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A study of factors affecting the implementation of ISO 9000 in Taiwan's construction industry

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A STUDY OF FACTORS AFFECTING THE IMPLEMENTATION OF ISO 9000 IN TAIWAN'S CONSTRUCTION INDUSTRY

A Dissertation Submitted

In Partial Fulfillment

Of the Requirements for the Degree

Doctor of Industrial Technology

Approved:

Dr. John T. Fecik, Advisor

Dr. Charles D. Johnson, Co-Advisor

Dr. H. Stephan Egger, Committee Member

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May 1999

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An Abstract of a Dissertation

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Dr. John T. Fecik, Advisor

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ABSTRACT

The purpose of this study was to determine the attitude of Taiwanese construction companies regarding the adoption and implementation of ISO 9000. This was accomplished by conducting a survey to investigate the perceived factors affecting the intention to adopt ISO 9000 and its successful implementation.

The survey instrument was developed through the review of related literature as well as through validations. One hundred eighty (180) construction companies were randomly sampled from the 1998 Membership Directory of the National Construction Association of the Republic of China (Taiwan), which consisted of 60 Type-A, Type-B, and Type-C construction companies. In total, 62 respondents returned their questionnaires, and the return-rate was 34.44%. The data analysis was performed using the Statistical Package for Social Sciences (SPSS). The statistical analysis included percentage value, frequency, mean value, ANOVA test, and Fisher's Least Significance Difference.

There were several major findings based on the analysis of data. The level of knowledge about ISO 9000 from the entire respondents ($\underline{M}$ = 3.24) was low medium. The mean value for level of knowledge in quality assurance from

all respondents was 3.41, which was medium to high. The level of implementing ISO 9000 was being low for entire population, because only 44 entities of all the 6,559 construction companies (0.67%) have adopted ISO 9000 during the time period of the survey. The 62 respondents agreed with the following statement: (a) ISO 9000 can have a contribution to quality control ($\underline{M}$ = 3.94); (b) Both the quality assurance program and ISO 9000 system are necessary to a company's quality management system ($\underline{M}$ = 3.87 & 3.84); and (c) ISO 9000 is important to the management system ($\underline{M}$ = 3.81). The major reasons of not adopting ISO 9000 were (a) the time to implement ISO 9000, (b) the transition to quality assurance program, (c) the adjustment of working processes, (d) the organizational change or company structure change, and (e) the system maintenance. The five major perceived factors influencing the adoption of ISO 9000 were (a) peer competition, (b) internal initiative, (c) customers' expectations, (d) global competition, and (e) customers' pressure. The three most important factors affecting the success of implementing ISO 9000 were (a) management involvement, (b) success of employee education, and (d) employee involvement.

The major recommendations of this study were as follows: (a) the Taiwanese government and the Construction Association in Taiwan needs to more aggressively advocate the development of ISO 9000 and quality assurance programs; (b) the National Construction Association of Taiwan can standardize the documentation of implementing ISO 9000; (c) the local construction associations can also help their members in employees education; (d) the larger size construction companies or the ISO certified companies should motive or require their subcontractors to adopt ISO 9000; (e) the education about total quality management and total involvement would be necessary for the construction industry in Taiwan in the future.

For my mother,

and

to the memory of my father.

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CHAPTER I

INTRODUCTION

The implementation of ISO 9000 is a worldwide trend with rapidly increasing applications and implementation in many manufacturing and service industries (Goetsch & Davis, 1997; Patterson, 1995). Brunig (1994) has stated that the suppliers of many industries in European countries were required to be ISO 9000 certified after 1987, and the certification of ISO 9000 already has become a basic requirement of sales and a valuable marketing tool. "This trend is rapidly expanding beyond the EC, and becoming a worldwide requirement" (Brunig, 1994, p. 132).

Even though ISO 9000 system was instituted only 11 years ago in 1987, more than 90 countries have adopted the ISO 9000 quality certification system to regulate the development of quality assurance for the manufacturing and service industries (Riswadkar, 1995; Yates & Aniftos, 1995). Moreover, 70 countries and territories have assigned ISO 9000 as their national standards (Hou, 1997). Also more than 40,000 European businesses have adopted ISO 9000 guidelines for managing quality, and about 5,000 manufacturing and service companies have implemented the

ISO 9000 system in the United States (Yates & Aniftos, 1995).

In Taiwan, 1,693 companies in the manufacturing and service industries have applied for the certification of ISO 9000, and 1,315 of them have already been ISO 9000 certified by the Bureau of Inspection of Taiwan as of July 31, 1997. In those ISO 9000 certified companies, 10% have been certified by the ISO 9001 category, and the other 90% have been certified by the ISO 9002 category (Bureau of Inspection of the Ministry of Economic Affairs of the Republic of China (Taiwan), 1997).

Construction companies in Taiwan are aware of the ISO 9000 certification trend. They further understand that the way to achieve competitiveness and to meet global competition is to enhance the total quality of their projects, to conduct total quality management or optionally a quality management and assurance program, and to adopt ISO 9000 (Chou, 1995; Hou, 1997). Adopting ISO 9000 to meet global competition will become inevitable for Taiwanese construction companies in the near future (Chou, 1995; Hou, 1997).

Statement of Problem

The intent of this study was to investigate the perceived factors that will affect the adoption and implementation of ISO 9000 in Taiwan's construction industry in order to make recommendations that will facilitate the adoption process and thus ultimately enhance the industry's quality management and trade competitiveness.

Statement of Purpose

The primary purpose of this study was to collect information from Taiwan's construction companies to determine their attitudes toward adopting and implementing the ISO 9000 system. This research had four emphases:

1. Study of the current problems of quality management of construction industry in Taiwan.

2. Investigation of the level of knowledge, the recognition of importance, and the level of implementation of the ISO 9000 standards.

3. Study and conduct a survey to the perceived factors affecting the Taiwanese construction companies' willingness of adopting ISO 9000 and the success of implementing ISO 9000.

4. Draw a conclusion and make a recommendation on ways to familiarize Taiwan's construction industry with the procedures for adopting and implementing ISO 9000.

Statement of Need

In Taiwan, the construction industry has to make constant efforts to create an environment of competitive advantage through continuous improvement. The construction industry in Taiwan needs such an environment to meet both global competition and internal pressure (Lu, 1995). For this reason, the adoption and implementation of ISO 9000 has become a critical issue. Moreover, the perceived factors affecting the adoption and implementation of ISO 9000 for the construction industry in Taiwan will become more important when the industry faces greater global competition (Lu, 1995). In addition to the worldwide trend to adopt ISO 9000 and the trend to adopt ISO 9000 in Taiwanese manufacturing and service industries, the other needs for this study are presented in the next 4 sections.

Continuous Improvement and Competitive Advantage

C. E. Morris (1997) in his article entitled, "ISO 9000 Impact Slow but Sure," pointed out that the ISO 9000 quality certification system could provide all types of industries both internal and external benefits. The

internal benefits could be the continuous improvement of document works, quality, productivity, cost, and profits for a company. The external benefits might be the improvement of the company's image and the greater competitiveness (C. E. Morris, 1997). D. R. Hansen and Mowen (1997) pointed out that "continuous improvement and elimination of waste are the two fundamental principles that govern a state of manufacturing excellence. Manufacturing excellence is the key to survival in today's world-class competitive environment" (p. 6). Normally, lowering the cost and raising the quality of products have been the usual ways for most business to meet the competition (D. R. Hansen & Mowen, 1997), and this was also true for the construction industry. However, reducing the cost of managing quality while raising quality is a challenging task for any type of company (D. R. Hansen & Mowen, 1997).

In his research, Lee (1995) pointed out that ISO 9000 can help construction companies achieve both long-term and short-term benefits, which consist of the following: "reduced waste, better team spirit, less staff conflicts, increased efficiency, and reduced customer complaints" (p. 9).

ISO 9000 and Quality Management System

ISO 9000 can be a very helpful system for confirming quality management program, which can enhance or facilitate trade (Knight, 1997). Knight (1997) has stated that ISO 9000 can create some benefits for a company, both internal and external, and the major contribution of ISO 9000 is to increase the maturity of the pre-existing quality management program. According to the survey by Knight (1997), the level of the Quality Management Grid was considered as low to moderate when a company adopted ISO 9000 prior to implementing the criteria of total quality management (TQM) or the Malcolm Baldrige National Quality Award in a company's quality management system. Those companies that adopt ISO 9000 as a result of internal initiative or a self-assessment rather than at the request, demand, or expectation of their customers have better performance in quality management than other ISO 9000 certified companies (Knight, 1997).

The Future Effect of WTO

Taiwan intends to join the World Trade Organization (WTO) and has attempted to accomplish that for a long time. As part of the effort, the government agencies stressed that Taiwanese construction companies and construction-

consulting companies need to be ISO certified in the near future (Civic Service Protection & Training Commission, 1998).

Chou (1995) pointed out that Taiwan would soon become a member of the World Trade Organization (WTO). After joining the World Trade Organization (WTO), Taiwan will have to liberalize its construction market and remove all restrictions against foreign construction firms. Consequently, global competition will intensify, and the Taiwanese construction industry will face a severe challenge in the near future. Taiwan's construction companies will then have to improve their competitiveness to meet the global challenge (Chou, 1995).

The Effort and Attitude of the Taiwanese Government

Government Agencies and ISO 9000

The Taiwanese government has assigned specific duties to three government agencies under the Ministry of Economic Affairs of the Republic of China (Taiwan). The three agencies are listed as follows: (a) the China National Accreditation Board, (b) the Central Standard Bureau Affairs, and (c) the Bureau of Inspection.

The China National Accreditation Board handles and develops the quality certification system in Taiwan. The

Central Standard Bureau Affairs is responsible for the development of ISO 9000 and the development of a national standard system related to ISO 9000 and a quality management system. The Bureau of Inspection of the Economic Affairs is authorized to be in charge of the affairs of auditing and issuing the certification of ISO 9000 and ISO 14000 (The Ministry of Economic Affairs of Taiwan).

The Central Standard Bureau of the Ministry of Economic Affairs of the Taiwanese government (R.O.C.) started to advocate and promote the development of the quality certification system of ISO 9000 in 1991. The Taiwan government has since set the CNS 12680-12684 to be the national standard according to the series of standards in ISO 9000 (Hou, 1997). Moreover, the Taiwanese government has directly been involved in the development of ISO 9000 and ISO 14000.

Policies and Regulations of the Taiwanese Government

In 1995, the Taiwanese government announced that companies which had already received the approval status of "Cheng-Tzu Piao-Chi" of National Products Standard would have to adopt the ISO 9000 into their quality management system before June 30, 1998 (Bureau of Inspection of the

Ministry of Economic Affairs of the Republic of China (Taiwan), 1997).

On August 4, 1998, the Committee of Public Infrastructure of the Executive-Yuan of Taiwan (R.O.C.) announced the following qualifications for bidding public projects (ISO 9000 certified, 1998):

1. The construction company must be ISO 9000 certified in order to bid on public projects where unit prices exceed NT$ 1,000,000,000 after July 1999.

2. The construction company must be ISO 9000 certified to bid on a public project if the unit price is more than NT$ 200,000,000 after July 2000.

Consequently, the construction industry of Taiwan has to recognize that the key to its future survival is to learn how to compete in an increasingly competitive global environment through constant efforts to improve quality and lower cost (Chou, 1995). In the meantime, an effort to continuously improve to create an environment of competitive advantage is the only way for an enterprise to permanently survive in the future (D. R. Hansen & Mowen, 1997). Under these circumstances, the quality of management becomes more and more important for the construction industry of Taiwan than ever before since they

now have to face external competition and internal pressures.

Research Questions

The aim of this research is to study and provide the necessary information for the future adoption and implementation of ISO 9000 for the construction industry in Taiwan. This study first determined the level of knowledge, importance, and implementation regarding the ISO 9000 standards. Secondly, the study identified the factors perceived to affect Taiwan's construction industry's willingness to adopt ISO 9000 and the success of implementing ISO 9000. The research questions included the following:

1. What is the current level of knowledge, the level of importance, and the level of implementation of ISO 9000 standards in the construction industry of Taiwan?

2. What are the factors perceived to affect the successful adoption of ISO 9000 for the construction industry in Taiwan?

3. What are the relationships between the size of a company and the level of knowledge, the level of importance, and the level of implementation?

4. Is there any relationship between size of company and factors affecting the successful adoption of ISO 9000?

Assumptions

The following assumptions were made in pursuit of this study:

1. The questionnaire was appropriately designed to extract the information and data needed to answer and analyze all of the research questions.

2. For the purpose of supporting the success of implementing ISO 9000 and enhancing the effort to make continuous improvement and create competitive advantage, it is necessary for some construction companies of Taiwan to conduct a quality assurance or management program, including such items as a quality control circle (QCC), total quality management (TQM), integrated quality management (IQM), strategy quality management (SQM), or the Malcolm Baldridge National Quality Award.

3. Some companies or industries in Taiwan have already adopted the ISO 9000 into their quality management systems.

4. The generalized information obtained from the survey of sampled Taiwanese construction companies might represent all the companies in the population.

5. The respondents will honestly answer the questionnaire.

6. The instrument and statistical procedures will be adequate to measure the significance of perceived factors or variables.

7. Senior managers in Taiwanese construction companies have the appropriate expertise to correctly judge the knowledge level and perception of employees and junior managers in Taiwanese construction companies.

8. The respondents answering the questionnaire were persons with primary responsibility for making decisions about developing and implementing ISO 9000 in the sampled construction companies in Taiwan.

Delimitation

This study was delimited to the following:

1 This study was delimited to the adoption and implementation of ISO 9000 in the Taiwan territory.

2. The perceived factors affecting the adoption and implementation of ISO 9000 were based upon the relevant research studies conducted by Cokins (1996), Desai (1993), Goetsch and Davis (1997), Lee (1995), Lin (1996), McTeer and Dale (1995), C. E. Morris (1997), Piplani (1993),

Reimann and Hertz (1994), Stephens (1994), Tan and Lu (1995), Yates and Aniftos (1995).

Limitation

The following limitation was applied to guide this study in the completing the investigation. The questionnaire depended on self-reported data as well as subjective opinions and perceptions.

Methods of Procedure

Methodology

One part of this research was to identify the perceived factors that facilitate or impede the adoption and implementation of ISO 9000 in the construction industry of Taiwan. A second part of this study was to survey and analyze the perceived factors which will affect the willingness, decision making, and success of adopting and implementing ISO 9000 in the construction industry of Taiwan. At the same time, the advantages and disadvantages of adopting and implementing ISO 9000 were scrutinized.

The methodology for this study included (a) population, (b) sample, (c) instrument, (d) data collection, and (e) data analysis.

Population

The population in this study consisted of all the construction companies in Taiwan that was involved in public construction projects or large private sector projects.

Sample

The sample for this study consisted of 180 Taiwanese construction companies. All categories of construction companies in Taiwan were included in this study, such as heavy and highway construction, industry and commercial construction, residential construction, civic engineering, electric engineering, and plumbing and line contractors.

For the purpose of selecting samples, the population was classified into three groups--Type-A, Type-B, and Type-C--based on their business classifications as licensed by the government. These different levels of construction companies are based on their operational capital or previous performance of operation (Wang, 1996). According to current regulations for founding a construction company in Taiwan, the operational capital for establishing a Type-A Company must exceed NT$ 100,000,000 (US$ 3,215,000), for Type-B Company NT$ 15,000,000 (US$ 468,800), and for Type-C Company NT$ 3,000,000 (US$ 93,750).

In the meantime, the National Association of Construction Companies of the Republic of China (Taiwan) has similarly classified their members for three levels, Type-A, Type-B, and Type-C, according to the members' business classification licensed by the government (the National Construction Association of the Republic of China, 1998). A total of 6,559 construction companies appeared in the 1998 Membership Directory of the National Construction Association of the Republic of China (Taiwan).

In total, 180 companies were randomly selected to be surveyed for this study, which included 60 companies each from the three types of companies comprising the population (Cheng & Wei, 1995; Guy, Edgley, Arafat, & Allen, 1987). In the process of sampling, the population for each classified group (Type-A, Type-B, and Type-C) was based on the classification of the 1998 Membership Directory of the National Construction Association of the Republic of China (Taiwan). The sampling task was accomplished by first using the cluster sampling method according to the geographic location and classification of companies followed by the simple random sampling technique to choose the samples by computer (Ghauri, Gronhaug, & Kristianslund, 1995; Guy et al., 1987).

Instrument

To collect the necessary information and data, a questionnaire was sent by mail to the sampled companies. Sax and Newton (1997) indicated that mailing a questionnaire is a convenient and inexpensive method for collecting direct information from a particular sector or population to acquire data and to provide the accurate results from the respondents.

The questionnaire was gleaned and formulated from other research instruments and used to obtain data for the following questions:

1. What is the significance of perceived factors causing the current quality problems of construction management in the construction industry of Taiwan?

2. To what extent is ISO 9000 implemented by the Taiwanese construction companies?

3. What is the level of knowledge about ISO 9000 in Taiwan's construction industry?

4. What is the level of the importance the Taiwanese construction companies attach to the implementation of ISO 9000?

5. What are the advantages and disadvantages of implementing ISO 9000 as disclosed by the construction industry of Taiwan?

6. What is the significance of perceived factors that influenced the willingness or the decision to adopt ISO 9000?

7. What is the significance of the perceived factors affecting the successful implementation of ISO 9000?

Content-related validity test. Fraenkel and Wallen (1996) pointed out that a content-related validity test could support research evidence about the validity of the targeted data. As a general rule, consulting professional persons and conducting a pilot test is an excellent way to establish the validity of an instrument.

The first draft of the questionnaire was made available to members of the dissertation committee for their review and to make any necessary corrections and/or revisions before conducting the pilot test.

After the second draft of the questionnaire was completed, a panel of experts or professional persons in the field of quality assurance, or in the ISO 9000 quality certification systems participated in the pilot test to identify any ambiguity and format problems (Gay, 1996).

After conducting the pilot test, the instrument was revised again.

