ISO 14000 certification among Japan, Taiwan, Korea and Hong Kong are shown in Figure 1 and Figure 2, which indicate that ISO certification has been highly regarded by the enterprises in these four countries.

This study explores the motivations of firms registering ISO 9000 and ISO 14000 in the above four far eastern countries. Meanwhile, the benefits received from implementation of ISO 9000 and ISO 14000 certification among these four countries are discussed and compared from an academic perspective. The partial design of this international questionnaire is listed in the Appendix of survey questions. After collecting the survey data, a detailed statistical analysis of motivation and implementation on ISO 9000 and ISO 14000 has been conducted. Finally, we provide valuable findings and suggestions based on the conclusions.

There have been several studies (Terziovski et al., 1996; Singels et al., 2001) investigating firms’ motivations for certification, their implementation experiences, and the benefits received; however, somewhat surprisingly for what is inherently an international standard, no study has yet done this on a global scale. Therefore, it is necessary to perform a simultaneous survey and cross-country comparison on motivation and implementation of ISO 9000/14000 certification on a global scale.

2. Literature review

The standards of ISO 9000 certification, which was set forth by the Technical Community of the International Organization for Standardization (ISO/TC 176) in March 1987, are used as the guidelines of quality management and quality assurance. In Taiwan, such standards were
translated into Chinese National Standards (CNS-12680-12684) in March 1990. The European Common Market (ECM) promulgates all the products imported into the Common Market to be in compliance with the standards of ISO 9000 series in 1992. In Taiwan, for the expansion of business in European markets and improvement of quality, there is a growing trend toward the promotion of Quality Assurance Systems based on ISO 9000 standards. More than 300,000 public and private firms/organizations worldwide have received ISO 9000 certification as of December 30, 1999 and this number is growing by 50,000-60,000 annually (Corbett and Kirsch, 2001).

According to the 10th cycle of the ISO survey released by ISO Central Secretariat (2001), ISO 9000 and 14000 certification experienced another year of strong overall...
growth. The worldwide total of ISO 9000 certificates was 408,631 and that of ISO 14000 certificates was 22,897 at the end of 2000. The new edition of the ISO Directory of ISO 9000 and ISO 14000 accreditation and certification bodies (ISO Central Secretariat, 2001) provides evidence of the continuing growth of the management system conformity assessment industry. ISO requires regular review and update of all the standards every five years. The first revision of ISO 9000 series is published on July 1st, 1994 (Lee, 1998). The technical committee of International Organization for Standardization has conducted the second audit of ISO standards and the revised quality management system standards (ISO 9000, 9001 and 9004) have been published in the final quarter of year 2000. The 2000 version of ISO 9001 was structured much like the PDCA system. Now the elements of the 1994 version are summarized into five clauses, 22 categories and 39 items in order to meet customer requirements and process management. The five main clauses of the 2000 version of ISO 9001 are:
1. Quality management system.
2. Management responsibility.
3. Resource management.
5. Measurement, analysis and improvement.

Sun et al. (2000) survey Norwegian Quality Association members to examine the impact of employee involvement (EI) on total quality management (TQM) implementation, and the contribution of ISO 9000 to business performance. The results show that EI is highly related to TQM implementation, but slightly correlated with ISO 9000 achievement. According to the research conducted on 55 nations (Corbett and Kirsch, 2001), the number of ISO 14000 certificates by country (deflated by Gross Domestic Product) is strongly correlated with each country’s export orientation, its attitude toward environmental protection, and the number of ISO 9000 certified firms. Using data from the same global survey as the current paper, Corbett (2002) confirms that exports did play an important role for firms in deciding to seek ISO 9000 certification. The Standard of the Environmental Certification of ISO 14000 is aimed to promote the awareness among business enterprises to establish, based on the business character, a system of environmental management, and integrate it with other management activities. Starting with preventive measures, the promotion of ISO 14000 is working toward a goal of encouraging business enterprises to continually improve their environmental performance. But the standard is promulgated to ensure that the environmental policy is carried out and the environmental performance is continually improved by firms/organizations. It does not specify any specific actions or emissions targets for firms to be certified.

3. Research methods

The data were collected by the means of survey questionnaire. A series of statistical analysis procedures has been performed to explore the motivations/effects/benefits for implementing the ISO 9000/14000 certification as well as to provide useful suggestions for business enterprises. Figure 3 illustrates the flow chart of our analytical process using various statistic methods.

