

A Research into Managerial Performances of the Firms certified the ISO 9000 Series of Manufacturing Industry in Taiwan, R.O.C

Li-Hsing Ho, Chen-Lung Yang, Yi-Chen Chung, Shih-Chia Chang, Ru-Jen Lin, Ling-Feng Hsieh
Department of Industrial Engineering and Management , Chung Hua University
Hsinchu, Taiwan , R.O.C.

ABSTRACT

This study investigates the current situation of the ISO 9000 manufacturing industry in Taiwan, analyzing the business influence of ISO 9000 and the relation of the influence to industry-related characteristics. The study utilized polling and was approached from six aspects, using 26 indicator items to evaluate performance. The six approaches consisted of business management, finance management, production management, human resources management, marketing management, and a company's overall situation.

Methods used to analyze the collected data were mainly drawn from descriptive statistics, e.g., the T test and analysis of single factors with variation. The study found that 96.6 % of the industry thought that the introduction of the ISO 9000 series was somewhat beneficial. The 26 indicator items among the six approaches were proved substantially effective by the T test. It was obvious that the effect of the ISO 9000 series industry standard was beneficial and helpful to the manufacturing industry.

1. Preface

The economic miracle that Taiwan created through fast development over the past 30 years is well known. Free trade and internationalization further speeded the island's transformation, while the integration of the regional economy forced Taiwan to strengthen its competitiveness. With Taiwan now set on becoming an Asian transportation hub, the island today faces major challenges associated with internationalization and free trade. Needing to increase international market share in the face of strong global competition, industries have to constantly improve their production techniques in order to boost production quality. To internationalize and standardize every country's production and quality management, the International Organization for Standardization (ISO) enacted the ISO 9000 international quality management and quality assurance standard. Since it was promulgated, many countries have come to regard the ISO 9000 series as an industry norm. Currently, over 90 countries have accepted the ISO 9000 standard as their national benchmark. The great increase of ISO 9000 certified companies has established itself as a trend. ISO 9000 has become a common language for quality assurance in each industry. It has been seven years since Taiwan adopted the standard. The number of Taiwan ISO 9000 certified

companies quickly increased. From the above, we can see that this quality assurance system has been highly regarded. The present study investigated Taiwan's manufacturing industry, famed for the small size and the flexibility of the companies that created the economic miracle. This study adopted polling methods to investigate manufacturing industries recorded by Bureau of Commodity Inspection and Quarantine, and analyzed survey results.

There were four goals to the research:

1. To survey the current situation of the manufacturing industry's introduction of the ISO 9000 standard in Taiwan.
2. To analyze the business effects of the practice of the ISO 9000 standard by the certified industries.
3. To investigate the relation between the performance of certified companies and the characteristics of the industry under the ISO 9000 quality assurance system.
4. Study the analyzed results and offer suggestions for the industry's further reference.

2. Background Reference

The origin of the ISO 9000 series was closely related to the development of American national defense standards. During World War II, the American government introduced the military standard MIL-Q958A quality control system, and the MIL-K45208 examination system, as the evaluation standard for the supply of military spare parts. By August 1995, more than 70 countries adopted the standard, and more than 70000 companies or organizations were certified. Today more than 90 countries worldwide have adopted ISO 9000 as their national standard. In 1989, Taiwan's Bureau of Commodity Inspection and Quarantine introduced the ISO 9000 series, and on March 1990, the Bureau of Central Standardization changed to the CNS 12869 quality management and quality assurance national standard. The current version of the ISO 9000 series includes six parts in which ISO 8420 provides definitions of terms, ISO 9000 offers options and guidelines, ISO 9001~9003 is a model for quality assurance, and ISO 9004 contains guidelines for internal quality assurance. Six major changes were made in ISO 9000's 1994 version:

1. Customer-guided concepts of total quality management (TQM) were introduced.
2. Planning and prevention concepts were stressed.
3. Attention was paid to both system and production quality.
4. The participation of both entrepreneurs and managers was considered.
5. Flow charts were extended and broadened.
6. ISO 9003 was greatly expanded.