Because the respondents to the questionnaire were probably familiar with Chinese characters only, an appropriate Chinese version of the questionnaire was made available with an English version to avoid any misunderstandings emanating from the language translation.

Data Collection

The final version of the questionnaire included a cover letter and a self-addressed and stamped envelope sent to the targeted Taiwanese construction companies by mail in early July 1998. The cover letter requested that the questionnaire must be completed by the person responsible for the operational management or quality management in the construction company. Furthermore, the position of the respondents should be that of manager or supervisor of operations or quality management or a position with that responsibility at a higher level of management. In addition, the letter also assured respondents that their answers would remain confidential.

According to the research of Cheng and Wei (1995), phone calls and follow-up letters are common methods to urge and obtain a further response from respondents. To

achieve at least the minimum expected response rate of 30%, the first and second follow-up letters were made one and two or three months after the first letter. Many follow-up phone calls were also made during the data collection period. Phone calls were made to all companies that did not return the questionnaire.

Data Analysis

The data from the questionnaire was analyzed as follows:

1. The questions designed for categorizing or grouping were only calculated by the percentage of the portion within each category or group.

2. A frequency distribution of the demographic data was reported.

3. The responses regarding the level of understanding, recognition, and implementation of the ISO 9000 standards were summarized with a mean score.

4. The responses relating to the perceived factors affecting the adoption and implementation of ISO 9000 were summarized with a mean score.

5. The responses relating to the advantages and disadvantages of the implementation of ISO 9000 were

analyzed via a mean score in order to figure out the level of recognition.

6. An ANOVA test was used to determine the statistical significance between the mean scores of the three independent targeted groups--Type-A, Type-B, and Type-C companies (Hittleman & Simon, 1997; Hurlburt, 1998).

7. The ratio of Fisher's Least Significance Difference (LSD) test, the post hoc test of ANOVA, was the index to directly identify the homogeneity, normality, or consistency of the mean values of samples (Clarke & Clarke, 1972; Kervin, 1992).

Research Procedures

The research procedures used to structure this study were as follows:

1. The review of related literature included the following:

a. A description of the current development, application, documentation, and implementation of ISO 9000,

b. The trends concerning the implementation of ISO 9000 from the international viewpoint,

c. A review of the relative research regarding the application, development, and implementation

experiences with ISO 9000 in the construction industry of Hong Kong and the United States,

d. The information regarding the efforts of the Taiwanese government in regard to enhance the competitiveness for the construction industry of Taiwan,

e. The impact to the construction industry in Taiwan after Taiwan has gained membership in the World Trade Organization (WTO),

f. An introduction to the current situation and the development of quality management programs in the Taiwanese construction companies,

g. A review of the current problems of quality management and the perceived factors which caused problems for the construction industry in Taiwan,

2. A questionnaire was used to document the attitudes regarding the adoption and implementation of ISO 9000 in the Taiwanese construction industry and to support the needs of this study. There were as follows:

a. The level of implementation of ISO 9000 in the Taiwanese construction companies,

b. The level of knowledge about ISO 9000 in the Taiwan's construction industry,

c. The level of importance to a company in implementing ISO 9000 in the Taiwanese construction industry,

d. The importance of perceived factors affecting decision making to adopt ISO 9000 and the success of implementing the ISO 9000 standards in Taiwan's construction industry (Cokins, 1996; Desai, 1993; Goetesch & Davis, Lee, 1995; Lin, 1996; McTeer & Dale, 1995; C. E. Morris, 1997; Piplani, 1993; Reimann & Hertz 1994; Stephens, 1994; Tan & Lu, 1995; 1997; Yates & Aniftos, 1995) were gleaned from these sources:

(1) Government attitude,

(2) The cost of implementation,

(3) Changing environment--including global and internal competition,

(4) Relationship between an auxiliary quality assurance program and a quality management system,

(5) Customers' demands or expectations,

(6) Partnerships with subcontractors or vendors,

(7) Additional documentation,

(8) Employee training and education,

(9) Additional human resources,

(10) Employees' attitudes toward the implementing ISO 9000,

(11) Management involvement or leadership,

(12) System maintenance or continuous assessment of ISO 9000,

(13) Adjustment and interruption of the construction processes,

(14) Company structure or organizational change.

e. The willingness of Taiwanese construction companies to adopt ISO 9000 in the future,

f. The advantage and disadvantage of implementing ISO 9000,

g. The future desire to continuously implement ISO 9000 in Taiwan's construction industry.

3. A summary, conclusion, and recommendation were developed after collecting, analyzing, and summarizing data collected to provide the necessary information for the construction industry of Taiwan in the process of adopting and implementing ISO 9000.

Definition of Terms

The following terms are defined to clarify their usage throughout this research:

1. Competitive Advantage--"Creating better customer value for the same or lower cost than that of competitors, or creating equivalent value for lower cost than that of competitors" (D. R. Hansen & Mowen, 1997, p. 354).

2. Continuous Improvement--"Gradual unending improvement doing 'little things' better; setting and achieving ever-higher standards," and "continuous improvement applied to cost reduction in the manufacturing stage of a product's life" (Kaplan & Cooper, 1998, p. 58).

3. ISO--"ISO stands for the International Organization for Standardization founded in 1946. This group promotes the development of international standards to facilitate worldwide trade" (Gautschi, 1994, p. 210).

4. ISO 9000--A certification system used to form a confirmation system for a company's quality management or assurance system within the manufacturing and service industries (Patterson, 1995; Reimann & Hertz, 1994). "ISO 9000 defines key quality terms and provides guidelines for selecting and using the other ISO 9000 standards in the series" (Piplani, 1993, p. 40). "ISO 9000 standards series

consists of five separate quality standards--ISO 9000 through ISO 9004" (Piplani, 1993, p. 40). Figure 1 is the basic structure of ISO 9000.

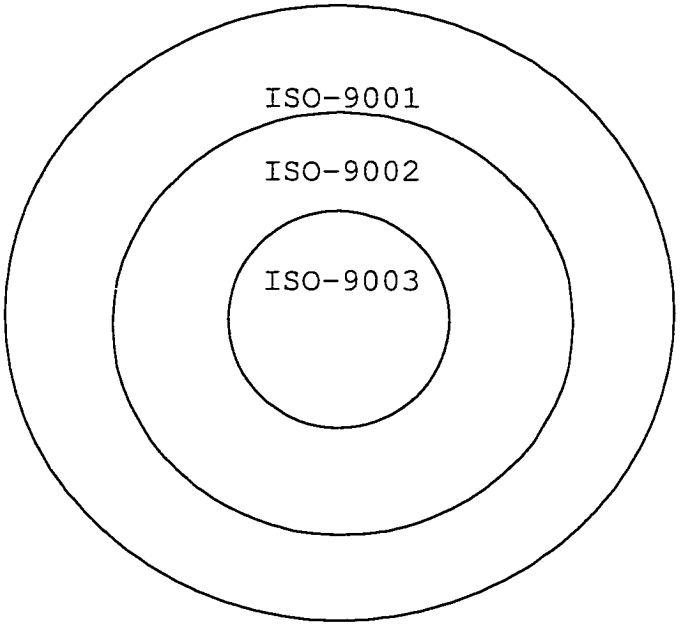

Figure 1. The Relationship of ISO-9001, ISO-9002, and ISO-9003.
Note. From The practical application of ISO-9002 in construction industry (p. 9), by K. I. Farng, 1997, Taipei, Taiwan: Chang's Books.

5. ISO-9001--It is the most comprehensive quality management system of ISO 9000. "ISO 9001 outlines a model for quality assurance during the design, development, production, installation, and service of a product. This

standard is used by the supplier to demonstrate to his customers that he is capable of manufacturing and/or providing service and delivery as specified in the purchase order" (Piplani, 1993, p. 40).

6. ISO-9002--This quality management system contains 18 quality requirements (Patterson, 1995). "ISO 9002 focuses on quality assurance for companies involved in production and installation" (Piplani, 1993, p. 40).

7. ISO-9003--A quality management system containing 12 elements of requirements, and the number of elements of ISO 9003 is the least in ISO 9000 system family (Patterson, 1995). "ISO 9003 is a model for quality assurance in the final product inspection and testing" (Piplani, 1993, p. 40).

8. ISO-9004--"ISO 9004 offers guidelines for a company to use to develop an internal quality system to help meet its business needs" (Piplani, 1993, p. 40).

9. JIT (Just in Time) Manufacturing--"JIT manufacturing is a demand-pull system. The objective of JIT Manufacturing is to eliminate waste by producing a product only when it is needed and only in the quantities demanded by customers" (R. D. Hansen & Wowen, 1997, p. 373).

10. Life Cycle of Construction—This can be divided into primary planning, detailed planning, detailed designing, budgeting, biding, building, and finishing (Chang, 1996).

11. TQC (Total Quality Control)--"Total Quality Control is an approach to managing quality that demands the production of defect-free products" (D. R. Hansen & Mowen, 1997, p. 363).

12. Quality--"Quality is a dynamic state associated with products, services, people, processes, and environments that meets or exceeds expectations" (Goetsch & Davis, 1997, p. 3).

13. Quality Policy--"The overall intentions and direction of an organization regarding quality, as formally expressed by top management . . . [and] . . . quality policy provides the map and the rules of the road for the journey . . ." (Kallnosky, 1990, p. 50).

14. Quality Management--"Quality management is the aspect of the overall management function that determines and implements quality policy" (Kallnosky, 1990 June, p.50). "Quality management includes strategic planning, resource allocation, and other systematic activities such as quality planning, operations, and evaluations" (M. D. Hansen, 1994, p. 45).

15. Quality System--This definition was consolidated from the definitions considered as relevant to the study. The definitions used were: (a) "Quality system is the organizational structure, responsibilities, procedures, processes, and resources for implementing quality management" (Kallnosky, 1990, p. 50). (b) "A quality system is a formalized approach to ensuring that all requirements (the customer's and the company's) are systematically addressed and incorporated into the product or service that a company provides" (Heisey, 1993, p. 69). (c) "A quality system is essential to a successful continuous improvement of the culture in a company" (Heisey, 1993, p. 69). In addition, "If quality management is the driver, and the quality system is the vehicle" (Kallnosky, 1990, p. 50).

16. Quality Control--"Quality control is the operational techniques and activities used to fulfill quality requirements. This includes monitoring processes to eliminate causes of unsatisfactory performance and, thus, continually improve those processes" (M. D. Hansen, 1994, p. 45).

17. Quality Assurance--"Quality assurance involves planned systematic actions needed to ensure that a product

or service will satisfy the given quality requirements. Related aspects include an ongoing evaluation of the design or specification, and audits of production, installation, and inspection operations. These activities provide confidence to management" (M. D. Hansen, 1994, p. 45).

18. TQM (Total Quality Management)--"Total Quality Management is the management discipline developed by Dr. Deming and Dr. Juran introduced to the Japanese automotive industry in the early 1950s" (Relyea, 1995, p. 73). "The ultimate goal of TQM is improved customer and employee satisfaction. Improved customer satisfaction comes about from higher quality of product and services" (Relyea, 1995, p. 73). Furthermore, Goetsch and Davis (1997) have identified the following definition of total quality management:

> TQM consists of continuous improvement activities involving everyone in the organization-managers and workers-in a total integrated effort toward improving performance at every level. This improved performance is directed toward satisfying such cross-functional goals as quality, cost, schedule, mission need, and suitability. TQM integrates fundamental management techniques, existing improvement efforts, and technical tools under a disciplined approach focused on continued process improvement. The activities are ultimately focused on increased customer/user satisfaction. (p. 4)

19. Malcolm Baldrige National Quality Award--"The most prestigious award for quality in the United States, which was established by the U. S. Congress in 1987" (Goetsch & Davis, 1997, p. 437), and "the Baldrige Award was named after the former U.S. Secretary of Commerce who died in 1987" (Hillary, 1996, p. 34). This award is presented to the performance leader in the field of quality management according to the following seven criteria: (a) leadership, (b) information and analysis, (c) strategic quality planning, (d) human resource development and management, (e) management of process quality, (f) quality and operation results, and (g) customer focus and satisfaction (Goetsch & Davis, 1997).

20. Total Quality Commitment--Two definitions were used because their different approaches arrived at similar points of reference: (a) "Total quality commitment is a commitment to excellence-its goal is increased customer satisfaction" (Desai, 1993, p. 65). (b) It can help ". . . a company to develop the company's team-building approach achieving customer focus through organizational commitment, cultural reformation, and employee involvement" (Wacker, 1993, p. 98).

21. Cost of Quality--"The cost of quality for an organization can be defined as any costs incurred due to either bad quality or efforts to ensure good quality. More specially, COQ is the sum of four generally agreed upon categories: prevention (P), appraisal (A), internal failure (IF), and external failure (EE)" (Gupta & Campbell, 1995, p. 43).

22. Value-Chain Analysis--"Value-Chain Analysis is identifying those internal and external linkage that result in a firm achieving either a cost leadership or a differentiation strategy" (D. R. Hansen & Mowen, 1997, p. 359).

23. Quality Management Grid—Grid is "a network of uniformly spaced horizontal and perpendicular lines" (Gove, 1993, p. 998), and it is "a grating made of crossed bars" (C. Morris, 1992, p. 959). Grid can be "one used for locating points . . . [and] . . . by means of a system of coordinates" (Gove, 1993, p. 998). Heaphy and Gruska (1993) indicated that Quality Management Grid is a tool to measure the performance of a quality management system that consists of crossed-function criteria and items. For example, the criteria of Malcolm Baldrige National Quality Award (MBNQA) system contains seven categories, and the

seven categories are detailed by 28 items and 92 areas. Those functional concepts are summarized in a quality management grid in order to evaluate the outcomes of the competing companies' quality management system (Heaphy & Gruska, 1993).

Description and Outline of Subsequent Chapters

In Chapter Two, the research literature related to this study provided the information about the development of ISO 9000 and the current condition of implementation around the world was investigated. Quality problems of construction projects and the development of quality management in Taiwan were included. Also, the effort of the Taiwanese government to urge the adoption of ISO 9000 is investigated. In order to provide the information necessary for development of the survey instrument, the perceived factors affecting the willingness of adopting ISO 9000 and the success of implementing ISO 9000 were identified in the literature review.

Chapter Three presented a detailed description of research procedures, including identification of the population, preparation of the instrument, validation of the instrument, collection of the data, and analysis of the data.

In Chapter Four, the reports and the findings of the collected and analyzed data are presented and described. It provides the necessary information for summarizing the findings and guided the disclosure of conclusions and recommendations.

Chapter Five includes the summary, conclusions and recommendations. These are based on the literature review and the findings of this study.

CHAPTER II

LITERATURE REVIEW

Introduction

Several research endeavors and limited writings were available regarding the perceived factors that will affect the adoption and implementation of the ISO 9000. These will be presented in this study to structure a general concept about the willingness, impact, and effectiveness of implementing ISO 9000. Headings for this chapter were based the following areas: (a) ISO and ISO 9000 Standard, (b) the implementation procedures for ISO 9000, (c) benefits of ISO 9000, (d) the total quality commitment, (e) the current problems of quality management, (f) the construction industry in Taiwan, (g) the efforts of the Taiwanese government, (h) the character of the construction industry, (i) the worldwide trend of ISO 9000, (j) the issue of cost of quality, (k) the perceived factors, and (l) the perception due to the size of a company.

ISO and ISO 9000 Standard

ISO

ISO is the International Organization for Standardization which is a worldwide federation of standards founded in 1946 in London, United Kingdom, by 25

countries (Patterson, 1995). The headquarter of ISO is located at Geneva, Switzerland, and presently, there are over 90 members around the globe (Patterson, 1995). The major mission of ISO is to develop the standards of all industries, except the electrical and electronic engineering industry, and to promote the standards for manufacturing, trade, and communication (Hou, 1997; Patterson, 1995).

ISO 9000

"ISO 9000 is a series of five international quality standards developed by the International Organization for Standardization-ISO" (Flister & Jozaitis, 1992, p. 33). ISO 9000 is an international standard of goods and services, consisting of a set of standards (ISO 9001-9003), relative guidelines, and documentation of the implementation (Goetsch & Davis, 1997; Stephens, 1994). Consult Figure 2. ISO 9000 is a quality certification system and also a subset system of the total quality management or assurance system for production in the manufacturing and service industries (Goetsch & Davis 1997; Patterson, 1995). So, we can say, "ISO is not a product quality standard but, rather, a quality management system standard" (Spreha & Helms, 1995, p. 46).

ISO 9000 was derived from British standards, BC 5750, by the 18 members of the European Community (EC) in March 1987, and it was further revised in October 1994 (Hou, 1997; Patterson, 1995). Originally, the members of European Community compromised to use this ISO 9000 quality certification system to remove trade barriers (Patterson, 1995; Russo, 1995).