3.1 Sampling method

About 9,703 questionnaires were mailed to organizations throughout four far eastern countries. A total of 2,951 organizations filled in the questionnaires correctly and returned them, which makes a response rate of 30 percent approximately. Notice that the response rate of Japan is the highest, followed by Taiwan, Hong Kong and Korea. The results can be attributed to:
- Our Japanese partners were spending tremendous efforts in sending the questionnaires with the cooperation of the appropriate authorities, the Japan Accreditation Board.
- Lottery tickets were offered to the organizations in Taiwan if the questionnaires were correctly answered and returned.

As of July 31, 2000, there were 1,668 firms with ISO 9000 certification, based on the data of Bureau of Standards, Metrology, and Inspection; Ministry of Economics Affairs of Taiwan. And there were 761 firms with the ISO 14000 certification, based on the data of Environmental Management Association of Taiwan. Excluding 23 firms with both ISO 9000 and ISO 14000 certification, a total of 2,196 firms has been selected to be surveyed in this study. There were 456 returns for these ISO 9000/14000 certified firms. Table I summarizes the response rate by nature of business for these four countries. Notice that 92.8 per cent of responses in Taiwan, 82.5 per cent of responses in Korea, 55.4 per cent of responses in Japan and 14.1 per cent of responses in Hong Kong were manufacturing firms, which is fairly consistent with the current structure of these four countries based on nature of the business. Comparison
Figure 3
Flowchart of statistical data analysis procedures

Data Analysis Method

- Descriptive Statistics (Frequency, Percentage, Std.dev. etc.)
- Factor Analysis and Reliability Analysis
- Kruskal-Wallis test
- Multiple Comparison
- Cluster Analysis
- T test and Regression Analysis
- Hypothesis Testing

1. Establish Codes for Returned Survey Data
2. Entering the Survey data into Excel Format
3. Calculate basic Statistics
   - 1. Extract the key factors of motivations for ISO certification
   - 2. Extract the key factors of benefits received from the ISO implementation
   - 1. For each factor of motivations, compare the differences among various
     (1) sizes of the company
     (2) ownership of the firm
     (3) natures of the business
     (4) types of the industry
   - 2. For each factor of certification benefits, compare the differences among various
     (1) sizes of the company
     (2) ownership of the firm
     (3) natures of the business
     (4) types of the industry
   - significant difference?
   - Yes: Find out the contributing reasons/factors among business countries
   - No: Explore different groups with better/worse benefits received from ISO certification
   - Investigate the relationship between Overall Benefits and Specific items of ISO certification benefits
   - Evaluate the performance of the suppliers of ISO 9000 and 14000
   - Conclusions/Suggestions
of responses by company’s ownership and industrial types have been summarized in a similar way. The above group characteristics play an important role in explaining the differences/similarities for motivations/benefits of ISO certification among the four countries. The collected data were separated into the following three groups for further statistical analysis:

1. All the companies with ISO 9000 certification.
2. All the companies with ISO 14000 certification.
3. Companies which had sought both ISO 9000 and 14000 certification.

### 3.2 Statistical analysis methods

#### 3.2.1 Factor analysis

The principal component method (Johnson and Wichern, 1998) is used to extract factors of motivation and certification benefits. Factors with the associated eigenvalues greater than the average eigenvalue will be chosen. To further investigate the relations among variables, a Varimax rotation method is adopted. The score coefficient matrix of factor is employed to decrease the variable dimension. Original data will be transformed to factor scores by utilizing the factor score coefficient matrix.

#### 3.2.2 Cluster analysis

RMSSTD (Root Mean Square Standard Deviation) is used to measure the within-cluster similarity. The smaller value of RMSSTD indicates the observations will be similar within the same cluster. \( R^2 \) is used to measure the dissimilarity between clusters. The larger value of \( R^2 \) indicates that clusters are less similar. That is, the larger value of \( R^2 \) is more plausible in cluster analysis. Cluster analysis (Johnson and Wichern, 1998) is used to differentiate several groups of firms based on their implementation effects.

Further investigation is also conducted to explore the properties within each cluster.

#### 3.2.3 Kruskal-Wallis test

Kruskal-Wallis test (Daniel, 1990) is used to examine whether the size, nature of business and type of industry would make a difference in terms of enterprises’ motivation for certification, as well as the implementation effects/certification benefits. Furthermore, Dunn’s multiple comparison (Dunn, 1964) is employed to explore significant differences for the characteristics described as above.

#### 3.2.4 Reliability analysis

Cronbach's Alpha (DeVellis, 1991) is widely accepted in practice to evaluate the consistency of an attitude test. The study employs Cronbach’s Alpha to determine whether a variable should be included into a factor.