The effects of the industry's introduction of ISO 9000 have been these:

1. According to a *Management Magazine* interview, management quality and production quality have increased as a result of the practicing of ISO 9000, defect rates have decreased, product orders from abroad have increased, responsibility is now easily tracked, paperwork is not accumulating and holding up orders, job transfers have become easier, the work shift system has benefited, exam and audit systems have been established, systemizing equipment has been fine

tuned, production power has increased, employee morale has improved, employees feel more fulfilled, managing costs have decreased, standardization has spread, and company images have become highly regarded.

2. According to an *Outstanding Magazine* interview, by practicing ISO 9000 the companies have become more active and aggressive, customers don't have to repeat the auditing process, production quantity has increased, production power has increased, quality costs have decreased, and customer complaints have declined.
3. According to a domestic study, companies do benefit from the promotion of ISO 9000. The visible benefits in the short term are gains in quality consciousness, gains in human resources, gains in production power, filing system improvements, and the advance of entrepreneurialism. For ISO 9000 certified companies, increases of production quality, reduction of costs, and sales increases are all visible long-term benefits of the practice of ISO 9000.
4. According to a report by Zhu Hua Ji, the ISO 9000 certified companies gained positive performance from reduced costs, reduced customer complaints, reduced defect rates, and reduced customer complaints; and from quality improvements, higher rates of finished products, increased equipment tune ups, etc.

The effects reported by certified foreign companies are these:

1. According to a Raynem and Porter report based on interviews with 20 British certified companies, the biggest benefit from practicing ISO 9000 was an increase of sales. Other benefits were retention of customers, an increase in new customers, expansion of markets, a decrease in dissatisfied customers, an increase in business control, stronger internal discipline, and a reduction in unwanted goods.
2. George Dzus, using Du Pont's experience, found that the benefits to companies practicing ISO 9000 are: (1) production increases, (2) reduced customer complaints, (3) reduced production variations, and (4) increase in companies' competitiveness.
3. Cynthia A. DeAngelis, citing ICI Advanced Materials as an example, found that the benefits of the companies which practiced ISO 9000 included: reduced production costs, reduction in repetitive work, reduced customer complaints, and reduced necessity of after-sales service.
4. According to a British Manchester Business School report covering about 1190 companies in various fields practicing ISO 9000, the benefits are: better management, better sense of problem solving, better production promotion methods, better customer service, increased efficiency, reduced problems, retention of old customers, increased customer satisfaction, better new employee guidelines (i.e., better orientation), and increased market share. The survival rate of the certified companies was four times that of uncertified companies in a stagnant British business environment.
5. A study of ISO 9000 performance in industry, done by Surrey University in 1995, showed that the growth of financial competition of ISO 9000 certified companies has been two times stronger than that of uncertified companies. In its comparison and analysis, this study compared 222 certified machinery manufacturers and related companies with uncertified companies.

3. Methodology

This study investigated the results of certified companies practicing ISO 9000 in Taiwan. Business management, financial management, production management, human resource management, marketing management, and the overall company were all evaluated. The definition of manufacturing industry followed the business classification standard of the ROC. The study resource was compiled from companies licensed by Bureau of Commodity Inspection and Quarantine from January 1, 1991 through October 1997. The study questionnaire was based on ISO 9000 related reference material as modified by specialists. Those responding to the questionnaire were the managers of quality control or quality management for each company. The questionnaire was distributed by mail. According to data from the Bureau of Commodity Inspection and Quarantine, there were 1373 ISO 9000 certified companies as of October, 1997. Among the 1373 companies, the number of electronic appliance companies was 161, the number of electronic companies was 247; in the machinery industry there were 460; in the chemical industry, 391; in the food industry, 34; and in other industries, 80.