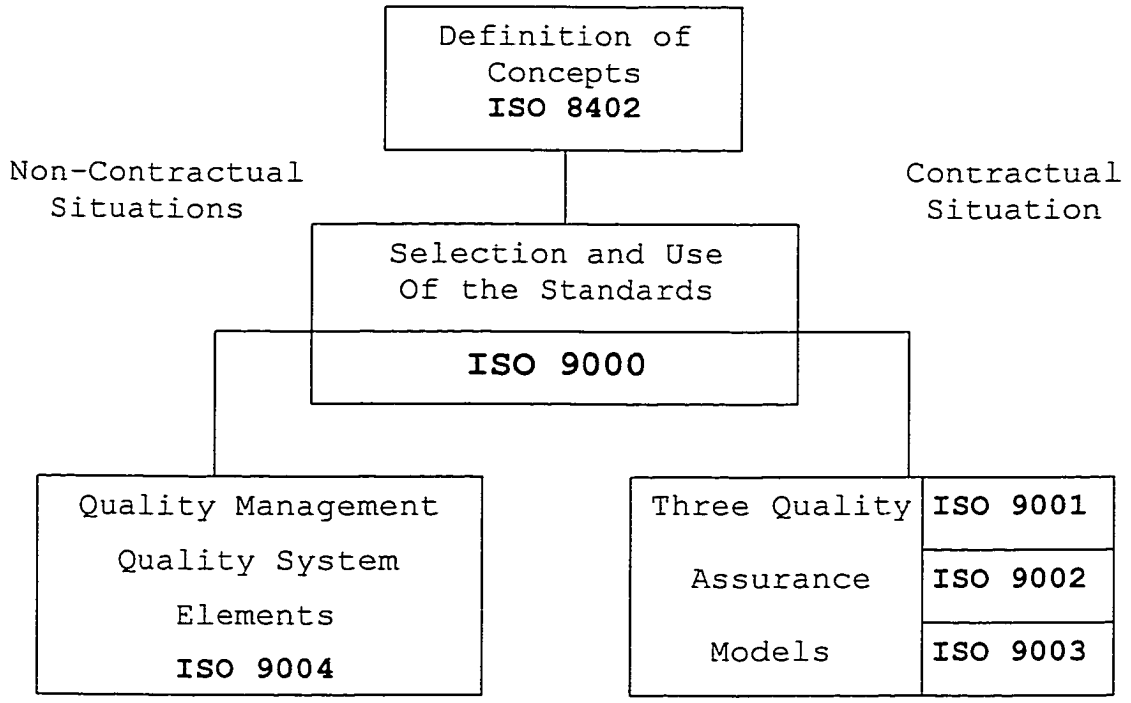

Figure 2. Structure of the ISO 9000 Quality Certification System.
Note. From "ISO 9000 and Total Quality" by K. S. Stephens, 1994, Quality Management Journal (QMJ), p. 60.

The major theme behind implementing ISO 9000 is "If you are ISO 9000 series certified, the certification tells customers you do what you say do and you can document it. Nothing more; nothing less" (Patterson, 1995, p. 4). The primary purpose of ISO 9000 is to form a confirmation system of a quality management system or quality assurance program within a company to enhance and facilitate trade to meet the global competition (Reimann & Hertz, 1994).

The Difference Between ISO and ISO 9000

The differences and major myths between ISO and ISO 9000 are listed as follows:

1. ISO--the International Standard Organization is only an organization to develop quality and production standards and to advocate the implementation of ISO 9000 (Mary, 1992). ISO is a federation "to ease international trade through the development of world standards for systems, products, and services" (Patterson, 1995, p. viii).

The task of certifying companies is not directly done by ISO, but by the authorized registers in any country that has adopted ISO 9000 as part of its international standards (Patterson, 1995). ISO does not directly become involved in the general affairs of auditing quality assurance

systems and issuing the certificates of ISO 9000 or ISO 14000 (Patterson, 1995). "Any application of ISO 9000 standards requires third-party system registration" (Mary, 1992, p. 25).

2. ISO 9000 is a quality certification system of quality standards, and it consists of a series of generic system standards from 9001 to 9003 and the relative requirements and documents (Goetsch & Davis, 1997; Mary 1992). "ISO 9000 is a quality system standard, not a technical product standard" (Patterson, 1995, p. viii), and, "ISO 9000 series certification is for the quality process, not the product" (Patterson, 1995, p. 68). The actual meaning of ISO 9000 can be "equal" and "continuous improvement" (Patterson, 1995).

ISO 9000 only approves the certified companies for they have the ability to conduct quality management or quality assurance programs after implementing the ISO 9000. ISO 9000 does not directly assure the quality of final products or services of the certified companies (Hou, 1997; Patterson, 1995).

The Structure of ISO 9000

The ISO 9000 standards system is organized by the following subsystems of ISO-9001, ISO-9002, ISO-9003, and

ISO-9004, and several guidelines and documentation are included in the ISO 9000 system to guide the task of implementation (Hou, 1997; Russo, 199). Figure 3 is the comparison of the common elements found in the ISO 9001, ISO 9002, and ISO 9003.

	YES = Applies in this series NO = Does not apply in the series	ISO 9000 Categories		
		9001	9002	9003
1	Management responsibility	YES	YES	YES
2	Quality system	YES	YES	YES
3	Contract review	YES	YES	NO
4	Design control	YES	NO	NO
5	Document control	YES	YES	YES
6	Purchasing	YES	YES	No
7	Purchaser-supplied product	YES	YES	No
8	Product identification and traceability	YES	YES	NO
9	Process control	YES	YES	NO
10	Inspection and testing	YES	YES	YES
11	Inspection, measuring and test equipment	YES	YES	YES
12	Inspection and test status	YES	YES	YES
13	Control of nonconforming product	YES	YES	YES
14	Corrective action	YES	YES	NO
15	Handling, storage, packaging, and delivery	YES	YES	YES
16	Quality records	YES	YES	YES
17	Internal quality audits	YES	YES	NO
18	Training	YES	YES	YES
19	Servicing	YES	NO	NO
20	Statistical techniques	YES	YES	YES

Figure 3. The 20 ISO Elements of ISO 9000 as Found in ISO 9001, 9002, and 9003
Note. From ISO 9000: Worldwide Quality Standard (p. 22) by J. C. Patterson, 1995, Menlo Park, CA: Crisp Publication Inc.

ISO 9001

This is a category for quality assurance in design, development, production, installation, and serving. "ISO 9001 ensures conformance to requirements during design and development, production, installation, and servicing" (Flister & Jozaitis, 1992, p. 33). It is the most comprehensive quality system of ISO 9000. The ISO 9001 system consists of all 20 items of quality requirements to guide the company engaged in the field of design, develop, produce, install, and service in order to conduct its quality management and to meet with the customers' expectation or requirements (Patterson, 1995; Russo, 1995).

ISO 9002

ISO 9002 is a model for quality assurance in production, installation, and servicing. "ISO 9002 specifies a model for quality assurance when only production and installation conformance are required" (Flister & Jozaitis, 1992, p. 34). ISO 9002 consists of 18 quality requirements of the ISO 9000 system. It provides guidelines for companies to manage quality and to satisfy customers' needs, involved in the field of production, installation and services (Patterson, 1995; Russo, 1995).

Compared to the ISO 9001 system, this system does not apply the parts of (4) design control, and (19) serving in the 20 elements of ISO 9000 quality requirements (Patterson, 1995). ISO 9002 is the most popular quality system in the ISO 9000 family. This system can be adopted by the construction industry because most construction companies do not conduct the work of design and development (Patterson, 1995; Russo, 1995).

ISO 9003

This category is a model for quality assurance in final inspection and testing. "ISO 9003 requires only conformance in final inspection and testing" (Flister & Jozaitis, 1992, p. 34). It is a quality system for companies that only conduct the final inspection and testing procedures to control quality work.

ISO 9003 is the category of least detail in the ISO 9000 family of standards (Patterson, 1995; Russo, 1995). ISO 9003 has only the 12 elements of 20 items in 9001 quality-requirement in its system. It does not contain the following elements: (3) contract review, (4) design control, (6) purchasing, (7) purchase-supplied product, (9) process control, (14) corrective action, (17) internal quality audits, and (19) servicing of the ISO 9000's 20

elements of quality requirement (Patterson, 1995; Russo, 1995).

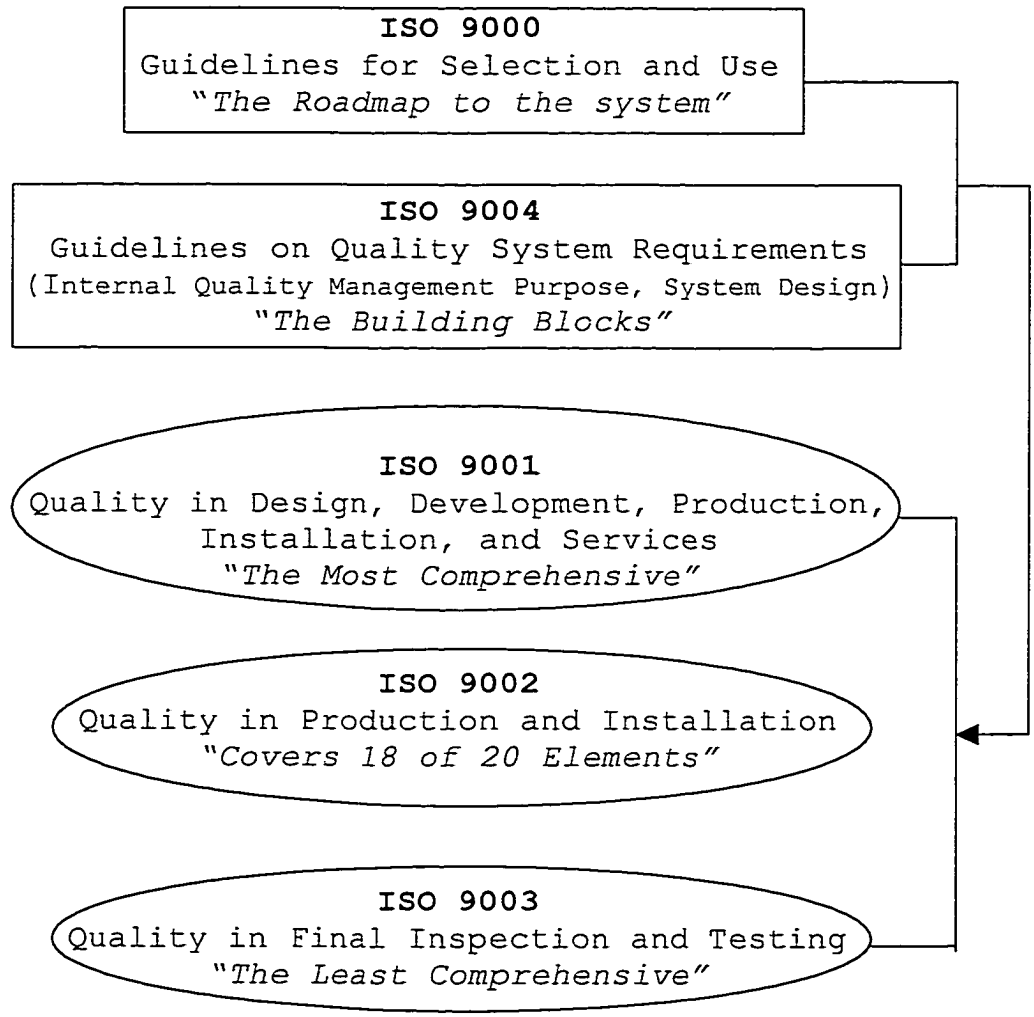

Figure 4. The ISO 9000 Series from Top to Bottom
Note. From ISO 9000: Worldwide Quality Standard (p. 20) by J. C. Patterson, 1995, Menlo Park, CA: Crisp Publication Inc.

ISO 9004

This system includes the quality management and quality system elements of ISO 9000. "ISO 9004 contains guidance on technical, administrative, and human factors affecting the quality of production and services" (Flister & Jozaitis, 1992, p. 34). It consists of guidelines and requirements of quality management and quality assurance to help an industry conduct an internal evaluation (Patterson, 1995; Russo, 1995).

Otherwise, the following quality standards and guidance documents are the necessary information that a company has to understand before adopting the ISO 9000.

ISO 8402

This section contains all the related quality vocabulary definitions (Patterson, 1995; Russo, 1995).

ISO 9000-2

This section provides the generic guidelines (part 2) for conducting quality management and quality assurance standards for a company in the application process of implementing of ISO 9001, ISO 9002, and ISO 9003 (Patterson, 1995; Russo, 1995).

ISO 9004-2

This section is part 2 of a guideline for services to provide the necessary information regarding the quality management and quality system elements (Patterson, 1995; Russo, 1995).

ISO 10011-1

ISO 10011-1 is the part 1 of auditing quality systems, and it contains a set of guidelines for auditing quality (Patterson, 1995; Russo, 1995).

ISO 10011-2

In this section, the information related to the qualification criteria for auditors is described. It is the part 2 of auditing quality systems (Patterson, 1995).

ISO 10011-3

This section is a set of guidelines of providing the information about managing audit programs in the part 3 of auditing quality systems (Patterson, 1995; Russo, 1995).

ISO 10012-1

The information listed in this section regards the quality assurance requirements for measuring equipment, and for the management of measuring equipment (Patterson, 1995; Russo, 1995).

Implementation Procedures for ISO 9000

Fourteen Processes to Meet ISO 9000

Patterson (1995) has determined that the following 14 processes will be a very helpful road map for meeting and accomplishing the task of conducting the certification of the ISO 9000 within a company. These were noted as: (a) establish and train an ISO 9000 steering council, (b) evaluate and select a registrar, (c) determine who is responsible for quality, (d) determine how to structure your procedures, (e) let individual departments develop their own quality manuals, (f) define document standards, (g) write the quality manual, (h) maintain your records and documentation, (i) educate everybody about ISO 9000, (j) develop ISO quality teams for each operational area, (k) have a system to upgrade your procedures, (l) develop corrective action for nonconformance, (m) create and train internal auditors, and (n) conduct a final assessment.

Five Procedures of Implementation

Murakami (1994) has stressed the following five procedures as necessary for implementing ISO 9000 within a company: (a) ISO assessment, (b) quality assurance and quality policy manual preparation, (c) training of

employees in ISO 9000, (d) documentation of work instructions, and (e) registration audit. See Figure 5.

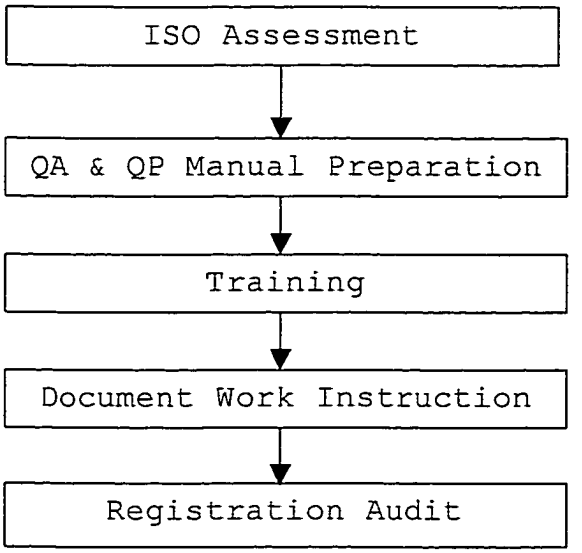

Figure 5. ISO 9000 Implementation Flow Chart
Note. From "How to Implement ISO 9000" by R. Murakami, 1994, CMA Magazine, p. 40.

Nine Steps to Be ISO 9000 Certified

Piplani (1993) has pointed out the following steps to guide a company in completing the certification task:

(a) Management commitment--vision, mission, and goal; (b) Establish--ISO steering group, goals communication, define audit teams; (c) Commence--Facility/operations assessment, flow chart "as is" operation, identify areas of improvement, employee participation and training; (d)

Quality systems manual--Prepare, approve, circulate; (e) Implementation--Implementation of quality procedures, quality records documentation; (f) Certification--Revise quality manual, submit quality manual to registrar, conduct compliance audit, implement corrective actions; (g) ISO Registrar—conduct Pre-assessment, identify and correct deficiencies; (h) Final Assessment; (i) ISO Certification.

Practical Experience of Implementing ISO 9000

Taiwan--Pacific Construction Inc

Pacific Construction Incorporation (PCI) is the first construction company in Taiwan that has adopted the ISO 9000 quality system. PCI was certified by the category of ISO 9002 on January 17, 1995 (Hou, 1997). According to Hou's (1997) study, the Pacific Construction Inc has adopted the following criteria from the ISO 9000 standards into company procedures based on the regulations of the Bureau of Inspection of the Ministry of Economic Affairs of the Republic of China (Taiwan):

1. Stage of preparation: (a) structuring an implementing plan, (b) setting up a developing committee, (c) examining the existing quality management program, and (d) conducting the total employee training;

2. Stage of development: (a) forming the documentation frame and (b) structuring and designing the necessary documentation;

3. Stage of application: (a) conducting the internal auditing procedure, (b) evaluating the feedback of adopting ISO 9000 system, and (c) instituting an award and punishment system.

Benefits of ISO 9000

"ISO 9000 is a vital component of the continuous improvement process" (Webster, 1997, p. 7). A successful implementation of ISO 9000 can create several advantages for a company, such as: improve quality, increase productivity, and improve organizational competitiveness (Elmuti & Kathawala, 1997). Webster (1997) has pointed out that the confirmation of the ISO 9000 quality certification system can benefit companies by collecting new customers and increasing more orders from its existing customers to an ISO 9000 certified company. Also, "the corrective action and internal audit system provide feedback in process problems and the root causes of the problems are being identified and resolved" (Webster, 1997, p. 7). McTeer and Dale (1995) have indicated that there are some benefits for small business in adopting ISO 9000. The

benefits are an "improved level of control within the business; increase in sales turnover; greater clerical accuracy; better understanding and documented controls; and the usual benefits of reduced scrap rates and customer complaints" (McTeer & Dale, 1995, p. 44).

Implementing ISO 9000	Registering ISO 9000
Consistency throughout the company	Strengthened customer confidence
Strengthened relationships between suppliers and customers	Access to markets
Strengthened customer confidence	Reduced cost of customers' supplier programs
Improved management decision-making	Reduced operating costs
Continuous improvement	Competitive advantage
Institutionalized training	Fewer supplier quality assurances audits
Reduced dependence on individuals	
Added value	

Figure 6. Benefits of ISO 9000
Note. From "Foxbor's ISO 9000 experience," by Alice M. Davin and A. S. McCampbell, 1996, Third Quarter, Production and Inventory Management Journal, p.3.

Davin and McCampbell (1996) have pointed out that Foxboro Company had many significant improvements in their quality management system after they adopted and implemented ISO 9000. Consult Figure 6.

The ISO registration can help the company "to eliminate waste and repetition, as well as to reduce time cycles, both of which result in cost savings" (Miller, 1993, p. 6). In the meantime, ISO registration can be a good "step toward a more thorough total management program" (Miller, 1993, p. 6).