### 4. Statistical analysis results of the survey data

#### 4.1 Reasons for ISO 9000 certification

In question 9b of the survey, we asked organizations what were the main reasons for seeking ISO 9000 certifications. The comparisons of motivation for ISO 9000 certification by country is summarized in Table II and the top five common reasons for ISO 9000 certification among four far eastern countries are italicised. Generally speaking, the desire for “quality improvement”, followed by “corporate image”, is the most important reason for ISO 9000 certification. Gaining “marketing advantage” is also an important reason, while “capturing workers’ knowledge” and “customer pressure/demands” are often considered important too. There are some interesting differences among countries with respect to motivations. Japanese and Korean firms were more driven by the consideration of “quality
improvement” than by “corporate image”. For companies in Hong Kong and Taiwan, enhancing “corporate image” is somewhat more important than “quality improvement” probably due to the reason that Taiwanese and Hong Kong firms consider export to be an important reason for ISO 9000 certification.

4.1.1 Factor analysis of motivation for certification

In the questionnaire, the response categories on each question consisted of a five-point scale of the Likert-type. We first conducted a factor analysis to confirm if factors, and the items of which they were composed, were chosen meaningfully. When eigenvalues greater than one are considered, we have extracted three to four common factors, which can explain 64.79 per cent, 70.38 per cent, 63.5 per cent and 58.23 per cent of the total variation for Taiwan, Hong Kong, Japan and Korea respectively. The first common factor of Taiwan is named “External pressure” since it is composed of “customer pressure/demand”, “many competitors were already ISO 9000 certified”, “marketing advantage”, “avoid potential export barrier” and “benefits experienced by other certified companies”. The second common factor of Taiwan is named “Competitive edge-internal portion” and the third common factor of Taiwan is named “Improvement of public relations” accordingly. Similar approaches have been applied for the rest of the countries too. The results indicate motivations of Taiwanese and Korean firms are quite similar probably due to the fact that most responses from these two countries are from manufacturing firms.

4.1.2 Comparative analysis for the motivation of each factor by group characteristics

1 Difference by ownership of the firm and nature of the business. For each factor of motivations, Kruskal-Wallis tests and multiple comparisons have been performed to compare the difference among various ownership structures of the firm and nature of the business at the 5 per cent significant level. There are no significant differences of motivation for the firms in Korea. However, in terms of the “External pressure” including “marketing advantage”, “many competitors were ISO 9000 certified”, the motivation of certification for publicly, privately and foreign owned firms are significantly higher than that of the state-owned firms in Taiwan. Moreover, the motivation of manufacturing firms is higher than that of the service firms in Taiwan, which is contrary to the motivation of Hong Kong and Japanese firms. In terms of the “External pressure”, the motivation for privately, publicly and state-owned firms in Taiwan are significantly higher than that of the foreign firms, which is contrary to the motivation of Japanese firms. In terms of “Improvement of public relations”, the state and publicly owned firms are significantly higher than privately owned and foreign firms in Taiwan.

2 Difference by types of industry. There are no significant differences of motivation for the industries in Hong Kong and Korea. However, in terms of the “External pressure”, the motivation for computer equipment/peripherals, communication, semiconductors and electronics are
significantly higher than that of the food industries in Taiwan. In terms of “Improvement of public relations”, the food industries are significantly higher than semiconductor and mechanical industries in Taiwan. In Japan, the food and textile industries had lower motivation in terms of “External pressure” and “Gaining marketing advantage”.

4.1.3 Factor analysis for ISO 9000 certification benefits
We have also conducted factor analysis for certification benefits to confirm if factors, and the items of which they are composed, are meaningfully chosen. When eigenvalues greater than one are considered, we have extracted two to three common factors for each country. The first common factor of Taiwan is named “Improved competitive edge” since it is composed of “increased productivity”, “quality improvements”, “increased customer satisfaction”, “increased profit margin” and “cost reductions”, etc. The second common factor of Taiwan is named “improved public relations” since it is composed of “improved relations with authorities and communities”. Similar approaches have been applied to the other three countries:

1. Difference by ownership of the firm and nature of the business. For each factor of motivations, Kruskal-Wallis test and multiple comparison have been performed to compare the difference among various ownership of the firm and nature of the business at 5 per cent significant level. There are no significant differences in terms of ownership of the firm for the Hong Kong, Japanese and Korean firms. However, in terms of the “Increased competitive edge”, the certification benefits for privately, publicly and foreign owned firms are significantly higher than those of the state-owned firms in Taiwan. Moreover, the certification benefits for manufacturing firms are higher than those of the service firms in Taiwan, which is different than Japanese firms.