In this questionnaire, performance was analyzed from six aspects using 26 items as indicators of ISO 9000 certified companies' progress. Narrative statistics, the T test, the chi square test, and single factor variant analysis were utilized in analyzing data. Further descriptions of the methodology follow:

3.1 Narrative statistics:

Narrative statistics use time distributions calculated for average, standard difference, and frequency of happening to understand the samples' distribution status. The analyzed content included the following basic company data: company's location, age of the company, type of business, number of employees, amount of capital, average revenue over three years, status of the company's ISO 9000 performance (length of time from adoption to certification of ISO 9000), adoption mode, motivation for introducing ISO 9000, the organizations which helped implement it, and the degree that implementing ISO 9000 brought about the expected effect.

3.2 T test:

The purpose of the T test is to compare the difference of a certain quality of two origins with the same variance or to compare the difference of two samples from the same origin. In this study, the statistical method is to compare the difference of the effect of certified companies and uncertified companies.

3.3 Chi square test:

If the origin and sample are classified by two or two more standards, we can use chi square test to examine the independence of these classifications. In the study, the chi square independence test is used to examine the relation between companies' attributions and indicators or items of performance from each aspect.

3.4 Analysis of single factor variance:

Single factor analysis of variance was used to analyze the relation between the attributes of each item of basic data and average effect of each aspect; then Least-Significant Difference was used to find the apparent variance. The result and analysis of questionnaire (polling) was as follows:

4. Survey Results and Analysis

By February 1998, the questionnaire had been sent to 1373 investigated companies. By April 10th, 323 companies responded but 35 companies' answers were either not clear or were incomplete, leaving 288 that were valid.

4.1 Analysis of current trends:

We can understand the current situation of the manufacturing industry practicing ISO 9000 by referring to the analysis of narrative statistics based on respondent data as presented in Chart 4.1.

4.2 Analysis of indicated performance:

Judging from items or indicators of degree of performance in basic data collected, most companies more or less reached their expected goals after being certified. To understand whether the performance of each aspect really increased, in addition to obtaining the average and standard difference of each effect to understand the difference, the T test was used to examine the following hypothesis to understand whether the accurate degree of difference was obvious.

From the analysis of each aspect in the study, it is clear after the T test that each item or indicator of progress showed positive results. In other words we can conclude that ISO 9000 certification is quite beneficial to certified companies in each aspect. Although some companies found that their indicated performance lost ground in some aspects, the overall performance of most companies under ISO 9000 was obviously positive

4.3 Analysis of relation and difference:

In this section, the study used the chi square independence test and the analysis of single factor variance to analyze the relation between two variances. If the analysis result reached an obvious standard, it was obvious that the two variances affected each other greatly. This study mainly analyzed the basic data collected from companies in order to understand the current situation of companies practicing ISO 9000 series and to understand the differences and relation among the items or indicators of effect in each aspect.

4.3.1 Analysis of the relation of basic data collected:

Here we studied whether the length of time of the ISO 9000 series introduction, the assisting organizations, and degree of reaching expected goals by the certified companies caused obvious differences owing to differences in certain company characteristics.

1. Relational analysis of the length of introduction time and the basic data collected

Here we used the chi square independence test to conduct the relational analysis. The total length of introduction time varied obviously because of the companies' location, the age of the companies, the companies' business revenue, and the influence of ISO 9000 assisting

organizations. The length of introduction time also influenced greatly the degree of expected effect recognized by the companies.

2. Relational analysis of the ISO 9000 assisting organizations and the basic data collected:

Among the basic data collected from the companies, five variables reached an obvious standard: difference of assisting organizations, the age of the companies, the number of employees, companies' capital assets, their business revenue, and the length of introduction time. The first four variables were closely related to the size of companies. That is, the size of companies apparently influenced the assisting organizations. In addition, the choice of different assisting organizations also obviously influenced the length of introduction time.

3. Relational analysis of the variance of the number of employees and the total length of the introduction period:

In this part, indicated performance reached an obvious standard.