The correct implementation of ISO 9000 can help a company achieve its targeted goals of quality and quality assurance (Bougher, 1993). That will benefit a company in the following field of management criteria: "(1) defines processes exactly; (2) outlines employee responsibility at every level; (3) eliminates duplication of activities; (4) provides communication for continuous process improvement through employee interaction; (5) establishes a formal training system for employees; and (6) provides improved customer-supplier relationships toward meeting requirements of product quality and service" (Bougher, 1993, p. 96).

Total Quality Commitment

ISO 9000 and Total Quality

ISO 9000 is not the same as total quality, and it is only "a subset system of total quality" (Goetsch & Davis, 1997, p. 643). The structure and criteria of ISO 9000 standards is not as broad as that of the Malcolm Baldrige National Quality Award, and it is not coherent with all the philosophies of total quality. Because several major themes, such as the procedure, checks, and management involvement of total quality, are already addressed in the ISO 9000 standard, the ISO 9000 can be only a auxiliary quality system of total quality (Goetsch & Davis, 1997).

ISO 9000 is a good start for a company that intends to conduct the total quality management system (Goetsch & Davis, 1997). Also, it can be an excellent system or technique to improve the quality management grid of a pre-exiting quality management system (Knight, 1997). Merrill (1995) stated that ISO 9000 could be a good foundation for a company that is just starting to conduct a quality assurance program. ISO 9000 can also be a good system to force a company to conduct its quality management program in an excellent condition (Merrill, 1995). Ahire, Landeros and Gohar (1995) have pointed out that the task of ISO 9000

standards is "to take the form of a conformance instrument for existing quality systems" (p. 281).

Knight (1997) has indicated that the ISO 9000 can be adopted prior to conducting the auxiliary quality management or quality assurance program in order to achieve the better performance of quality management within a company. In the meantime, according to the research of Knight (1997), ISO 9000 can provide many benefit for a company, both internal and external. The major contribution is raising the maturity of a pre-existing quality management program.

Structuring the Total Quality Commitment

To structure a total quality commitment to achieve an excellent outcome of implementing the ISO 9000 is a good strategy for a company in the way of adopting ISO 9000 (Desai, 1993). In his research, Desai (1993) has pointed out that the total quality commitment plan can consist of the following pillars: (a) customers' requirements, (b) employee involvement, (c) continuous improvement, (d) statistical process control/critical parameters, and (e) supplier quality management. On the other hand, the foundation of a total quality commitment plan is based on (a) the performance of corporate quality policies, (b)

quality management system/ISO 9000, and (c) awareness, education, and training (Desai, 1993). Consult Figure 7.

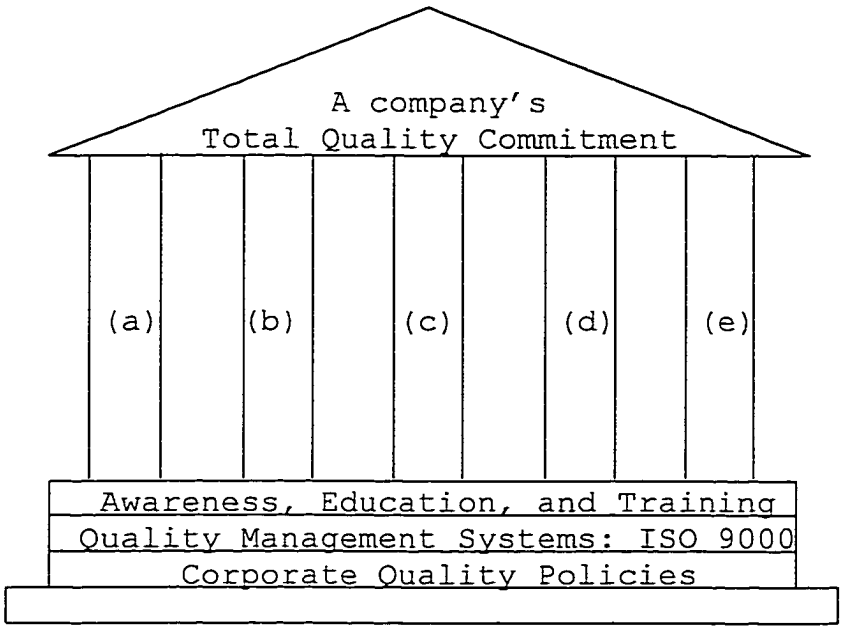

Figure 7. Total Quality Commitment Plan.
Note. From "Success Through Total Quality Commitment," by M. Desai, 1993, Quality Progress, p. 65.

Piplani (1993) has suggested that to adopt the ISO 9000 system and conduct a quality management or quality assurance program at the same time is a good strategy for a company to enhance the effectiveness of implementing ISO 9000. Using these programs simultaneously can benefit companies, since the major philosophies of excellent

quality (continuous process improvement for achieving customer satisfaction and product loyalty, employee participation, recognition and training of employee, and quality cost) are not clearly identified in the ISO 9000 standards. These philosophies have been addressed in the themes of total quality management and in Deming's 14 points to accomplish a good quality assurance program (Piplani, 1993).

The Current Problems of Quality Management

Obstacles of Conducting Quality Management

The environment in the construction industry of Taiwan has been much more complex than in other industries (Chou, 1995; Lu, 1997). McCollough and Benson (1993) have noted five obstacles that can affect the effectiveness of conducting total quality management in construction projects. The five barriers are: "(1) lack of trained workers, (2) competitive markets, (3) poor plans and Specifications, (4) bad attitudes, (5) lack of competent field managers" (pp. 297-298).

Five Barriers to Adopt a Quality Assurance Program

In his research, Lu (1995) has stated the five barriers that affect the effectiveness of implementing a quality management system or a quality assurance program in

a construction company. The five barriers were (a) the backward ability of conducting projects, (b) the outdated legal-regulations, (c) the future global competition, (d) the special characteristics of the construction life cycle, (e) the attitudes and abilities of managers and workers to conduct the projects.

In other words, the barriers of conducting total quality management will influence a company's willingness to adopt ISO 9000 in the construction industry of Taiwan (Hou, 1997). ISO 9000 is a certification system of qualify management to certify the ability of conducting a quality assurance program and a quality management system in a company. It is also only a fundamental step for adopting a total quality control system (Desai, 1993; Stephens, 1994). If barriers have existed in the quality management system or quality assurance program, those will influence the success of implementing ISO 9000 and the willingness to adopt ISO 9000 in the future (Stephens, 1994).

The Construction Industry in Taiwan

The Problems of Quality

The quality of construction has always been a critical issue and serious problem in the Taiwan's construction industry. Many harmful accidents have occurred during the

past 30 years, injuring or killing many innocent people (Lu, 1995). For example, a very harmful construction accident in the summer of 1997 resulted in the death of 12 people and injured 25 others in one small community located in the mountain area of the Shi-Chu City of Taipei County. The buildings were constructed on very unstable ground and then collapsed. One apartment building of 30 units totally collapsed into the unstable ground beneath it. The nearby foundation of a comparable apartment building slid for about 20 meters from its original location (Construction incident, 1997).

The Factors of the Quality Problems

In his research, Lu (1995) has figured out several factors that have caused quality-related problems in the construction industry of Taiwan.

1. Rapid economic development has influenced some aspects of the construction industry of Taiwan, altering their values and standards of judgement. This has caused come companies to neglect or overlook the quality of construction in order to increase business profits.

2. The crowded living environment has made it difficult to ensure the high quality in construction and building projects.

3. The construction laws and regulations of Taiwan cannot fully control current construction activities, qualitative issues, and technical affairs. Furthermore, the government agencies have been lax in their efforts to enforce compliance with the existing laws and regulations.

4. The Taiwanese construction companies did change the concept of managing quality and management skills in accordance with the rapidly changing conditions and surroundings.

5. Employees in the construction industry have not been well trained to meet the challenge of the new environment of quality control.

6. Almost none of the construction companies in Taiwan have fully developed the ability to conduct a project throughout the product life cycle (planning, designing, budgeting, biding, detailed designing, building, finishing, and evaluating project) to meet this new changing environment.

7. Among the managers of Taiwan's construction industry, the concept of managing quality is not consistently applied at every stage of the project, but focused instead on the final stage.

8. The partnering system of subcontractors has typically not been well organized, and this has caused an inconsistency in quality at the various stages of a project (Lu, 1995).

These factors have fostered a very bad reputation, image, and the nickname, "Old 3 K," which stands for a dangerous working environment, a dirty working site, and the poor project quality in the construction industry of Taiwan (Hou, 1997).

The Development of ISO 9000 in the Construction Industry of Taiwan

In Taiwan, the China National Accreditation Board is the government agency in charge of the development of quality assurance and environment management. The Bureau of Inspection is the government agency responsible for handling the auditing of quality assurance systems and the approval of ISO 9000 (the Ministry of Economic Affairs of the Republic of China--Taiwan). Currently, the Bureau of Inspection does not provide service to the construction industry. However, there are several international certification bodies, such as Entela, BSI, RWTUV, and TUV-Rheinland, which have offered their service to the

construction companies in Taiwan (China National Accreditation Board; See Appendix C).

Since Pacific Construction Corporation, the first construction company to adopt ISO 9000 in Taiwan, received their certificate of ISO 9002 on January 17, 1995, at least, 44 construction companies received the approval of ISO 9000, according to the information provided by the certification bodies (Hou, 1997). See Appendix C.

The Efforts of the Taiwanese Government

The Quality Assurance of Public Projects

Within the next 10 years, the government of Taiwan will try to promote the economic status of Taiwan from that of a new developing country to that of an industrialized country. As a first step toward that goal, the government of Taiwan has tried to structure Taiwan as the Asian Operation Center in the 21st century. For this reason, the government of Taiwan has planned and invested in many public-engineering projects to promote the economic development (Hou, 1997). During this phase, the quality assurance of all the public construction projects contracted will become more important than before because they will influence the final consequence of all activities

promoting Taiwan's goal as the Asian Operation Center (Hou, 1997).

In recent years, the government of Taiwan has made many efforts to encourage and force the construction industry in Taiwan to change their attitude toward quality management, but the construction industry has not followed the government's policies until now (Hou, 1997). For example, in October 1991, the government of Taiwan instituted a system called "The Quality Management System for the Public Engineering Projects" to advocate the importance of quality management in public engineering projects (Hou, 1997). The government of Taiwan has subsequently tried to use this plan to encourage the construction industry to improve the level of quality in construction. But, the quality of construction remained less than satisfactory and only minute progress has been accomplished. In spite of the government's efforts, serious accidents are still occurring, reoccurring, and becoming increasing by serious with time and incidents (Lu, 1997).

Developing and Forcing the Adoption of ISO 9000

The Taiwanese government started to import and promote the ISO 9000 standard in March 1990, and it has instituted the CNS12680-12684 for a national quality standard based on the requirements and regulations of the ISO 9000. In the meantime, the "The Regulation of Adopting an International Quality Standard in Taiwan" was established on January 1, 1991, to guide the implementation of ISO 9000 in Taiwan (Bureau of Inspection of the Ministry of Economy Affairs of the Republic of China). Since then, the Taiwanese government has pledged NT$150 million to annually achieve the development of ISO 9000 standards (Yates & Aniftos, 1995).

According to the information from the China National Accreditation Board, the Bureau of Inspection of the Ministry of Economy Affairs of Taiwanese Government (ROC) is the only local agency that can issue the certification of ISO 9000 to the manufacturing or service industries. But, they do not provide service to the construction industry of Taiwan. For this reason, several international agencies or organizations of inspection or standardization, such as BVQI (France), DNV (Norway), ENTELA (USA), UL (the United States), BSI (England), SGS (England), LRQA

(England), TUV-Essen (Germany), TUV-PS (Germany), TUV-Rheinland, RWTUV (Hong Kong), have provided the service of certifying ISO 9000 to the construction companies in Taiwan (China National Accreditation Board, 1998; Consult Appendix C).

For Taiwanese companies to conveniently receive the ISO 9000 certification from another country, the Bureau of Inspection of the Taiwan government has signed bilateral ISO 9000 certification agreements with several international organizations including the BSI-QA of England, the UL of the United of States, the DQS of Germany, and the AVI of Belgium. According to the bilateral agreements, Taiwanese companies can directly get ISO 9000 certification from the cooperating organizations under the approval of the Bureau of Inspection in Taiwan (Bureau of Inspection of the Ministry of the Republic of China, 1998). In the meantime, the Bureau of Inspection of Taiwan has signed an individual memorandum with several other international organizations in several countries, such as SQS of Switzerland, CISQ of Italy, OQS of Austria, QMI of Canada, and in France to support the development of ISO 9000 (Bureau of Inspection, 1998).

Otherwise, the Taiwan government has instructed all companies which have already gotten the approval of the "Cheng-Tzu Piao-Chi," a National Production Standard of Taiwan, to adopt the ISO 9001 or ISO 9002 into their quality management system before June 30, 1998, to promote the development of ISO 9000 (Bureau of Inspection, 1998).

Another effort was made by the central Taiwan government to develop a new promotional guideline to lead the construction industry to again upgrade quality when the "The Quality Assurance Year of Public Engineering Projects" was announced in 1996 (Lu, 1995). In addition, the government of Taiwan has been encouraging Taiwanese construction companies to adopt the ISO 9000 and is also considering forcing all of them to meet the ISO 9000 standard in the near future (Hou, 1997).

The Entry of Taiwan to the World Trade Organization

To obtain membership in the World Trade Organization (WTO) is another important goal for the government of Taiwan, and the Taiwanese government has for several years made many efforts and has used many resources in hopes of reaching this target (Chou, 1995). But once the purpose is reached, the Taiwanese construction industry will face a greater challenge: construction companies will compete not

just with other companies on Taiwan but also with foreign firms (Chou, 1995). The challenge is daunting, because the construction companies of Taiwan lag far behind industrialized countries in quality management and quality assurance (Hou, 1997). Failure to improve their ability to manage the quality of construction projects will result in the closure of many Taiwanese construction companies (Hou, 1997).

The Character of the Construction Industry

Special Product Life Cycle

The product life cycle of the construction industry is quite different and much longer than that of other industries (Chang, 1996). For example, the product life cycle is about 3 or 5 months for the electronics industry and only 1 year or less for most other industries. However, the product life cycle of the construction industry is always more than 2 or 3 years, and it is much longer than that of other manufacturing industries (Chang, 1996). For that reason, the construction industry has to face the following problems: maintaining the same high quality at each engineering stage, and managing the quality of different subcontractors. These two factors are much

more difficult and complex to regulate than quality-related factors in other industries (Chang, 1996).

Special and Dangerous Working Environment

Furthermore, the working environment in construction is much more dangerous and unstable than in other industries. Each construction project has its own unique characteristics and requirements, and this absence of similarities among projects makes it difficult for the construction industry to quickly accumulate the experience of handling construction quality (Chang, 1996). This causes the learning curve for controlling quality to be much lower than in other industries (Goetsch & Davis, 1997). All of these factors influence the progress in adopting quality management in construction projects (Nunally, 1998).

The World Wide Trend of ISO 9000

In a broader perspective, more than 70 countries in the world have set the ISO 9000 as the national standard. That is a changing trend of quality management, and no one in the world can escape that trend (Hou, 1997). But, different countries have different achievement records in the development of ISO 9000, and it depends on the involvement or the attitude of their governments. The

development of ISO 9000 in the construction industries of Hong Kong, Singapore, and the United States are discussed.

Hong Kong

Hong Kong was the first territory among Asian countries to adopt ISO 9000 into the construction industry, and the Hong Kong government started to structure the regulation of the adopting ISO in 1990 (Hou, 1997). Three years after the publication of the ISO 9000 series of standards, the Hong Kong government has established the first certification body in 1990, Hong Kong Quality Assurance Agency (HKQAA) (Lee, 1995). "HKQAA issued its first ISO 9000 certificate in April 1991" (Lee, 1995, p. 6).

The Hong Kong government had imposed the following restrictions to guide their construction companies to adopt and implement ISO 9000 (Hou, 1997):

1. The general contractors of public construction had to adopt the ISO 9000 certification system before 1993.

2. The electric contractors in the construction industry had to adopt the ISO 9000 quality certification system before October 1994.

3. Fire protection and safety equipment contractors had to adopt the ISO 9000 quality certification system no

later than the end of October 1995. In Hong Kong, more than 100 construction companies so far have received the approval status of ISO 9002 (Hou, 1997).

Singapore

The Singapore government started to advocate adopting the ISO 9000 standard in 1991 just one year after Hong Kong did, and, at that time, set the standard for the national standard of SS-ISO 9000 (Hou, 1997). Then the Singapore government has organized a new department, the Construction Industry Development Board (CIDB), in the Ministry of National Development, to collaborate with the Singapore Institute of Standards and Industrial Research (SISIR) to persuade the construction industry to adopt the ISO 9000 (Hou, 1997). In the meantime, the government of Singapore has signed a memorandum with the British Standard Institution (BSI) to mutually accept the certificate of ISO 9000 issued by BSI (Hou, 1997). According to this memorandum, all of the contractors in the construction industry had to adopt the ISO 9000 standard and get the ISO 9000 certification before 1999 (Hou, 1997).

The United States

According to a survey conducted by Quality Systems Updated and Dun and Bradstreet in January 1996, the ISO 9000 registered companies were already in many industries in the United States (C. E. Morris, 1997). In contrast, most of the construction companies in the United States did not adopt and implement the ISO 9000 system, and some of them did not know how to conduct that work (Yates & Aniftos, 1996). In the same research, the majority of the construction companies in the United States have recognized that the adoption of ISO 9000 is already a worldwide trend. And, they already understand that the implementation of ISO 9000 will help them remove the technical barriers of trading and improve the technical communication and mutual understanding in the world (Yates & Aniftos, 1996).

Yates and Aniftos (1996) pointed out that while the construction industry of the United States is aware of the ISO 9000 trend, and "they need to know about more how to get involved in the development of standards" (Yates & Aniftos, 1996, p. 35). Unlike Asian countries, the government of the United States did not directly involve itself in the development of ISO 9000 in the past years. That has caused the development of ISO 9000 to be far

behind European countries. But, to maintain its leading competitiveness in the world, it is necessary for the U.S. government to advocate and promote the implementation of ISO 9000 (Yates & Aniftos, 1995).