2. Difference among various types of the industry. There are no significant differences for ISO 9000 certification benefits of Hong Kong, Japanese and Korean industries. However, in terms of the “increased competitive edge”, the benefits for computer equipment/ peripherals, communication, and electronic firms are significantly higher than those of the food industries and textile industries in Taiwan.

4.1.4 Comparative analysis for the ISO 9000 certification benefits by different group characteristics
Besides the above statistical analysis results, a cluster analysis method has been performed in order to divide the ISO 9000 certified firms into two groups – Group #1 with better and Group #2 with worse certification benefits; so one can have a better insight of the group characteristics for these two different clusters. The Z test statistics revealed that the certification benefits including increased competitive edge and increased public relation for Group #1 are significantly higher than those of Group #2.

The results show that the reasons why Group #1 performs better than Group #2 are “implementation efforts – following standard procedures” and “corrective action” for the Taiwanese and Korean firms. On the other hand, the reasons for Hong Kong and Japanese firms are similar in terms of “identification of quality aspects” and “capital investment”. Moreover, the firms in Group #1 and Group #2 among four countries have the following characteristics:

- “Believe company’s continued success depend on ISO 9000 certification” for Group #1 is significantly higher than that of Group #2 for the firms in four countries.
- “The percentage of employees received training” for Group #1 is significantly higher than that of Group #2 for the Taiwanese and Japanese firms.
- “The proportion of firms that the year first obtained ISO certification” was before 1999 for Group #1 is significantly higher than that of Group #2 for the Taiwanese and Korean firms.
- The service firms of Taiwan received lower benefits, which is contrary to the service firms of Hong Kong.
- The manufacturing firms in Taiwan, Japan and Korea had better certification benefits.

4.1.5 Investigation of the relationship between “overall benefits” and “specific items” of ISO 9000 certification benefits
The comparative analysis results of ISO 9000 certification benefits among different countries are summarized in Table III. Notice that the common benefits received from ISO 9000 certification among four countries are: improved corporate image; quality improvements; increased customer satisfaction; and improved internal procedures. Moreover, by utilizing the Stepwise regression analysis method to select the variables, one can obtain the following
regression models of four countries for predicting overall benefit of ISO 9000
certification through specific items.
Although the indices of R squares of the
following models are lower than 0.6,
significant benefits can still be explored for
each country.

Taiwan’s model (R-Square = 0.493)
Total benefits = 0.375 + 0.312 (quality
improvements) + 0.232 (increased
productivity) + 0.131 (increased market
share) + 0.120 (improved corporate
image) + 0.107 (maintained/increased
profit margin)

Hong Kong’s model (R-Square = 0.398)
Total benefits = 1.332 + 0.299 (quality
improvements) + 0.285 (increased
customer satisfaction)

Japan’s model (R-Square = 0.391)
Total benefits = 0.541 + 0.188 (quality
improvements) + 0.185 (improved
internal procedures) + 0.163 (increased
market share) + 0.137 (cost reductions)
+ 0.071 (improved corporate image) +
0.065 (increased productivity) +
0.051 (improved employee morale) +
0.050 (increased customer satisfaction)

Korea’s model (R-Square = 0.469)
Total benefits = 1.068 + 0.245 (cost
reductions) + 0.243 (improved corporate
image) + 0.234 (quality improvements) +
0.181 (maintained/increased profit
margin)

4.1.6 Evaluation of the performance of ISO
9000 and 14000 suppliers
The following hypothesis test has been
performed to evaluate the performance for
the suppliers of ISO 9000 and 14000. The null
and alternative hypotheses are listed as
below:

\[H_0: \text{The proportion answering “yes” on 16 of survey questions is less than or equal to 0.5}\]
\[H_1: \text{The proportion answering “yes” on 16 of survey questions is greater than 0.5}\]

The results of hypothesis testing indicate
that the ISO 9000 certified suppliers have a
“better quality”, “more reliable delivery” and
“more responsive to customer request” than
those without certification among four
countries. Moreover, the ISO 14000 certified
suppliers have “better environmental
performance” than those without
certification among four countries.

4.2 Reasons for ISO 14000 certified firms
In question 9e of the survey, we asked
organizations what were the main reasons
for seeking ISO 14000 certification.
Comparison of the motivation for ISO 14000
certification by country is summarized in
Table IV. The italicised items are the top
four common reasons for ISO 14000
certification among four far eastern
countries. Generally speaking, the desire
for improving “corporate image”, followed
by “environmental improvement”, is the
most important reason for ISO 14000
certification. Gaining “marketing
advantage” is also an important reason,
while “improving relation with
communities” is often considered important
too. There are some interesting differences
among countries with respect to
motivations. The Korean firms were more
driven by improving “corporate image” and
gaining “marketing advantage” than by
“environmental improvement” and
improving “relations with others”.