4.3.2 Relational analysis of the degree of expected effect and the basic data collected:

The study also investigated the growth of performance in each business aspect, and relationships among certain characteristics in the basic data collected from companies. In terms of statistics, the chi square independence test and single factor analysis were conducted to analyze differences. The six business aspects investigated in this study included business management, financial management, production management, human resource management, marketing management, and the overall company. The study investigated the relation between the items or indicators of progress in each aspect and the basic company data collected.

The analysis in each aspect in the study showed that differences in company recognition of the degree of effect after certification greatly affected most performance of terms or indicators of effect (84.62%). Also, differences in the companies' recognition of the degree of effect after certification was related to four aspects: business management, financial management, production management, and marketing management. Therefore, the degree of goal implementation was obviously related to the results of most items or indicators of progress. The companies' characteristics and items or indicators of progress that were affected by introduction status were the 10 items below, and were unrelated to indicators in at least two aspects.

The result of the analysis of the variance in average performance in each aspect and basic data is partly different from the test of each item or indicator of effect. The reason might be that after averaging reduced extreme merits value partly, therefore related to basic data of each item or indicator of effect.

4.3.3 Relational analysis of motivation for practicing the quality control system:

1. The relational analysis of motivation for practicing the quality control system and the basic data collected:

This part of the study investigated various basic data to determine whether company motivation for practicing the ISO 9000 series varied. It was found that company location and introduction

mode do not influence motivation for promoting the ISO 9000 series. The age of a company and the type of business apparently do influence four motivations: improving the company's composition and business systems, the expectation of government policy, strengthening international competitiveness, and improving company image. The number of employees, capital assets and business revenue directly affect the characteristic of business scale, also obviously affecting the motivations of expectation of government policy and strengthening international competitiveness. The motivations of the length of introduction time, customer demands, developing new markets, and the ISO 9000 trend are closely related. The assisting organizations are only obviously affected by the motivation of expectation of government policy.

2. The relation between introduction motivation and average performance in each aspect:

The goal was to understand whether a company's motivation for promoting the ISO 9000 series had an obvious influence on the average affect in each aspect. Variance analysis showed that active motivations have obvious good influence on companies' average performance in each aspect and passive motivations do not.

5. Conclusions and Suggestions

The following are the study's conclusions and the suggestions.

1. Numerous companies hoped that the ISO 9000 system could be a stepping stone for pursuit of overall quality control. It was obvious from the study that the ISO 9000 quality control system did benefit companies, lifting their performance. Thus, the ISO 9000 standard can be recommended to not-yet-practicing ISO 9000 companies, provided that they implement the ISO 9000 standard carefully to avoid running up certification costs and otherwise burdening their finances by rushing to pass certification and failing to carry out the standard.
2. The study showed that the ISO 9000 quality control system suits different industries. Before introducing the ISO 9000 series, it is important for each company to understand the content and regulations of the system, carefully choosing the proper certification mode and then carrying out the standard.
3. The introduction of ISO 9000 quality control system is a process involving all business aspects of a company. Accordingly, the whole company must work to build the sense of quality, cooperating to carry out the standard. Otherwise, the system will fail.
4. A company should establish an evaluation function in order to understand and assess the effect of practicing the ISO 9000 quality control system. In this way, the company can really understand the current status of the company's quality management and control mission, and avoid system failure and wasted effort.
5. Companies should not regard ISO 9000 certification as a basic quality requirement for practicing overall quality and safety environment management. Solidly carrying out a quality management system and satisfying customers' needs are the keys to company success and survival.