The Issue of Cost of Quality

Before a construction company adopts an ISO 9000 quality certification system, the cost of managing quality is a critical issue to consider (Gupta & Campbell, 1995). Gupta and Campbell (1995) pointed out that "quality costs for service and manufacturing firms have been skyrocketing over the past several decades. For American businesses struggling to remain competitive in a global economy, the staggering quality costs can spell disaster" (p. 43). High quality at a lower cost is an expectation for any construction company in the process of adopting the ISO 9000 quality certification system and conducting quality management program (Gupta & Campbell, 1995).

The Perceived Factors

According to several authors' research or studies and the general consensus about this research, the following factors have been surveyed to assist the Taiwanese construction companies in understanding the major problems in the process of adopting and implementing ISO 9000. That

information will help the construction industry of Taiwan achieve the competitive advantage by creating an environment of continuous improvement in the future global competition.

The Attitude of Government

Hillary (1996) has indicated that because the federal government of the United States did not get directly involved or encourage the implementation of ISO 9000, this is the major reason the development of ISO 9000 in the United States is far behind the United Kingdom. In their research, Yates and Aniftos (1995) have stated that the government's positive attitude toward participating in the development of ISO 9000 standards is a very important factor in affecting the adoption and implementation of ISO for the construction industry in the future (Yates & Aniftos, 1995).

The Cost of Implementation

Lee's study, pointed out that the cost of implementing the system is one of the three major concerns that affects the willingness of construction companies in Hong Kong to adopt ISO 9000 (Lee, 1995). According to the survey of Small Business Research Trust (1992), the expense of obtaining a certificate of registration was one of the

major factors affecting the willingness of small businesses to adopt ISO 9000.

The total cost of implementation and registration will consist of an internal cost ranging from US $10,000 to $ 300,000, depending upon the size and complexity of the certified company. In addition, the registration fee will be at least US$ 15,000 (Murakami, 1994; Yates & Aniftos, 1995). Others have said, "a three year agreement with a registrar would cost between US$ 12,000 and US$ 45,000" (Hillary, 1996, p. 35). Those amounts are probably not too high for a large construction company to establish a reliable and successful quality management system, but it is still a negative factor that discourages the adoption of ISO 9000 for small or medium-sized companies (Hillary, 1996).

In the meantime, the following factors of internal costs are difficult to measure or account for, such as (a) the allocation of the additional expenditure of new employees, (b) the expense of continual on-job training, (c) the depreciation of inspection tools or equipment for quality assurance program, (d) the allocation of the invisible expense of additional documentation, and (e) the measurement of the cost of quality (Cokins, 1996). Those

factors will affect the willingness of adoption or the effectiveness of implementing ISO 9000 for a construction company (Yates & Aniftos, 1995).

The Adjustment or Interruption of Construction Processes

The time-consuming nature of writing procedures was one of the major factors affecting the willingness of a company to adopt ISO 9000 into the quality management system (Small Business Research Trust, 1992). The average time of conducting the certification of ISO 9000 will be 11 to 24 months (Yates & Aniftos, 1996). The major impact of this is that it will extend the time of adjustment or interruption of construction processes, and that will bring additional variables or expenditures that affect the willingness of companies to adopt ISO 9000 or the success of implementing ISO 9000 (Yates & Aniftos, 1995).

The Changing Environment

D. R. Hansen and Mowen (1997) indicated that global competition is already a crucial issue for any industry in the world, and continuous improvement is the key to survive in this competitive environment. "Achieving ISO certification can provide the potential to become a world market supplier" (Piplani, 1993, p. 41). In the meantime, the global competition will persuade the construction

industry to force the government to be an advocate and to develop ISO 9000 more aggressively (Yates & Anifots, 1995).

The Auxiliary Quality Assurance Program Or Quality Management System

The success of implementing the ISO 9000 of one company, in order to achieve the highest quality of its product, depends not only on the ISO 9000 system, but also the quality management system or the auxiliary quality assurance program within a company (Piplani, 1993). "The ISO 9000 series of standards may not be good enough since it only represents 'doing what you say you are doing'" (Yates & Aniftos, 1995, p. 120). ISO 9000 is a certification standard of a quality management system, which certifies only one company's ability to conduct a quality management system and quality assurance program but does not directly certify to the final products (Goetsch & Davis, 1997).

Several researchers advocated that, in order to achieve better effectiveness, the development and implementation of ISO 9000 needs an auxiliary quality assurance program or quality management system (Desai, 1993; Piplani, 1993). Because the ISO 9000 is only a basic foundation of a total quality commitment, it needs an

additional element, a quality assurance program, of total quality commitment/system to form a perfect quality management system (Desai, 1993; Reimann & Hertz, 1994; Stephens, 1994).

Piplani (1993) has also pointed out that the requirements of ISO 9000 do not directly identify the major themes of customer satisfaction, continuous process improvement, employee involvement, and employee recognition/training. Fortunately, those philosophies have already been disclosed in the concept of total quality management and Deming's 14 points.

Customers' Demands or Expectations

Lee (1995) has pointed out that the majority of construction companies in Hong Kong have adopted ISO 9000 to coordinate with their customers' demands or expectations. McTeer and Dale (1995) have indicated that customer demand is the most important factor that forces a company to adopt ISO 9000. Anonymous (1994) has indicated "the fact is that more and more enterprises are looking at ISO 9000 as a basic quality standard, and suppliers who have not demonstrated ISO 9000 compliance are operating with a distinct handicap" (p. 7). Lee (1995) also indicated that the government or major customers might

request construction companies to be ISO 9000 certified in order to meet the qualification to bid on public or large private projects. Consequently, the expectation or enforcement from the customers would be a major pressure for a construction company to adopt ISO 9000.

Partnership with Subcontractors

In his research, Lee (1995) has pointed out that the subcontractor assessment is one of the major factors affecting the success of implementing ISO 9000 for a construction project. Lee (1995) also indicated that if a construction company has not required its subcontractors to meet stringent standards, the company's relationship with the subcontractors would not be improved even though the company is already ISO 9000 certified. A ISO 9000 certified construction company needs to systematically evaluate its subcontractors, and that will help the company achieve better partnership with its subcontractors (Lee, 1995).

A construction company can use a combination of the following methods to evaluate its subcontractors that includes "assessing the subcontractors to fill off-site by the staff of the supplier, asking the subcontractors to fill in assessment forms, and auditing the subcontractors

on-site by the staff of the supplier" (Lee, 1995, p. 12). Another popular way of improving the relationship with subcontractors is requesting that subcontractors also be ISO 9000 certified (Lee, 1995).

Additional Documentation

"Documenting the processes in your organization is a first step in problem-solving techniques designed to eliminate and/or combine steps in the processes to reduce waste in the operation" (Sheldon, 1997, p. 43). Sheldon (1997) has also indicated that the documentation of ISO 9000 can provide consistency in the business and gain control of the business. It is also a training guide for implementing ISO 9000 to enable continuous improvement in a company.

"Documentation can be the greatest weakness of ISO 9000" (Merrill, 1995, p. 22). Increased documents or paperwork was one of the major factors affecting a company's willingness to adopt and implement ISO 9000 (Small Business Research Trust, 1992). Using much additional documentation to control the operation of managing quality is a special characteristic of the ISO 9000 system, and it also gives the image of paperwork intensity (Sheldon, 1997). The additional documentation

also needs additional manpower to process it, and that would increase the operational expense and decrease the operational profits for a company in the process of implementing ISO 9000 (Goetsch & Davis, 1997).

Employees Education and Training

McTeer and Dale (1995) have pointed out that employees education and training can help a company avoid or mitigate the problems of the new working procedures, practices, and disciples in the process of conducting and implementing ISO 9000. "Training of the people so as to provide the knowledge, skills, and tools is needed to make the plan happen, and training is also necessary for individuals to company properly with religious laws and regulation" (Kenett, 1995, p. 57).

Desai (1993) has indicated that ISO 9000 is one of the important foundations of total quality commitment, and the major goal of total quality commitment is to increase customer satisfaction. To provide continuous training and education for the employees is the key element in achieving the goal of total quality commitment (Desai, 1993).

Employees Involvement

McTeer and Dale (1995) have stated that the attitude and behavior of employees is another driving force or influence in a company adopting and implementing ISO 9000. "The keystone of the ISO system is the involvement and participation of the total organization workforce" (Bougher, 1993, p. 95). To achieve the goal of total quality commitment is the responsibility of everyone at every management level in a company, and employee involvement is a critical issue for a company to achieve its goal of total quality commitment (Desai, 1993).

Leadership--Top Management Involvement

McTeer and Dale (1995) have concluded that the pressure and involvement of senior management is another major factor affecting the willingness and success of implementing ISO 9000. "Without commitment to the continuous improvement of products and services by the CEO, president, plant manager, etc. the transformation will never occur" (Heisey, 1993, p. 69). "Senior management acts as a driver of TQM implementation, establishing values, goals, and systems to satisfy customers needs and expectations and improve organizational performance" (Ahire et al, 1995, p. 283). They also "drive quality council and

quality as a business strategy encompassing planning, control, and improvement" (Stephens, 1994, p. 62).

"Support of top management is essential for the successful implementation of a quality system" (Webster, 1997, p. 5). Flister and Jozaitis (1992) have stated that having top management directly support and be involved in the implementation of ISO 9000 is a critical issue for a company, and "providing resources to the projects is one of the crucial roles of management" (Flister & Jozaitis, 1992, p. 38). They also suggested that a company not start to adopt the ISO 9000 unless the implementation has the support of top management (Flister & Jozaitis, 1992). Bougher (1993) also indicated that "a fundamental requirement providing a main thrust toward ISO 9000 certification is solid commitment from senior management levels" (p. 94).

Company Structure or Organizational Change

Lee (1995) has indicated that there was significant evidence of using additional manpower after adopting ISO 9000 into a construction company. That would force the company to structure a new department or management team to handle the additional affairs after the implementation of ISO 9000 (Lee, 1995). Consequently, the organizational or

company structure change should require more staff to handle the necessary routine affairs of operation, quality management, and even documentation work, and that would bring additional cost and obligation for a company (Hou, 1997).

System Maintenance or Continuous Assessment

Lee (1995) has indicated that system maintenance after implementing ISO 9000 was another major concern for the construction companies adopting ISO 9000. In addition, the cost of maintaining the system was one of the major factors to influence a company's willingness to adopt ISO 9000, in order to assist its quality management system or quality assurance program and success of implementing ISO 9000 (Small Business Research Trust, 1992).

The major consideration of this factor came from the special characteristics of the ISO 9000 certification system. Approval of the ISO 9000 system is just an essential step in conducting a quality management system, but not the final end (Goetsch & Davis, 1997). The certification of ISO 9000 is not forever; it needs to be renewed annually three years after the approval. Also, to maintain the ISO 9000 system, a random, semi-annual surveillance review must be conducted (Riswadkar, 1995).

Another consideration is that the ISO 9000 system is a confirmation system of quality management. ISO 9000 only certifies one company's ability to conduct quality management or a quality assurance program, but it does not directly approve to the final products of ISO 9000 certified company (C. E. Morris, 1997). So, the ongoing maintenance or continuous assessment of an ISO 9000 system is another factor that will affect a company's intention to adopt ISO 9000 and its chance to successfully implement ISO 9000 (Lee, 1995).

Cost of Additional Manpower

Yates and Aniftos (1996) have indicated that, depending on the size of the company, additional staffs of 1 to 20 peoples is required to implement ISO 9000 into it's a quality management system. Lee (1995) has stated the majority of ISO 9000 certified companies in Hong Kong have hired additional employee after adopting ISO 9000, and the total expense of operation was increased by more than 5%.

The Perception Due to the Size of a Company

Lee (1995) has stated that the size of a company is not a concern for a company to adopt or implement ISO 9000. But, according to the survey of Small Business Research

Trust (1992), the condition of being ISO 9000 certified between small, medium, or large companies was obviously different. Only 1% of small businesses and 22.7% of medium businesses have received the ISO 9000 certificate (Small Business Research Trust, 1992).

The major factors affecting the willingness of small businesses to adopt ISO 9000 were: (a) the cost of conducting the procedure of registration, (b) the cost of system maintenance after adopted ISO 9000, (c) the documentation or paperwork, and (d) the adjustment or interruption of production process (Small Business Research Trust, 1992).

CHAPTER III

METHODOLOGY

The primary purpose of this study was to collect information from Taiwan's construction companies to determine their attitudes toward adopting and implementing ISO 9000. In addition, the study aimed to find out their levels of knowledge, concerning of the importance, and implementation of ISO 9000 standards. Furthermore, the study was also to investigate perceived factors that affect the intention of adopting ISO 9000 and the success of implementing ISO 9000. Fraenkel and Wallen (1996) have pointed out that conducting a survey to collect sufficient information, to analyze the data, and to summarize the findings from reliable samples of a population can provide the essential information for an entire group. The methodology of this study involves the use of a survey, and includes (a) identification of the population, (b) preparation of the survey instrument, (c) validation of the instrument, (d) sampling method, (e) collection of the data, and (f) analysis of the data.

Identification of the Population

The population of this study was the construction companies in Taiwan involved in public projects or the large projects of the private sector. The names and addresses of the population were obtained from the 1998 Membership Directory of the National Construction Association of the Republic of China (Taiwan).

The membership directory listed 6,559 Taiwanese construction companies, which consisted of 1,614 Type-A companies, 1,087 Type-B companies, and 3,858 Type-C companies (National Construction Association of the Republic of China, 1998). The original classifications of Type-A, Type-B, and Type-C were determined by the Ministry of Internal Affairs of the Republic of China (Taiwan) in conformity with a construction company's operational capital (Wang, 1996). According to current regulations for founding a construction company in Taiwan, the operational capital for establishing a Type-A Company must exceed NT$100,000,000 (about US$ 3,215,000), for Type-B NT$15,000,000 (about US$ 468,800), and for Type-C NT$3,000,000 (about US$ 93,750).

The construction companies in the 1998 Membership Directory of the National Construction Association of the

Republic of China included companies that meet the requirement for the population of this study. According to the current regulations governing the bid of public construction projects in Taiwan, the construction company intending to bid on public projects or large projects in the private sector needs to submit a certificate of membership issued by the National Construction Association of the Republic of China (Taiwan; Agreement on Government Procurement, 1998).

Preparation of the Survey Instrument

Development of the Questionnaire

Sax and Newton (1997) have indicated that mailing a questionnaire to conduct a survey is a convenient and inexpensive method to collect direct data and to acquire essential information from the respondents in order to provide related information for the needs of analyzing, summarizing the findings of a research. Also, Fraenkel and Wallen (1996) indicated that in using a mailed questionnaire, sufficient time must be given for the respondents to answer the questions. This helps the author get more thoughtful and meaningful responses for a research.

To support the research purposes and to identify the research questions, a survey questionnaire was developed. The design regarding the essential structure and format of the questionnaire followed the principles detailed in the books Improving Interview Method and Questionnaire Design (Bradburn, Sudman, & Associates, 1979) and Asking Questions (Sudman & Bradburn, 1982). The development of the questionnaire was based upon (a) the information reported in Chapter Two of this dissertation, (b) the input and advice of the dissertation advisory committee, and (c) the suggestion of the participants of the pilot test.

After the pilot test, three factors (internal initiative, risk of improperly adopting and the shortage of experienced consulting firms) were added to Part VI of the questionnaire. These factors were additional items that might influence the adoption of ISO 9000 by the Taiwanese construction industry.

In order to identify the different degrees of responses more broadly and clearly, some perceived factors were reorganized or divided into two or three more functional survey questions that could lead to a more comprehensive response. For example, the factors involving the attitude of government were reorganized because (a) the

adoption of ISO 9000 is a government requirement for a Taiwanese construction company, (b) the government provides a subsidy to encourage the adoption of ISO 9000, and (c) there is the non-financial encouragement from the government for the adoption of ISO 9000. Further, factors related to the cost of implementation were divided into (a) the registration cost, and (b) the internal cost of implementing ISO 9000. In addition, the factor of changing environment was separated into two survey questions: peer competition and global competition. Furthermore, customers' demands or expectations was substituted with (a) the pressure of customer demand and (b) the expectation of customers to adopt ISO 9000. The factor of employee education and training was split into (a) education or training for the entire employee group before the adopting of ISO 9000 and (b) the additional cost of employee training or education.

Structure of the Questionnaire

The questionnaire was divided into seven parts. Part I (Questions 1 to 10) was for investigating the demographic and implementation information of respondents. It included: (a) the type of company, (b) the condition of implementing ISO, (c) the certified categories of ISO 9000,

(d) the cost of implementing ISO 9000, (e) the time need to become ISO certified, (f) the reason to adopt ISO 9000, (g) the major obstacles of decision making to adopt ISO 9000, (h) the willingness to continue the adoption of ISO 9000, (i) the effectiveness after adopting ISO 9000, (j) the reason for not adopting ISO 9000, and (k) the willingness to adopt ISO 9000 in the future.

The second part (Questions 11 to 14) included the conditions of conducting a quality assurance program and the factors that influence a company's intention to conduct a quality assurance program. The third part (Questions 15 and 16) focused on questions related to the advantages and disadvantages of implementing ISO 9000. The questions in the fourth part (Questions 17 and 18) were intended to measure the level of knowledge about ISO 9000 and a quality assurance program at different management levels in the three types of Taiwanese construction companies.

Part V (Questions 19 to 24) of the questionnaire was used to point out the relationship between ISO 9000 and quality assurance program within a construction company. In Part VI (Questions 25 to 46) contained questions that were related to the significance of perceived factors affecting the willingness or the intention to adopt ISO

9000. Questions in Part VII (Questions 47 to 55) identified the significance of the perceived factors influencing the success of implementing ISO 9000.

The content of the questionnaire was formulated from several research projects or publications: Cokins (1996), Desai (1993), Goetsch and Davis (1997), Lee (1995), Lin (1996), McTeer and Dale (1995), C. E. Morris (1997), Piplani (1993), Reimann and Hertz (1994), Stephen (1994), Tan and Lu (1995), and Yates and Aniftos (1995).