Table III
Comparison of the ISO 90000 certification benefits among different countries

<table>
<thead>
<tr>
<th>Certification benefits</th>
<th>Taiwan</th>
<th>Hong Kong</th>
<th>Japan</th>
<th>Korea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost reductions</td>
<td>2.95</td>
<td>2.18</td>
<td>2.47</td>
<td>2.57</td>
</tr>
<tr>
<td>Increased productivity</td>
<td>3.26***</td>
<td>2.60</td>
<td>2.74</td>
<td>3.02</td>
</tr>
<tr>
<td>Quality improvements</td>
<td>3.86***</td>
<td>3.54***</td>
<td>3.73***</td>
<td>3.50***</td>
</tr>
<tr>
<td>Environmental improvements</td>
<td>3.39***</td>
<td>3.27</td>
<td>2.84</td>
<td>2.85</td>
</tr>
<tr>
<td>Increased on-time delivery to customers</td>
<td>3.40***</td>
<td>2.92</td>
<td>2.78</td>
<td>3.04</td>
</tr>
<tr>
<td>Increased customer satisfaction</td>
<td>3.81***</td>
<td>3.30***</td>
<td>3.49***</td>
<td>3.46***</td>
</tr>
<tr>
<td>Increased market share</td>
<td>3.13**</td>
<td>2.74</td>
<td>2.74</td>
<td>2.75</td>
</tr>
<tr>
<td>Maintained/increased profit margin</td>
<td>3.08*</td>
<td>2.26</td>
<td>2.31</td>
<td>2.59</td>
</tr>
<tr>
<td>Improved internal procedures</td>
<td>3.91***</td>
<td>3.68***</td>
<td>3.78***</td>
<td>3.72***</td>
</tr>
<tr>
<td>Improved employee morale</td>
<td>3.34***</td>
<td>2.78</td>
<td>3.64***</td>
<td>2.71</td>
</tr>
<tr>
<td>Improved relations with authorities</td>
<td>3.01</td>
<td>3.15</td>
<td>2.62</td>
<td>2.63</td>
</tr>
<tr>
<td>Improved relations with communities</td>
<td>2.83</td>
<td>2.81</td>
<td>2.41</td>
<td>2.94</td>
</tr>
<tr>
<td>Improved corporate image</td>
<td>4.02***</td>
<td>3.82***</td>
<td>3.69***</td>
<td>3.63***</td>
</tr>
</tbody>
</table>

Notes: *** indicates p-value < 0.001, ** indicates p-value < 0.01, * indicates p-value < 0.05
(T test of means > 3 are italicised)
4.2.1 Factor analysis of motivation for ISO 14000 certification

In the questionnaire, the response categories on each question consisted of a five-point scale of the Likert-type. We first conducted factor analysis to confirm if factors, and the items of which they were composed, were meaningfully chosen. When eigenvalues greater than one are considered, we have extracted two common factors of motivation, which can explain 59.92 per cent of the total variation for Taiwanese firms. The first common factor is named “External pressure” since it is composed of “customer pressure/demand”, “many competitors were already ISO 14000 certified”, “marketing advantage”, “avoid potential export barrier” and “benefits experienced by other certified companies”. The second common factor is named “Improvement of corporate image and public relations” accordingly. Similar approaches have been applied for the other three countries. The results indicate that the common factors of Taiwanese and Korean firms are quite similar probably due to the fact that most responses of these two countries are manufacturing firms.

4.2.2 Comparative analysis for the motivation of each factor due to different group characteristics

1. Difference among various ownership of the firm and nature of the business. For each factor of motivation, Kruskal-Wallis tests and multiple comparisons have been performed to compare the difference among various ownership structures of the firm and nature of the business at 5 per cent significant level. There are no significant differences of motivation for the Korean firms. However, in terms of the “External pressure” including “Customer pressure”, “many competitors were ISO 14000 certified”, etc., the motivation of certification for state owned firms of Taiwan are significantly higher than that of the foreign-owned firms. Moreover, the motivation of manufacturing firms of Taiwan and Hong Kong is higher than that of the service firms.

2. Difference by types of industry. There are no significant differences of motivation for the industries in Japan and Korea. However, in terms of “External pressure”, the motivation for communication, computer equipment/ peripherals, and semiconductor are significantly higher than those of food industries and mechanical industries. In terms of “Improvement of public relations”, there is no significant difference among various industries in Taiwan. In terms of “Improvement of corporate image and public relations”, the computer equipment and peripherals firms are significantly higher than those of food and metal industries in Hong Kong.