Table 4.1 Companies' Basic Data

| | Items of basic data | Number of times |
|---|------------------------------------|-----------------|
| Location | Northern Part | 130 (45.1%) |
| | Central Part | 74 (25.7%) |
| | Southern Part | 77 (26.7%) |
| | Eastern Part | 7 (2.4%) |
| How long companies in business | Fewer than 10 years | 47 (16.3%) |
| | Eleven to 20 years | 68 (23.6%) |
| | Twenty-one to 30 years | 93 (32.3%) |
| | Thirty-one to 40 years | 45 (15.6%) |
| | Forty-one to 50 years | 22 (7.6%) |
| | More than 50 years | 13 (4.5%) |
| Type of business | Electronic appliance industry | 57 (19.8%) |
| | Electronic industry | 60 (20.8%) |
| | Machinery industry | 84 (29.2%) |
| | Chemical industry | 25 (8.7%) |
| | Food industry | 21 (7.3%) |
| | Others | 41 (14.2%) |
| Number of employees | Fewer than 100 persons | 90 (31.3%) |
| | 101-300 persons | 89 (30.9%) |
| | 301-500 persons | 29 (10.1%) |
| | 501-1000 persons | 35 (12.2%) |
| | 1001-2000 persons | 25 (8.7%) |
| | More than 2000 persons | 20 (6.9%) |
| Capital assets | Less than 60 million NT\$ | 74 (25.7%) |
| | 60 million-300 million NT\$ | 72 (25.0%) |
| | 300 million-500 million NT\$ | 25 (8.7%) |
| | 500 hundred million-1 billion NT\$ | 29 (10.1%) |
| | 1 billion-3 billion NT\$ | 45 (15.6%) |
| | 3 billion-5 billion NT\$ | 18 (6.3%) |
| | 5 billion-10 billion NT\$ | 7 (2.4%) |
| | More than 10 billion NT\$ | 18 (6.3%) |
| Average business revenue for latest 3 years | Fewer than 60 million NT\$ | 14 (4.9%) |
| | 60 million- 300 million | 86 (29.9%) |
| | 300 million-500 million | 42 (14.6%) |
| | 500 million-1 billion NT\$ | 31 (10.8%) |
| | 1 billion-3 billion NT\$ | 44 (15.3%) |
| | 3 billion-5 billion NT\$ | 21 (7.3%) |
| | 5 billion-10 billion NT\$ | 23 (8.0%) |
| | More than 10 billion NT\$ | 27 (9.4%) |
| Mode | ISO 9001 | 40 (13.9%) |
| | ISO 9002 | 248 (86.1%) |

Table 4.1 Companies' Basic Datacon (continued)

| | Items of basic data | Number of times |
|-----------------------------|--|-----------------|
| When ISO 9000 introduced | 1990 | 2 (0.6%) |
| | 1991 | 6 (2.1%) |
| | 1992 | 25 (8.7%) |
| | 1993 | 59 (20.5%) |
| | 1994 | 68 (23.6%) |
| | 1995 | 70 (24.3%) |
| | 1996 | 58 (20.1%) |
| When certification obtained | 1992 | 4 (1.4%) |
| | 1993 | 27 (9.4%) |
| | 1994 | 59 (20.5%) |
| | 1995 | 55 (19.1%) |
| | 1996 | 87 (30.2%) |
| | 1997 | 56 (19.4%) |
| Motivation for introduction | Customer demand | 73 (25.6%) |
| | Improved management quality | 226 (79.3%) |
| | Improved company configuration | 169 (59.3%) |
| | Enter a new market | 42 (14.7%) |
| | ISO 9000 trend | 118 (41.4%) |
| | Anticipation of government policy | 31 (10.9%) |
| | Strengthened international competitiveness | 88 (30.9%) |
| | Improved company image | 170 (59.6%) |
| Mode of introduction | Self-introduced | 37 (12.8%) |
| | Aid from legal organizations | 116 (40.3%) |
| | Aid from private consultants | 102 (35.5%) |
| | Aid from academic organization | 4 (1.4%) |
| | Aid from certification organizations | 29 (10.1%) |
| | Other | 0 (0%) |
| Degree of performance | Completely achieved | 19 (6.6%) |
| | Partly achieved | 200 (69.4%) |
| | Slightly achieved | 60 (20.8%) |
| | Not achieved | 4 (1.4%) |
| | Not certain | 5 (1.7%) |
| Length of introduction | The average | 14.403 |
| | Standard variance | 5.972 |
| | Total length of time | 39 |
| | Unit | month |

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