Validation of the Instrument

Processed Validation

Frankel and Wallen (1996) pointed out that a content-related validity test could provide essential information about the validity of the collected data. After the questionnaire was developed, the first draft was submitted to the dissertation advisory committee for their input and recommendations. A pilot test conducted after revising the questionnaire resulted in three additional questions being added to the demographic segment and editing several words. The questionnaire was then translated into Chinese, since the respondents of this questionnaire could read Chinese better than English.

To avoid the ambiguity and misunderstanding resulting from language translation, the translated questionnaire was verified by Dr. Taifa Yu and Ms. Emily Chen. Dr. Yu teaches Political Science and courses about Far Eastern countries at the University of Northern Iowa, and is a member of the dissertation committee. Ms. Chen is a professional and experienced expert of English and Chinese translation with about 25 years of experience in Taiwan and the United States.

Pilot Test

To avoid the confusion, ambiguity, misunderstanding, and poorly prepared questions, it is necessary to conduct a pilot test for a questionnaire survey used in formal research with 5 to 10 participants (Wiersma, 1991). After the first draft of the questionnaire was formulated nine individuals (two educators, three senior operational or quality managers of construction companies, three senior operational or quality managers of other industries, and one professional consultant) were invited to participate in the pilot test. After conducting the pilot test, a group discussion was held to gather information about the content relevance, format, appropriateness, coding, and clarity. Three more questions were added to Part VI of the

questionnaire and several editorial changes were recommended by the group.

Sampling Methods

One hundred eighty companies were randomly selected from the 1998 Membership Directory of the International Construction Association of the Republic of China (Taiwan) to be the respondents to the survey. The 180 respondents consisted of 60 companies from each of the 3 types of construction companies in Taiwan: Type-A, Type-B, and Type-C companies.

The construction companies listed in the 1998 Membership Directory of the National Construction Association of Taiwan have already grouped by their geographic locations and the classification of companies. The sampling task was accomplished by first using the cluster sampling method according to the geographic locations and the classification of construction companies, and followed by the simple random sampling technique to choose the samples by computer. This procedure followed the study adopted from the book Research Methods in Business Studies printed by Ghauri et al. (1995) and the book Social Research Methods by Guy et al. (1987).

Guy et al. (1987) indicated that cluster sampling method is an another form of simple random sampling. It is also a good and inexpensive sampling technique if the clusters of population are geographically defined. Simple random sampling method is a basic sampling technique based on the probability sampling design. It also assumes that all the samples in the population will be equally and independently selected (Guy et al., 1987). Usually, the individual entity in the population list must be numbered before conducting the sampling procedure. The procedure will be accomplished by first selecting a random number from a table of random numbers, and followed by orderly reading the random numbers from the table. The random numbers will be used to correspond with the number in the population list to produce the samples from the population (Guy et al., 1987).

Collection of the Data

After the questionnaire was translated and printed in Chinese, the first mailing was sent on July 10, 1998, and included the cover letter (see Appendix A), questionnaire (see Appendix B), and self-addressed and stamped envelope. The cover letter explained the purpose of the research and asked for a response from the company's managers or

supervisors responsible for quality or operation management. In addition, the letter also assured them that their answers would remain confidential.

According to the research of Cheng and Wei (1995), return rate is a major concern for a questionnaire survey because the missing data coming from a low return rate will influence the results of research. Fraenkel and Wallen (1996) have indicated that low return rate is a crucial problem and a major disadvantage for questionnaire research. It has been reported that the return rate has gotten lower and lower in recent years, and using follow-up letters or making phone calls are the common ways to raise the return rate for a questionnaire survey (Cheng & Wei, 1995).

After the first mailing, only 13 questionnaires were received, which was far below the expected return-rate. To gather more responses from the respondents, the first follow-up letter was mailed by September 25, 1998. Before the end of October 1998, additional 32 questionnaires were received from the respondents. The second follow-up letter was mailed before the end of October 1998, and another 17 respondents returned questionnaires. During the time of

collecting data, many phone calls were equally placed to the respondents before reaching the expected return rate.

In total, 62 respondents responded and returned the questionnaires. This included 22 Type-A construction companies, 19 Type-B construction companies, and 21 Type-C construction companies. The total return rate for this survey was 34.44%. The individual return-rate was 36.67% for the Type-A companies, 31.67% for the Type-B companies, and 35% for the Type-C companies. According to the research of Yang, Wen, Wu, and Lee (1989), the average return rate for a questionnaire survey is usually around 30% in Taiwan, and it is sometimes lower than 10%. This questionnaire survey had attained a 34.44% return rate, therefore exceeding the average response in Taiwan.

Analysis of the Data

After the data were collected, all the information was processed by computer. A statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS).

In the demographic section of this study, a cross-table of three types of construction companies and their certified categories of ISO 9000 was produced to determine the situation of implementing ISO 9000 among the

respondents. A frequency distribution was used to measure the degree relating to the obstacles for making a decision to adopt ISO 9000 for those companies who have implemented ISO 9000. Several mean values were produced to identify the significance of the variables or factors in the following sections: (a) the condition of adopting ISO 9000 and a quality assurance program, (b) the advantages and disadvantages of implementing ISO 9000, (c) the level of knowledge about ISO 9000 and a quality assurance program, (d) the interrelationship of ISO 9000 and quality management, (e) the perceived factors affecting the intention to adopt ISO 9000, and (f) the factors influencing the success of implementing ISO 9000. The mean values of each question were subjected to the analysis and interpretation of the research questions.

An ANOVA test was used, after the mean scores of collected information were computed, to observe and detect the difference of mean values of Type-A, Type-B, and Type-C Taiwanese construction companies (Hurlburt, 1998; Kervin, 1992). The ratio of Fisher's Least Significance Difference (LSD) was used to directly identify the homogeneity, normality, and consistency of the variance of the mean values derived from the three types of companies, related

to the level of knowledge about ISO 9000 and a quality assurance program (Clarke & Clarke, 1972; Kervin, 1992). The critical value at the 0.05 level was used in order to detect and compare any significant differences between the three different sizes of construction companies and their three management levels.

An ANOVA test is an acceptable statistical method and useful tool for determining and comparing the significant differences of the variance of mean values of multiple factors by three or more than three groups of data (Hittleman & Simon, 1997; Hurlburt, 1998). Hurlburt (1998) pointed out that "ANOVA is a notion of how far apart sample means are from one another" (p. 261). "ANOVA test is a test of homogeneity and normality, and it uses F ratio to test the difference of means among two or more groups and to test for homogeneity of variance" (Craft, 1990, p. 139). The larger the F-test ratio that is produced, the lower the degree of homogeneity, normality, and consistency of mean values (Clarke & Clarke, 1972; Craft, 1990; Hurlburt, 1998, & Kervin, 1992)

Fisher's Least Significant Difference (LSD) is a post hoc test of the ANOVA test, and it can directly define the degree of homogeneity, normality, and consistency of the

variance of mean values (Clarke & Clarke, 1972). The ratio of Least Significance Difference (LSD) is the positive index of identifying the degree of homogeneity, normality, or consistency of the variance of mean values of multiple sampling groups (Clarke & Clarke, 1972; Hurlburt, 1998). The larger the ratio of Least Significance Difference (LSD) exhibited, the higher the degree of the homogeneity, normality, and consistency of the variance of mean values of samples will be noted (Clarke & Clarke, 1972; Craft, 1990; Hurlburt, 1998; Kervin, 1992).

CHAPTER IV

ANALYSIS OF THE DATA

The findings relevant to answer the research questions are analyzed and reported in this chapter. All of the findings were derived from an analysis of data from the questionnaire. Thus, the purpose of this chapter is to analyze the collected information related to the attitude and volition of the Taiwanese construction industry regarding the adoption and implementation of ISO 9000.

To facilitate the presentation of findings for this study, this chapter is structured into seven segments representing each of the survey parts. In segment one, which consisted of 4 sections, the profiles of the respondents and the demographic information were illustrated.

The profiles of respondents were described in the first section of segment one. In the second section, the demographic data subjected to the essential information of the entire 62 respondents was exposed, which included (a) the type of business and (b) the respondents' condition toward adopting ISO 9000.

The third section of segment one identified the implementation information regarding the respondents that

were already ISO 9000 certified. This included (a) the total cost of adoption, (b) the time used to adopt ISO 9000 and to be certified, (c) the reason for the adoption of ISO 9000, (d) the obstacles in making the decision to adopt ISO 9000, (e) the willingness to continue the adoption of ISO 9000, and (f) the effectiveness after adopting ISO 9000.

In the fourth section of segment one, implementation information related to the respondents that were not ISO 9000 certified was displayed. This covered (a) the reasons for not adopting ISO 9000 system and (b) the respondents' willingness to adopt ISO 9000 in the future.

In the second segment of this chapter, the condition for conducting a quality assurance program and adopting ISO 9000 was shown and included (a) the status and type of quality assurance program conducted, (b) the condition of conducting a quality assurance program and ISO 9000, and (c) the major factor influencing the quality of projects.

The advantages and disadvantages of adopting ISO 9000 as recognized by the respondents were explained in the third segment. The fourth segment consisted of two sections. In first section, the level of knowledge about ISO 9000 and quality assurance programs in the different management levels of respondents was described. The second

section presented the significant differences of three types of construction companies as determined by the Fisher's Least Significance Difference (LSD) and derived from ANOVA test.

The fifth segment of this chapter reported the interrelationship of ISO 9000 and quality management. In the sixth segment, the significance of the factors that influenced the intention to adopt ISO 9000 was presented. The significance of the factors affecting the success of implementing ISO 9000 was analyzed and discussed in the seventh segment.

Description of Respondents

Initially, 180 companies were randomly selected from the 1998 Membership Directory of the National Construction Association of the Republic of China (Taiwan), which included 60 companies in each of the following categories: Type-A, Type-B, and Type-C construction companies. After the first mailing and two follow-up mailings, a total of 62 questionnaires were returned by the respondents. This included 22 questionnaires from Type-A companies, 19 questionnaires from Type-B companies, and 21 questionnaires from Type-C companies.

The total return rate of the survey for this study was calculated at 34.44%. The return rate of the three types of construction companies was 36.67% for Type-A companies, 31.67% for Type-B companies, and 35% for Type-C companies.

Demographic and Implementation Information

The first part of the survey was used to determine demographic information and ISO 9000 implementing information. It consisted of three sections. The first section included (a) the type of company, (b) the condition of implementing ISO 9000, and (c) the certified categories of ISO 9000 for the respondents in this study.

In the second section of Part I, information concerning the construction companies that had been ISO 9000 certified was presented. This included (a) the total cost of adoption, (b) the time used to adopt ISO 9000 and to be certified, (c) the reason for adopting ISO 9000, (d) the obstacles in making the decision to adopt ISO 9000, (e) the company's willingness to continue the adoption of ISO 9000, and (f) the company's effect of adopting ISO 9000.

The third section in Part I was used to determine characteristics of the respondents that were not ISO 9000 certified. This consisted of (a) the reason for not

implementing the ISO 9000 system and (b) the willingness to adopt ISO 9000 in the future.

Types of Company and Condition of Implementing ISO 9000

From Table 1, we find that the three different types of companies differed in implementing ISO 9000. In totally, 22 of the respondents had implemented ISO 9000. Nineteen of the 22 were Type-A companies, and 3 were Type-B companies. None were a Type-C Company. Overall, the condition of implementing ISO 9000 had been adopted much more frequently by Type-A companies than in the other of two types of companies.

Table 1

Type of Company and Category of ISO 9000

Type of Company	Category of ISO 9000				Total
	9001	9002	Applying	None	
A	1	18		3	22
B		3	1	15	19
C				21	21
Total	1	21	1	39	62

Note. The cross tabulating of type of company and category of ISO 9000 implementation produced this table.

Of the 19 Type-A companies who had adopted a category of ISO 9000, only one company was certified in the category of ISO-9001, and the other 18 companies were approved for the category of ISO-9002. In the Type-B construction companies, only 3 of the respondents had been accredited in ISO 9002, and one other company was processing an application. None of the Type-C companies had implemented any category of ISO 9000.

Cost of Implementing ISO 9000

Based on the responses of 22 respondents that have been ISO 9000 certified, the average cost of adopting ISO 9000 including the cost of installing the system and the cost of registration was NT$ 840,632 (US$ 26,280). The minimum cost of implementing was NT$ 120,000 (US$ 3,750), and the maximum amount was NT$ 2,000,000 (US$ 62,500). These results were only computed from the data of 19 Type-A and 3 Type-B companies in the sample that were ISO 9000 certified.

Time to Become ISO 9000 Certified

After analyzing the information from the responses of 22 respondents that had been ISO 9000 certified, the average time to adopt the ISO 9000 system and to be ISO 9000 certified was 10 months ($\underline{M}$ = 10). The shortest time

to adopt ISO 9000 and to be ISO 9000 certified was 6 months, and the longest time to attain certification was 24 months. This information was derived from the information of 19 Type-A and 3 Type-B companies that were ISO 9000 certified.

Table 2

Reason to Adopt ISO 9000

Ranking	Reason to Adopt ISO 9000	Mean	SD
1	Standardize company	8.92	1.47
2	Improve documentation	7.45	1.92
2	Local competition	7.45	1.92
4	Reduce cost	6.90	1.48
5	Internal initiative	6.90	2.38
6	Global competition	5.39	2.66
7	Client's demand	5.05	1.36
8	Meet legal regulation	4.84	1.74
9	Not sure	1.45	0.69
10	Others	1.00	0.00

Note. Rank order scaled from 10 = Most to 1 = Least.

Reason to Adopt ISO 9000

In Table 2, the mean scores for reasons to adopt ISO 9000 was presented. The highest ranking reason for implementing ISO 9000 was to standardize the company (*M* = 8.92), followed by improve documentation (*M* = 7.45). Mean scores and rank order were shown in Table 2.

Major Obstacles in Decision Making to Adopt ISO 9000

For the respondents, the greatest obstacle in deciding to adopt ISO 9000 was the transition to a quality assurance program (*f* = 6). Refer to Table 3.

Table 3

Obstacles in Decision Making to Adopt ISO 9000

Ranking	Obstacles	Frequency
1	Transition to a quality assurance program	6
2	Interruption or adjustment of projects	5
3	Documentation works	4
4	Cost of implementing	3
4	Additional manpower	3
4	Organizational change	3
7	Others	0

Note. Frequency accumulated from the selection of most to the least.

A second major concern was the interruption or adjustment of projects (f = 5). Documentation work (f = 4) was another major obstacle for the respondents. The rest of the obstacles were the cost of implementation (f = 3), additional manpower (f = 3), and organizational change (f = 3). Consult Table 3.

Willingness to Continue the Adoption of ISO 9000

Nineteen of 22 (86.36%) respondents who were ISO 9000 certified replied that they would continue to adopt ISO 9000 in the future. Three of 22 (13.64%) respondents stated they were not sure about continuing the adoption of ISO 9000.

Effectiveness after Adopting ISO 9000

Respondents reported that the major effect after adopting ISO 9000 was to improve quality (M = 5.46), and the next was to meet customer satisfaction (M = 4.29). Consult Table 4. Increasing productivity (M = 4.19) was another positive effect for the respondents who were ISO 9000 certified. This was followed by increased marketing share (M = 3.47) and increased profits (M = 2.79). Refer to Table 4.

Table 4

The Effectiveness after Adopting ISO 9000

Ranking	Effectiveness	Mean	SE
1	Improve Quality	5.46	0.21
2	Customer Satisfaction	4.29	0.28
3	Increase Productivity	4.19	0.19
4	Increase Marketing Share	3.47	0.30
5	Increase Profits	2.79	0.25
6	Others	1.24	0.24

Note. Rank order scaled from 6 = most to 1 = least.

Reason for Not Adopting ISO 9000

Fifteen of 40 (37.5%) respondents who were not ISO 9000 certified indicated the cost of adopting or implementing ISO 9000 was the major reason for not adopting ISO 9000. Moreover, 10 of 40 (25%) replied the reason for not adopting ISO 9000 into their quality management system was that they were not interested (25%), and 6 of them (15%) directly responded that it was not necessary.

Willingness to Adopt ISO 9000 in the Future

Data from the 17 of the 40 (42.50%) respondents who were not ISO 9000 certified indicated they were not sure whether they would adopt ISO 9000 in the future, while the response of 13 of them (32.5%) indicated they were unwilling. However, 9 of the 40 (22.5%) respondents replied that they were willing to adopt, and 1 of the 40 (2.5%) answered that they have a strong willingness to adopt ISO 9000 in the future.

Quality Assurance Program and ISO 9000

Quality Assurance Beyond ISO 9000

Generally, the status of implementing quality assurance (14.48%) beyond ISO 9000 in the Taiwanese construction industry was low. Fifty-three of the 62 respondents (85.48%) replied that they had not adopted quality assurance programs other than ISO 9000, while 9 of the 62 respondents had adopted quality assurance programs beyond ISO 9000 (14.52%). Three of 62 (4.84%) respondents answered that they were processing other quality assurance programs but not ISO 9000, and 6 of 62 (9.68%) responded that they have conducted other quality assurance programs at the same time as the ISO 9000 system.

Auxiliary Quality Management Program

Thirty-nine of 62 (62.9%) respondents answered that they did not conduct the auxiliary quality management program of ISO 9000. Of those respondents (23 companies) who have conducted the auxiliary quality management program of ISO 9000, 11 of the 23 (47.83%) respondents reported that their auxiliary quality management programs were total quality management programs (TQM).

Table 5

Factors Influencing Quality of Project

Ranking	Factors	Mean	SD
1	Customer demand	8.11	1.92
2	Benefits of company	6.80	2.40
3	External competition	6.33	2.36
4	Teamwork	6.25	2.41
5	Legal regulation	5.91	2.72
6	Attitude of government	5.91	2.74
7	Partnership with subcontractors	5.80	2.14
8	Internal initiative	4.72	3.16
9	ISO 9000	4.67	1.82

Note. Rank order scaled from 10 = Most to 1 = Least.