4.2.3 Comparative analysis for the ISO 14000 certification benefits by different group characteristics

Besides the above statistical analysis results, a cluster analysis method has been performed in order to divide the ISO 14000 certified firms into three groups – Group #1 with best, Group #2 with better and Group #3 with worst certification benefits; so one can have a better insight of the group characteristics for these three different clusters. The comparative analysis of the best and worst group received benefits from ISO 14000 certification among different countries has also been conducted.

The above results indicate that the motivations for ISO 14000 certification for Group #1 among the four countries are quite similar. Meanwhile, the reasons why Group
#1 performs better than Group #3 in terms of implementation efforts – “training” and “workers’ commitment” – are the same for Taiwanese and Korean firms. Besides “training”, “capital investment” and “periodic audit” are the key reasons for the success of Japanese firms in Group #1. Moreover, the Group #1 and #2 firms among four countries have the following characteristics:

- The percentage of employees received training” for Group #1 is significantly higher than that of Group #3 for Taiwan, Japan and Hong Kong.
- “Believe company’s continued success depend on ISO 14000 certification” for the Group #1 is significantly higher than that of Group #3 for four countries.
- “The proportion of firms that some competitors registered when these firms decided to seek ISO certification” for Group 1 (18.8 per cent) is significantly higher than that of Group #3 (5 per cent).
- “The proportion of firms that the year obtained ISO 14000 certification was before 1999” for Group #1 is significantly higher than that of Group #3 for South Korea only.
- There are no significant differences in company’s ownership, nature of the business, industrial types for four countries.

4.2.4 Investigation of the relationship between “overall benefits” and “specific items” of ISO 14000 certification benefits

Notice that, from Table V, the common benefits received from ISO 14000 certification among four countries are: improved corporate image; environmental improvements; and improved relations with communities.

On #13 of survey questions, we asked “To what extent do you agree or disagree with the following statements?”
- Question 13d and 13f asked: “We require our key suppliers to have ISO 9000/14000 certification”.
- Question 13e and 13g asked: “We require all our suppliers to have ISO 9000/14000 certification”.

The results of attitude toward the requirement of suppliers to have ISO certification indicate that the Taiwanese and Japanese firms have more stringent requirements in both ISO 14000 and ISO 9000 certification than those of the Hong Kong and Korean firms. Significant gaps exist in ISO 14000 requirement imposed on suppliers among the four countries. The scores of Taiwanese and Japanese firms can be clustered into one group, which are significantly higher than firms in the other group consisting of Hong Kong and South Korea.

## 5. Conclusions and suggestions

Listed below are major findings based on the statistical analysis of the global mail survey:

### 5.1 ISO 9000 certified firms in four countries

- The factors of motivation for ISO 9000 certification extracted by Factor Analysis are: External pressure; Competitive edge; internal and external portions; Improvement of public relations, etc. The benefits of ISO 9000 certification are: Improved competitive edge; and Improved public relations for four far eastern countries.

<table>
<thead>
<tr>
<th>Table V</th>
<th>Comparison of benefits for ISO 14000 certification among different countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>Taiwan</td>
</tr>
<tr>
<td>Cost reductions</td>
<td>2.67</td>
</tr>
<tr>
<td>Increased productivity</td>
<td>2.77</td>
</tr>
<tr>
<td>Quality improvements</td>
<td>3.11*</td>
</tr>
<tr>
<td>Environmental improvements</td>
<td>4.12***</td>
</tr>
<tr>
<td>Increased on-time delivery to customers</td>
<td>2.61</td>
</tr>
<tr>
<td>Increased customer satisfaction</td>
<td>3.17**</td>
</tr>
<tr>
<td>Increased market share</td>
<td>2.75</td>
</tr>
<tr>
<td>Maintained/increased profit margin</td>
<td>2.65</td>
</tr>
<tr>
<td>Improved internal procedures</td>
<td>3.54***</td>
</tr>
<tr>
<td>Improved employee morale</td>
<td>3.34***</td>
</tr>
<tr>
<td>Improved relations with authorities</td>
<td>3.48***</td>
</tr>
<tr>
<td>Improved relations with communities</td>
<td>3.59***</td>
</tr>
<tr>
<td>Improved corporate image</td>
<td>4.20***</td>
</tr>
</tbody>
</table>

Notes: *** indicates p-value < 0.001, ** indicates p-value < 0.01, * indicates p-value < 0.05
(T test of means > 3 are italicised)
Owing to different ownership, nature of business and industrial type, the ISO 9000 certification benefits in the four countries are not quite the same.