Factors Influencing Quality of Project

In Table 5, customer demand (M = 8.11) was ranked as the highest mean value for the factor of influencing the quality of a project. The next highest ranking was benefits of company (M = 6.8). Refer to Table 5. External competition (M = 6.33) was ranked as the third major issue to influence the quality of project. Teamwork (M = 6.25) was another major factor for this section followed by legal regulation (M = 5.91), attitude of government (M = 5.91), partnership with subcontractors (M = 5.80), internal initiative (M = 4.72), and ISO 9000 (M = 4.67).

Advantages and Disadvantages of Adopting ISO 9000

Advantages of Adopting ISO 9000

In Table 6, most of respondents recognized that the major advantage of adopting ISO 9000 was to increase the quality of a project (M = 6.61). Other advantages were to increase a quality management grid (M = 6.22), to meet customers' satisfaction (M = 5.74), to increase efficiency (M = 5.41), to increase marketing share (M = 4.40), to increase productivity (M = 3.71), and to increase profits (M = 3.04). Consult Table 6.

Table 6

Advantage of Adopting ISO 9000

Ranking	Advantage	Mean
1	Increase quality	6.61
2	Increase quality management grid	6.22
3	Customers' satisfaction	5.74
4	Increase efficiency	5.41
5	Increase marketing share	4.40
6	Increase productivity	3.71
7	Increase profits	3.04
8	Others	1.00

Note. Rank order scaled from 8 = Most to 1 = Least.

Disadvantages of Adopting ISO 9000

Table 7 indicated that the major disadvantage of adopting ISO 9000 was the cost of implementation (M = 4.96). The need for additional manpower (M = 4.52) was the second most important factor followed by modifying working processes (M = 3.85), regulating QA program (M = 3.83), and organizational change (M = 2.91). Consult Table 7.

Table 7

Disadvantage of Adopting ISO 9000

Ranking	Disadvantage	Mean
1	Implementing cost	4.96
2	Additional manpower	4.52
3	Modifying working processes	3.85
4	Regulating QA program	3.83
5	Organizational change	2.91
6	Others	1.17

Note. Rank order scaled from 6 = Most to 1 = Least.

Level of Knowledge about ISO 9000 and Quality Assurance Program

Level of Knowledge about ISO 9000

Overall, the mean value of all 62 respondents regarding the level of knowledge about ISO 9000 was 3.25, and that was only a little higher than medium level. The larger the size of the company, the higher the level of knowledge, i.e., the mean score for Type-A was 3.53, Type-B 3.18, and Type-C 3.03. Refer to Table 8.

Table 8 indicates that higher management levels scored higher on level of knowledge about ISO 9000. The level of

knowledge about ISO 9000 by management level was also different by different type of company. Table 8 also shows that the mean score of knowledge level about ISO 9000 in a larger (Type-A or Type-B) company was always higher than in the smaller (Type-B or Type-C) company.

Table 8

The Level of Knowledge about ISO 9000 in Three Types of Companies

The Level of Knowledge about ISO 9000	Means of Different Types of Company			Mean of Total	F	LSD
	A	B	C			
Employee	2.82	2.63	2.57	2.68	0.490	0.615
Junior Managers	3.82	3.26	2.95	3.35	7.659	0.001
Senior Managers	3.95	3.63	3.52	3.71	1.496	0.232
Mean of Total	3.53	3.18	3.03	3.25	5.031	0.007

Note. Scale value from 5 = Very High to 0 = None.

In Table 8, the LSD ratios of the ANOVA test indicated, from low to high, 0.001 for the level of junior managers, 0.232 for the level of senior managers, and 0.615 for the level of employee. The knowledge level of ISO 9000 at the level of junior managers was significantly different

by size of company, since its LSD ratio was smaller than critical value 0.05. The knowledge level about ISO 9000 at level of junior manager was also the most far-apart in the three management levels followed by senior managers and employee. Because, the F values, from high to low, were 7.659 for junior managers, 1.496 for senior managers, and 0.490 for employee.

The employees in each different type of company did not show much difference about the knowledge of ISO 9000, since the mean scores were from 2.57 of Type-C companies, 2.63 of Type-B, to 2.82 of Type-A. Consult Table 8.

The Level of Knowledge about Quality Assurance Program

Generally, the level of knowledge about quality assurance from all 62 respondents was between medium and high ($\underline{M}$ = 3.41). This score ($\underline{M}$ = 3.41) was only a little higher than the knowledge level of ISO 9000 ($\underline{M}$ = 3.24) in Tables 8. The separate mean value of Type-A was 3.73, Type-B 3.39, and Type-C 3.09. Furthermore, the higher management levels had a higher level of knowledge about the quality assurance programs in all three types of company.

The individual LSD ratio of ANOVA test was 0.801 of employee level, 0.000 of junior managers, and 0.002 of

senior managers. Consult Table 9. The difference in knowledge level about quality assurance at the level of junior managers and senior managers presented significantly difference, since their LSD ratios were smaller than the critical value 0.05. After comparing the F value, LSD ratio, and the mean score in each management group, the level of knowledge about quality assurance program of junior managers had the higher far-apart and lower homogeneity than any other management level in any type of company.

Table 9

Level of Knowledge about Quality Assurance Program

The Level of Knowledge about Quality Assurance	Means of Different Types of Company			Mean of Total	F	LSD
	A	B	C			
Employee	3.05	2.95	2.90	2.97	0.222	0.801
Junior Managers	3.95	3.53	3.05	3.52	9.788	0.000
Senior Managers	4.18	3.68	3.33	3.74	7.205	0.002
Mean of Total	3.73	3.39	3.09	3.41		

Note. Scale value from 5 = Very High to 0 = None.

Table 9 also showed that the knowledge level about quality assurance at the employee level in three types of companies was only close to medium ($\underline{M}$ = 2.97), and the partial level of that was $\underline{M}$ = 3.05 in Type-A companies, $\underline{M}$ = 2.95 in Type-B, and $\underline{M}$ = 2.90 in Type-C. This situation was almost the same as the condition with the level of knowledge about ISO 9000.

The Interrelationship of ISO 9000 and Quality Management

According to the ranking and the mean score of total ($\underline{M}$ = 3.94) in Table 10, most companies recognized that ISO 9000 might make a contribution to the improvement of quality control. Also, they agreed that conducting a quality assurance program and adopting ISO 9000 at the same time was necessary ($\underline{M}$ = 3.87) for a Taiwanese construction company to achieve the task of improving project quality.

Regarding the special perceptions of smaller companies, the ranking and mean score of Type-C companies concerning the importance of ISO 9000 ($\underline{M}$ = 3.10) was much lower than that of Type-B ($\underline{M}$ = 4.11) and Type-A companies ($\underline{M}$ = 4.23). Refer to Table 10. That indicated the recognition of ISO 9000 as important and necessary to a company quality management system would depend on the size

of company. The bigger the company size the more important this item appeared to be. Refer to Table 10.

Table 10

Cross-Tabulation of ISO 9000 and Quality Management in Different Type of Company

Factors	Mean Score of Different Type of Company			Mean of Total	LSD
	A	B	C		
Contribution of ISO 9000 to quality control	4.14	4.00	3.67	3.94	0.105
Necessity of QA & ISO 9000	4.14	4.05	3.43	3.87	0.007
Necessity of QA	4.05	4.05	3.43	3.84	0.019
Importance of ISO 9000	4.23	4.11	3.10	3.81	0.000
Concept of activity-costing	3.85	3.79	3.40	3.68	0.091
Importance of cost of managing quality	3.32	2.84	3.48	3.23	0.115

Note. Scale value from 5 = Strongly Agree to 1 = Strongly Disagree.

Perceived Factors Affecting the Intention to Adopt ISO 9000

In general, peer competition (M =4.15), internal initiative (M = 4.13), customer expectation (M = 4.02), global competition (M = 3.97), and customer pressure (M =

3.95) were the five major factors affecting the intention to adopt ISO 9000 for a Taiwanese construction company. Individually, different sizes of company replied differently relative to their own particular situation.

There were different factors affecting the adopting of ISO 9000 by three types of companies. The respondents in Type-A companies indicated the importance of management involvement ($\underline{M}$ = 4.43), and that was a special recognition about the factor of management involvement according to their experience in adopting ISO 9000. The respondents of Type-B companies indicated the factors which would most highly affect their intentions to adopt ISO 9000 were if the government can provide a subsidy for the adoption ($\underline{M}$ = 4.21) and the government requested the adoption of ISO 9000 ($\underline{M}$ = 4.11). Responses from Type-C companies reported special concern about the factor of the cost of organizational change ($\underline{M}$ = 4.00), that would due to that the expenditure of changing is a huge loading to the small size of companies. Otherwise, both Type-B and Type-C companies indicated that customers' pressure ($\underline{M}$ = 4.11 in Type-B companies, and $\underline{M}$ = 3.81 in Type-C companies) was an important factor affecting the decision to adopt ISO 9000.

Table 11

Perceived Factors Affecting the Intention to Adopt ISO 9000

Rank	Perceived Factors Affecting the Intention to Adopt ISO 9000	Questionnaire Numbers	Mean Scores of Different Types of Company			Mean of Total
			A	B	C	
1	Peer competition	29	**4.32**	**4.16**	**3.95**	**4.15**
2	Internal initiative	32	**4.43**	**4.26**	3.71	**4.13**
3	Customers' expectation	34	3.95	4.05	**4.05**	**4.02**
4	Global competition	28	**4.00**	3.84	**4.05**	**3.97**
5	Customers' pressure	33	3.95	**4.11**	**3.81**	**3.95**
6	Management involvement	41	**4.43**	3.89	3.48	3.93
7	Partnership with subcontractor	36	**4.23**	**4.16**	3.29	3.89
8	Government requirement	25	3.82	**4.11**	3.67	3.85
9	Employee education	39	3.95	3.95	3.57	3.82
10	Cost of organizational change	44	3.71	3.68	**4.00**	3.80
11	Subsidies from government	26	3.77	**4.21**	3.43	3.79
12	Cost of additional manpower	43	3.95	3.63	3.71	3.77
13	Cost of system maintenance	42	3.91	3.53	3.57	3.68
14	Cost of employee education	40	3.55	3.84	3.62	3.66
15	Additional documentation	37	3.91	3.53	3.43	3.63
16	ISO 9000 prior to QA	35	3.71	3.58	3.52	3.61
17	Implementing cost	30	3.95	3.39	3.19	3.52
18	Registration cost	31	3.71	3.53	3.29	3.51
19	Adjustment of working process	38	3.38	3.42	3.52	3.44
20	Risk of improperly adopting	46	3.24	3.53	3.48	3.41
21	Shortage of consulting firm	45	3.29	3.42	3.33	3.34
22	N/F encouragement of government	27	3.36	3.21	3.29	3.29

Note. Scale value from 5 = Strongly Agree to 1 = Strongly Disagree. In order to indicate the significant difference of each group, the ranking of the highest five items are in bold type.

Table 12

Perceived Factors Affecting the Success of Implementing ISO 9000

Rank	Factors Affecting the Success of Adopting ISO 9000	Questionnaire Numbers	Mean Scores of Different Types of Company			Mean of Total	LSD
			A	B	C		
1	Management Involvement	49	**4.55**	**4.21**	**3.76**	**4.18**	0.024
2	Success of Employee Education	55	**4.36**	**4.05**	**3.86**	**4.10**	0.079
3	Employee Involvement	48	**4.23**	3.95	3.57	**3.92**	0.061
4	Success of System Maintenance	54	3.95	**4.11**	3.57	3.87	0.721
5	Adjustment of Working Process	51	3.64	3.84	**3.86**	3.77	0.131
6	Cost of Adopting ISO 9000	47	3.86	3.79	3.67	3.77	0.583
7	Success of Auxiliary QA Program	53	3.55	3.68	3.67	3.63	0.640
8	Partnership of Subcontractors	50	3.55	3.79	3.52	3.61	0.306
9	Success of Organizational Change	52	3.27	3.89	3.67	3.60	0.054

Note. Scale value from 5 = Strongly Agree to 1 = Strongly Disagree. In order to indicate the significant difference of each group, the ranking of highest three items are in bold type.

Perceived Factors Affecting the Success of Adopting ISO 9000

Generally, management involvement ($\underline{M}$ = 4.18), success of employee education ($\underline{M}$ = 4.10), and employee involvement ($\underline{M}$ = 3.92) were the three major perceived factors in affecting the success of implementing ISO 9000 for a Taiwanese construction company.

Separately, the response of adjustment of construction working processes ($\underline{M}$ = 3.86) in Type-C companies and the reply of the success of system maintenance ($\underline{M}$ = 4.11) in Type-B companies have reflected the particular concerns that came from their organizational differences. Refer the data in Table 12.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary of Study

The general purpose of this study was to determine the status of Taiwanese construction companies regarding the adoption and implementation of ISO 9000 and to determine the perceived factors affecting the willingness to adopt ISO 9000 and the success of implementing ISO 9000. In order to accomplish and guide the purpose of this study, the following research questions were developed:

1. What is the current level of knowledge, the level of importance, and the level of implementation of the ISO 9000 standards in the construction industry of Taiwan?

2. What are the factors that are perceived to affect the successful adoption of ISO 9000 for the construction industry in Taiwan?

3. What are the relationships between size of company and the level of knowledge, the level of importance, and the level of implementation?

4. Is there any relationship between size of company and factors affecting the successful adoption of ISO 9000?

In order to collect appropriate information, the survey questions in Parts IV, V, VI, and VII of the

questionnaire were developed to answer the research questions. Twenty-two survey questions (Questions 25 to 46) relating to the factors that influence the intention to adopt ISO 9000 were consolidated in Part VI of the questionnaire. Questions covering nine factors that were perceived to affect the success of implementing ISO 9000 were listed in Part VII of the questionnaire (Questions 47 to 55). The survey instrument, shown in Appendix B, was developed accordingly.

The population of this study included the Taiwanese construction companies that were involved in public construction projects or large private sector projects. To collect the appropriate information for this study, the samples were chosen from the members of the National Construction Association of the Republic of China (Taiwan). Six thousand five hundred fifty nine (6,559) construction companies were listed in the 1998 Membership Directory of the National Construction Association of the Republic of China (Taiwan). One hundred eighty (180) companies were randomly selected from the membership directory to form the sample for this study. Sampling work was accomplished, first, by the cluster sampling method to classify the population according to the geographic location and the

classification of company by size, followed by a simple random sampling technique to choose samples by computer (Ghauri, Gronhaug, & Kristianslund, 1995; Guy, Edgley, Arafat, & Allen, 1987). In total, 62 respondents returned the survey questionnaires, which included 22 of Type-A, 19 of Type-B, and 21 of Type-C companies. The total return rate of the survey was 34.44%. The individual return rate was 36.67% in Type-A, 31.67% in Type-B, and 35% in Type-C companies.

The percentage values were used to report: (a) a company's willingness to continue the adoption of ISO 9000, (b) the reason for not adopting ISO 9000, and (c) the willingness to adopt ISO 9000 in the future. Percentage values were also used to report the condition of companies that were conducting a quality assurance program beyond ISO 9000 and auxiliary quality management programs. Frequency values were used to determine the degree of the obstacles of decision making to adopt ISO 9000. Mean scores were used to report the degree of the several responding in the portions of demographic and ISO 9000 implementation information, which were: (a) the reason to adopt ISO 9000, (b) the major obstacles in decision making to adopt ISO 9000, (c) the willingness to continue the adoption of ISO

9000, (d) the effectiveness after adopting ISO 9000, (e) the reason to not adopt ISO 9000, and (f) the willingness to adopt ISO 9000 in the future.

Mean values were also the method used to describe the following topics: (a) quality assurance program and ISO 9000, and (b) the advantages and disadvantages of adopting ISO 9000. Furthermore, a mean score was the statistical technique for determining the significance of the following information: (a) the level of knowledge about ISO 9000 and a quality assurance program, (b) the level of importance of ISO 9000, and (c) the level of implementing ISO 9000.

The F value of the ANOVA test was used to detect the perceptual differences by company size, which included the level of knowledge, the level of importance, and the level of implementation, for the construction companies in Taiwan. The ratios of Fisher's Least Significance Difference (LSD) were used to identify the significant differences of the knowledge level about ISO 9000 and quality assurance among the three different management levels as well as by the three different types of companies (Clarke & Clarke, 1972; Craft, 1990; Kervin, 1992). The critical value of 0.05 was used to detect the significant difference among three different management levels in three

different types of companies. All the statistical analysis in this study was processed by the Statistical Package for the Social Sciences (SPSS).

Summary of Findings

Demographic and Implementation Information

1. The average cost of adopting ISO 9000 was NT$ 840,632 (US$ 26,280), which included registration and the cost of installing the ISO 9000 quality management system.

2. The average amount of time used to adopt ISO 9000 and to be ISO 9000 certified was 10 months (M = 10).

3. The major three reasons to adopt ISO 9000 were (a) standardizing the company (M = 8.92), (b) improving documentation (M = 7.45), and (c) local competition (M = 7.45). See Table 2.

4. The three important concerns influencing respondents who were in the process of making the decision to adopt ISO 9000 were (a) the transition to a quality assurance program (f = 6), (b) the interruption or adjustment of projects (f = 5), and (c) the documentation work (f = 4). See Table 3.

5. The majority (86.34%), which was 19 of the 22 respondents that were ISO 9000 certified, responded that

they would continue the implementation of ISO 9000 in the future.

6. The three significant and effective reasons for implementing ISO 9000 were (a) improving quality ($\underline{M}$ = 5.46), (b) customer satisfaction ($\underline{M}$ = 4.29), and (c) increasing productivity ($\underline{M}$ = 4.19). See Table 4.

7. The major portion (37.5%) of the respondents, 15 of 40 that were not adopting ISO 9000, indicated that the cost to adopt ISO 9000 was the major reason for not implementing ISO 9000. This information identified cost of implementation as prohibitive for Taiwanese construction companies to adopt ISO 9000.