The cluster analysis indicates that the ISO 9000 certified firms can be divided into two groups – with better and worse certification benefits for the four far eastern countries.

5.2 ISO 14000 certified firms in four countries

The factors of motivation for ISO 14000 certification extracted by factor analysis are: External pressure; Improvement of corporate image and public relations and others. The benefits of ISO 14000 certification are: Improved competitive edge; Improved corporate image and public relations and others for four countries.

Owing to different ownership, nature of business and industrial type, the ISO 14000 certification benefits of the four countries are not quite the same.

The cluster analysis indicates that the ISO certified firms can be divided into three groups – with best, better and worst certification benefits for the four countries.

5.3 The eight common points for ISO 9000 and ISO 14000 certified firms in four countries

1 “Improving corporate image”, “quality improvement”, “gaining marketing advantage”, “capturing worker’s knowledge” and “customer pressure/demands” are the common reasons of four far eastern countries for ISO 9000 certification.

2 “Improving corporate image”, “environmental improvement”, “gaining marketing advantage”, and “improving relations with communities” are the common reasons of four countries for ISO 14000 certification.

3 “Improved corporate image”, “quality improvement”, “increased customer satisfaction”, and “improved internal procedures” are the top four benefits received from ISO 9000 certification.

4 “Improved corporate image”, “environmental improvements”, and “improved relations with communities” are the top three benefits received from ISO 14000 certification.

5 The performance of ISO 9000 suppliers have “better quality”, “more responsive to customer requests”, and “more reliable delivery” among the four different countries.

6 The performance of ISO 14000 suppliers have “better environmental performance” and “more responsive to customer requests” among the four countries.

7 Enhancing corporate image ranked high for both standards, being the leading motivator for seeking ISO 14000 and the second most important motivator for seeking ISO 9000.

8 “Training” is the most significant contributing factor among groups with the best and worst benefits received from ISO 9000 and 14000 certification for the firms of Taiwan, Hong Kong, Japan and South Korea.

It is informative to compare reasons and certification benefits for seeking ISO 9000 certification with those for ISO 14000 certification. The survey results indicate that companies with strong motivation and believe “company’s continued success depend on ISO certification” will receive better ISO 9000/14000 certification benefits among the four countries. Comparing common point (1) vs (3); (2) vs (4), we can also find the strong linkage between motivations of implementing ISO 9000/14000 and certification benefits. Therefore, consensus within the corporation is extremely important for seeking/maintaining ISO certification. Besides, the common point (8) indicates training is the most important part of quality and environmental improvement. Ishikawa (1985) stated that, in Japan, quality control begins with education and ends with education. Hence, institution of a vigorous training program is another key contributing factor toward successful implementation of ISO 9000 and ISO 14000 systems standards. Other derived conclusions and proposed suggestions are listed as follows:

- “Training”, “Implementation of corrective action”, “not following procedures”, “worker’s commitment”, “identification of quality aspects” and “capital investment” are major items that need to be further enhanced for the group with worse ISO 9000 certification benefits.

- “Training”, and “worker’s commitment”, “identification of environmental aspects” are major items that need to be further enhanced for the group with worst ISO 14000 certification benefits.

- It is necessary for the enterprises to require their suppliers to have ISO 9000/14000 certification since suppliers with ISO certification perform far superior to those without certification.

Hopefully, the above managerial implications and directions will provide a useful reference for the enterprises, which are in the process of seeking or maintaining ISO 9000/14000 certification.
References

Further reading
Appendix

A Global Study of ISO 9000 and ISO 14000

8. If your company is certified to ISO 9000 or ISO 14000 (or is currently seriously considering it), to what extent did your company's continued success depend on certification?

<table>
<thead>
<tr>
<th></th>
<th>not certified and not considering</th>
<th>not important at all</th>
<th>not important</th>
<th>somewhat important</th>
<th>important</th>
<th>extremely important</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 9000</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>ISO 14000</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

9b. Please indicate how important each of the following reasons was for seeking, maintaining, or seriously considering ISO 9000 certification. (If you do not have ISO 9000 certification and are not considering it, please do not answer this question.)

<table>
<thead>
<tr>
<th>Reason</th>
<th>not important at all</th>
<th>not important</th>
<th>somewhat important</th>
<th>important</th>
<th>extremely important</th>
</tr>
</thead>
<tbody>
<tr>
<td>cost reductions</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>quality improvements</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>marketing advantage</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>customer pressure/customer demands</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>many competitors were already ISO 9000 certified</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>benefits experienced by other certified companies</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>avoid potential export barrier</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>capturing workers' knowledge</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>relations with authorities</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>relations with communities</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>corporate image</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

9c. How many of your competitors were registered to ISO 9000 when you decided to attain registration, and how many are registered today?

<table>
<thead>
<tr>
<th>Competitors registered when we decided to seek registration:</th>
<th>unknown</th>
<th>none</th>
<th>very few</th>
<th>some</th>
<th>most</th>
<th>all</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitors registered today:</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

10. Please indicate which group within your organization initiated the main drive for certification to each of the following standards; circle all that apply.

<table>
<thead>
<tr>
<th>Group</th>
<th>ISO 9000</th>
<th>ISO 14000</th>
</tr>
</thead>
<tbody>
<tr>
<td>not applicable</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>quality department</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>environmental, health and safety department</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>marketing</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>operations</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>CEO, top management</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>whole organization</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>R&amp;D, design, development department</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

11. What percentage of your employees received training for each of the following certifications?

<table>
<thead>
<tr>
<th>Certification</th>
<th>not applicable</th>
<th>0-20%</th>
<th>21-40%</th>
<th>41-60%</th>
<th>61-80%</th>
<th>81-100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 9000</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>ISO 14000</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

(continued)
12a. Please indicate how much effort you had to put into each of the following factors, in order to obtain or maintain ISO 9000 certification, and how important each factor was for successful implementation. (If you do not have ISO 9000 certification, please do not answer this question.)

<table>
<thead>
<tr>
<th>Identification of quality aspects</th>
<th>How much effort did it take?</th>
</tr>
</thead>
<tbody>
<tr>
<td>(re)defining standard procedures</td>
<td></td>
</tr>
<tr>
<td>documentation</td>
<td></td>
</tr>
<tr>
<td>Training</td>
<td></td>
</tr>
<tr>
<td>Capital investment</td>
<td></td>
</tr>
<tr>
<td>Top management commitment</td>
<td></td>
</tr>
<tr>
<td>Middle management commitment</td>
<td></td>
</tr>
<tr>
<td>Workers’ commitment</td>
<td></td>
</tr>
<tr>
<td>Periodic audits</td>
<td></td>
</tr>
<tr>
<td>Following standard procedures</td>
<td></td>
</tr>
<tr>
<td>Implementation of corrective action</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Importance</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>Very High</th>
<th>Little Effort</th>
<th>Medium Effort</th>
<th>High Effort</th>
<th>Very High Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

13. To what extent do you agree or disagree with each of the following statements?

13d: "We require our key suppliers to have ISO 9000 certification."

<table>
<thead>
<tr>
<th>Degree of Agreement</th>
<th>1: Strongly Disagree</th>
<th>2: Somewhat Disagree</th>
<th>3: Neutral</th>
<th>4: Somewhat Agree</th>
<th>5: Strongly Agree</th>
</tr>
</thead>
</table>

13e: "We require all our suppliers to have ISO 9000 certification."

13f: "We require our key suppliers to have ISO 14000 certification."

13g: "We require all our suppliers to have ISO 14000 certification."

(continued)
15a. How would you assess the specific benefits achieved, in each of the following categories, from ISO 9000 certification?

<table>
<thead>
<tr>
<th>Benefit</th>
<th>not certified</th>
<th>no benefits</th>
<th>minor benefits</th>
<th>moderate benefits</th>
<th>substantial benefits</th>
<th>very substantial benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost reductions</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Increased productivity</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Quality improvements</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Environmental improvement</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Increased on-time delivery to customers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Increased customer satisfaction</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Increased market share</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Maintained/increased profit margin</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Improved internal procedures</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Improved employee morale</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Improved relations with authorities</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Improved relations with communities</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Improved corporate image</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

16. Please indicate whether, in your experience, suppliers with each of the following certifications perform better or not better than suppliers without certification, along each of the following dimensions. (If you do not have any direct experience with certified suppliers or have no certified suppliers, please do not answer the question.)

<table>
<thead>
<tr>
<th>Benefit</th>
<th>ISO 9000</th>
<th>ISO 14000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower price</td>
<td>1: better</td>
<td>2: not better</td>
</tr>
<tr>
<td>Better quality</td>
<td>1: better</td>
<td>2: not better</td>
</tr>
<tr>
<td>Better environmental performance</td>
<td>1: better</td>
<td>2: not better</td>
</tr>
<tr>
<td>More reliable delivery</td>
<td>1: better</td>
<td>2: not better</td>
</tr>
<tr>
<td>More innovative</td>
<td>1: better</td>
<td>2: not better</td>
</tr>
<tr>
<td>More responsive to customer requests</td>
<td>1: better</td>
<td>2: not better</td>
</tr>
</tbody>
</table>
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