8. A minority (25%), or 10 of the 40 respondents that did not implement ISO 9000, responded that they intend to adopt ISO 9000 in the future. This 25% consisted of 22.5% (9 of 40 respondents) that responded that they were willing to adopt ISO 9000. Also, 2.5% (1 of 40 respondents) who replied that they were strongly willing to adopt ISO 9000 in the future.

9. The majority of respondents (85.48%), or 53 out the 62, replied they did not conduct other quality assurance or quality management programs except ISO 9000.

10. A majority (62.9%), or 39 of the 62 respondents that have adopted ISO 9000, answered that they did not adopt an auxiliary program of quality assurance for ISO 9000 into their quality management system. In the meantime, total quality management was the most favored program of auxiliary quality management for the respondents that had adopted an auxiliary program of quality management.

11. The three major factors influencing the quality of projects were (a) customer demand ($\underline{M}$ = 8.11), (b) benefits to the company ($\underline{M}$ = 6.80), and (c) external competition ($\underline{M}$ = 6.33). Refer to Table 5.

12. The three significant advantages of adopting ISO 9000 were (a) increasing quality ($\underline{M}$ = 6. 61), (b) increasing quality management grid ($\underline{M}$ = 6.22), and (c) customers' satisfaction ($\underline{M}$ = 5.74). See Table 6.

13. The three momentous disadvantages of adopting ISO 9000 were (a) implementation costs ($\underline{M}$ = 4.96), (b) additional manpower ($\underline{M}$ = 4.52), and (c) modifying working processes ($\underline{M}$ = 3.85). Consult Table 7.

Research Question Data

Research Question 1

What is the current level of knowledge, the level of importance, and the level of implementation of ISO 9000 standards in the construction industry of Taiwan?

The Level of Knowledge

The general performance of the level of knowledge about ISO 9000 for the entire 62 respondents from the construction industry of Taiwan was low medium level. Result showed that, universally, the mean value ($\underline{M}$ = 3.25) was only a little higher than medium level, separately, the mean score was 3.53 in Type-A companies, 3.18 in Type-B, and 3.03 in Type-C. See Table 8.

Regarding the different management levels, the mean value of the level of knowledge about ISO 9000 was only 2.68 at the position of the employee. This was only under the medium level and far below the high level. The mean value at the management level of junior manager was 3.35. That was only a little higher than the medium level but much different than the high level. Also, the mean value at the management level of senior managers was 3.71, and which was still lower than the high level. Refer to Table 8.

The Level of Importance

Generally, the level of importance about ISO 9000 was moderately high for the whole 62 respondents, since the mean value was 3.81 which was lower, but closer to the high level. Individually, the degree corresponded to that of ISO 9000 which can have the contribution of the improvement of quality control was $\underline{M}$ = 3.94 from the entire 62 respondents, and it very closed to the high level. The response regarding whether ISO 9000 is important and necessary to the quality management system of company was $\underline{M}$ = 3.84. See Table 10.

The Level of Implementing ISO 9000

Universally, the level of implementing ISO 9000 was extremely low (0.67%) in the construction industry of Taiwan. According to the information provided by the international certification bodies (see Appendix B), only 44 Taiwanese construction companies had an approved ISO 9000 certificate at the time of the survey. The percentage implementing ISO 9000 was only 0.67%, if the 44 certified entities were divided by the 6,559 members of the National Construction Association of the Republic of China (Taiwan).

Research Question 2

What are the factors perceived to affect the successful adoption of ISO 9000 for the construction industry in Taiwan?

In order to answer this question more persuasively, two groups of functional questions were designed in the survey. The first group (Questions 25 to 46, Part VI of the questionnaire) was designed to detect which perceived factors will influence the intention to adopt ISO 9000. The second group (Questions 47 to 55, Part VII of the questionnaire) was developed to observe how the perceived factors should affect the success of implementing ISO 9000.

Based on the analysis, (a) peer competition ($\underline{M}$ = 4.15), (b) internal initiative ($\underline{M}$ = 4.13), (c) customers' expectation ($\underline{M}$ = 4.02), (d) global competition ($\underline{M}$ = 3.97), and (e) customer pressure ($\underline{M}$ = 3.95) were the five major factors that influence the intention to adopt ISO 9000. Consult Table 11. Generally, the mean values of 22 questions were from low-agree (4.15) to low-uncertain (3.29), and the distinction between the largest mean and smallest mean was 0.86. Separately, three questions in this group have a higher mean value than the rank of agree (4). Also, the mean scores of the other 15 questions were higher than the rank of medium-uncertain (3.5) but less

than the rank of agrees (4). The residual 4 questions had the mean value of less than the rank of medium-uncertain (3.5) but greater than the rank of uncertain (3). Refer to Table 11.

The information in the second group of questions (46 to 55) indicated that there were three important factors affecting the success of implementing ISO 9000 for the Taiwan's construction companies. They were (a) the attitude of management involvement ($\underline{M}$ = 4.18), (b) the success of employee education ($\underline{M}$ = 4.10), and (c) the attitude of employee involvement ($\underline{M}$ = 3.92). Those factors were followed by the factors of the success of system maintenance ($\underline{M}$ = 3.87), the adjustment of working process ($\underline{M}$ = 3.77), the cost of adopting ISO 9000 ($\underline{M}$ = 3.77), the success of auxiliary QA program ($\underline{M}$ = 3.63), the partnership of subcontractors ($\underline{M}$ = 3.61), and the success of organizational change ($\underline{M}$ = 3.60). Consult to Table 12.

Generally, the mean scores of all factors affecting the success of implementing ISO 9000 were from 4.18 to 3.60, and the distinction was only 0.58. Individually, the mean values of two items in this group were higher than 4, and mean values of the other seven items were higher than

3.60, which was between the level of agree and medium-uncertain.

Research Question 3

What are the relationships between size of a company and the level of knowledge, the level of importance, and the level of implementation?

The Level of Knowledge

As a whole, the difference in level of knowledge about ISO 9000 depended on the size of company and the management level. The larger companies reported a higher level of knowledge about ISO 9000, and the higher management positions also reported a higher level of knowledge about ISO 9000. See Table 8 and 9.

Relationship between knowledge level and size of company. The overall knowledge level in the three different types of companies (Type-A, Type-B, and Type-C) was compared using the ANOVA test. A 0.007 level of significance was computed, showing that there was significant difference in knowledge level by size of company.

As shown in Table 8, the overall mean values for knowledge level was 3.53 for Type-A, 3.18 for Type-B, and 3.03 for Type-C companies. Based on the data, the larger

companies possessed a higher level of knowledge of ISO 9000 than that of the smaller companies. See Table 8.

Relationship of knowledge level with management level. Basically, the F value of the ANOVA test can detect the difference of mean values of multiple sampling groups up to three or more than three (Hurlburt, 1998). Also, the ratio of Fisher's Least Significance Difference (LSD) can indicate the significant difference of variances of mean values between the independent subgroups of respondents (Clarke & Clarke, 1972; Hittleman & Simon, 1997; Hurlburt, 1998; Rong, 1997). Hittleman and Simon (1997) also pointed out that there is a curvilinear relationship between LSD ratios and the difference of the variance of mean values. The larger the difference of the variance of mean values of independent groups is, and the smaller the LSD ratio that will be produced. Normally, the critical value of 0.05 is a reliable index for detecting the significant difference of the mean value of samples. The relationship of knowledge level with the management level in the three different types of construction companies is shown in Table 8, and discussed in this section.

1. The Level of Employees

The mean value for the knowledge level of employees about ISO 9000 was 2.68. Individually, the mean values for employees was 2.82 for Type-A, 2.63 for Type-B, and 2.57 for Type-C companies. The significance ratio of the ANOVA test for the employee level was 0.615, which was higher than the critical value of 0.05. When focus on employee's knowledge level, there was no significant difference between the three types of companies. Refer to Table 8.

The significance ratio (LSD = 0.615) also identified that the knowledge level of employees in the three types of companies appear to have a higher level of homogeneity, normality and consistency of variance than senior managers and junior managers do. Of the three groups, employees had the lowest F value, which showed at 0.490. Consult Table 8.

2. The Level of Junior Managers

The overall mean value for the knowledge level of junior managers about ISO 9000 was 3.35. But depending upon the size of companies, mean values varied. The mean value for Type-A companies was 3.82, as compared with the mean values of 3.26 and 2.95 for Type-B and Type-C companies respectively. The significance ratio of the ANOVA test for the junior managers in the three types of

companies was 0.001, which was lower than the critical value of 0.05. This information indicated that the mean value of the knowledge level of the junior managers in the three different types of companies was significantly different. Refer to Table 8.

The significance ratio (0.001) also provided evidence that the variance of mean values of knowledge level about ISO 9000 of junior managers was the least homogeneous, normal, and consistent of the three groups, followed by senior managers (LSD = 0.232) and employees (LSD = 0.615). The F value of junior managers (F = 7.659) also indicated that the difference in knowledge level of junior managers by size of company was larger than that of senior managers and employees. Consult Table 8.

3. The Level of Senior Managers

In general, the overall mean score of senior managers' knowledge level about ISO 9000 was 3.71, which was the highest level in the three groups. The mean values for senior managers were 3.95 for Type-A, 3.63 for Type-B, and 3.52 for Type-C companies. The significance ratio for senior managers by size of company was 0.232, which was higher than the critical value of 0.05. Consequently, the

senior managers' knowledge level about ISO 9000 in three types of companies was not significantly different.

The significance value (0.232) indicated that the homogeneity, normality, or consistency of the knowledge level of senior managers was between the senior managers and employees. Given the F value of the senior managers (F = 1.496), the difference in mean values of senior mangers' knowledge level by size of company was higher than that of employees (F = 0.490) but lower than that of junior managers (F = 7.659). See Table 8.

The Level of Importance

Generally, the larger Taiwanese construction companies presented the stronger level of sense regarding the importance of ISO 9000. Individually, the mean value of the importance of ISO 9000 at Type-A companies was 4.23, and it was ranked first for the six perceived questions. Then, the mean value of that at the Type-B companies was 4.11, and it was also ranked first of the six questions. Furthermore, the mean value of that at the Type-C companies was only 3.10, and it was ranked last in the perceived questions. Refer to Table 10.

The Level of Implementing ISO 9000

According to the information provided by the international certification bodies of ISO 9000 in Taiwan (see Appendix D), the level of implementation of ISO 9000 in the Taiwanese construction industry was severely low. It was only 0.67% of the 6,559 Taiwanese construction companies at the time this research was conducted.

Separately, the different sizes of companies have different levels of implementation, and the larger companies had performed the higher level of implementing ISO 9000. The individual levels of implementation were displayed as follows:

1. Thirty-nine of 44 ISO 9000 certified construction companies were Type-A companies, that was 2.42% of the total 1,614 Type-A construction companies.

2. Five of the 44 (11.36%) construction companies, which were ISO 9000 certified, were Type-B companies. That was only 0.46% of the total 1,087 Type-B construction companies.

3. None of the Type-C companies was ISO 9000 certified at the time of the research projected.

Research Question 4

Is there any relationship between size of company and factors affecting the successful adoption of ISO 9000?

As shown in Table 12, only one factor of the nine factors that could affect the success of implementing ISO 9000, the factor of management involvement, showed significant difference when considering the size of company. The significance ratio (0.024) of the management involvement factor by size of company was smaller than the critical value of 0.05. The significance values of the other eight factors (Ranking from 2 to 9 in Table 12) were larger than the critical value of 0.05. There was no evidence to support the fact that there were significant differences in perceptions in the three types of companies about the other eight factors affecting the success of implementing ISO 9000.

According to their ranking, the three major factors were (a) the attitude of management involvement ($\underline{M}$ = 4.18), (b) the success of employee education ($\underline{M}$ = 4.10), and (c) the attitude of employee involvement ($\underline{M}$ = 3.92). All types of companies had the same concept about the importance of management involvement and the success of employee

education, which were ranked the leading two factors. Refer to Table 12.

In order to compare the difference of recognition in the three types of Taiwanese construction companies, the significant perceptions were stated as follows:

1. The attitude of management involvement, ($\underline{M}$ = 4.55 in Type-A companies and $\underline{M}$ = 4.21 in Type-B companies) was ranked the first important factor in both groups. But, it was only ranked third place for Type-C companies ($\underline{M}$ = 3.76).

2. The success of system maintenance ($\underline{M}$ = 4.11) was ranked the second important factor in the Type-B group.

3. The adjustment of working processes ($\underline{M}$ = 3.86) was ranked the first important factor in the Type-C companies. Consult Table 12.

Conclusion

Following the examination of the statistical information presented in the Chapter IV, the conclusion of this study were formulated as follows:

1. The average cost of implementing ISO 9000 was NT$ 840,632 (US$ 26,280) computed from the 22 companies that have adopted ISO 9000. In addition, the major reason of not adopting ISO 9000 was concerning the cost of ISO 9000

implementation responded by the 15 of 40 (37.5%) respondents who did not adopt ISO 9000. Total samples (N = 62) reported in this survey also indicated that the significant disadvantage of adopting ISO 9000 was the implementation cost (M = 4.96). Turn to Table 7 to view this figure. Obviously, high cost was one of the major obstacles for not adopting ISO 9000 for most construction companies in Taiwan.

2. Normally, the adoption of a new quality management system would cause the adjustment or interruption of the working processes, a change of company structure, and the maintenance of the system. That is especially crucial in the medium and small enterprises (Goetsch & Davis, 1997; Lee, 1995). In this study, the average amount of time needed to adopt ISO 9000 and to be ISO 9000 certified was 10 months (M = 10). The major concerns influencing the decision making to adopt ISO 9000 were (a) the transition to a quality assurance program (f = 6) and (b) the interruption or adjustment of projects (f = 5). Refer to Table 3. Also, the exceptional concerns about the factors affecting the success of implementing ISO 9000 were system maintenance in Type-B companies (M = 4.11) and adjustment of working processes in Type-C companies (M = 3.86).

Consult Table 12. Therefore, the long period of time for implementing ISO 9000 would be the major generator to influence or extend the adjustment of working processes or system maintenance.

Accordingly, the following factors might be the major reasons of not adopting ISO 9000 for the Type-B and Type-C companies. The factors were (a) the time to implement ISO 9000, (b) the transition to a quality assurance program, (c) the adjustment of working processes, (d) the organizational change or the company's structure change, and (e) the maintenance of the ISO system.

3. The three major reasons for adopting ISO 9000 as identified by those respondents who were already ISO 9000 certified were (a) to standardize the company ($\underline{M}$ = 8.92), (b) to improve documentation ($\underline{M}$ = 7.45), and (c) to meet local competition ($\underline{M}$ = 7.45). Examine Table 2. Further, peer competition ($\underline{M}$ = 4.32), internal initiative ($\underline{M}$ = 4.43), and customers' expectation ($\underline{M}$ = 4.02) were the three leading factors influencing the intention to adopt ISO 9000. Consult Table 11. Those evidences pointed out that to motivate the internal initiative for standardizing the management system, and to form an environment of peer

competition would be good reasons that could lead to the adoption of ISO 9000.

4. The majority (86.36%) of the 22 respondents (19 Type-A and 3 Type-B companies) that had adopted ISO 9000 system said they would continue the implementation of ISO 9000. In the meantime, the mean value of the level of recognition regarding the importance of ISO 9000 was 4.23 in Type-A, 4.11 in Type-B, and 3.10 in Type-C companies. Refer to Table. 10. But, only a few (22.5%) of the 40 respondents that had not adopted ISO 9000 indicated a willingness or strong willingness to adopt ISO 9000 in the future. These responses revealed that the companies would like to continue the assessment of ISO 9000 after they have adopted ISO 9000 and recognized the importance of ISO 9000.

5. The major portion (85.48%) of the total samples (N = 62) replied that they had not implemented a quality assurance program beyond ISO 9000. In addition, the majority (62.9%) of all 62 respondents responded that they did not adopt an auxiliary quality management program into their management system. Further, Table 9 shows that the level of knowledge about quality assurance was low medium (M = 3.41) for all 62 respondents. Refer to Table 9. Those evidences indicated that the most respondents lacked

a quality management system, which should be a major reason causing the quality problems on construction projects in Taiwan.

6. According to all responding survey participants, the customer demand was the most important factor influencing the quality of projects (M = 8.11). Consult Table 5. In Table 11, the mean value for customer expectation was 4.05 in both Type-B and Type-C companies, and customer pressure had a mean value of 4.11 in Type-B and 3.81 in Type-C companies. Obviously, customer pressure and customer expectations were the two major factors influencing the intention to adopt ISO 9000 for medium or small construction companies in Taiwan. See Table 11.

The finding also indicated the respondents had already recognized the importance of "customer orientation." Customer orientation is the most crucial factor in quality and cost management since the development of total quality management was launched (Cokins, 1996; Goetsch & Davis, 1997).

7. The partnership with subcontractors influences the whole quality of construction projects (Goetsch & Davis, 1997). The partnership with subcontractors was ranked as the fourth major factor (M = 4.23) affecting the intention

to adopt ISO 9000 in the Type-A companies. This finding suggests that a major concern of larger companies is the quality level of work down by subcontractors. Also, customer expectation and customer pressure were two important factors influencing the intention to adopt ISO 9000 for Type-B and Type-C companies. Consult Table 11. In order to enhance quality of construction projects throughout the entire construction industry, an important task for the larger size companies should be to structure an environment to encourage, urge, or force the smaller size companies to practice ISO 9000.

8. Overall, the mean value of the level of knowledge about ISO 9000 for all respondents (N = 62) was 3.25, which was only a little higher than medium level. Separately, the knowledge level about ISO 9000 was moderately high at the management level of junior managers (M = 3.35) and senior managers (M = 3.71) in the construction industry of Taiwan, but was medium to low at the employee level (M = 2.68). Table 8 reports these numbers. This condition may contribute to the level of implementation being very low (0.67%) for the samples. This information also indicated that employee education might be very important in the future.

9. The mean value of the level of knowledge about quality assurance in the total sample was 3.41, while the individual values were 3.73 for Type-A, 3.39 for Type-B, and 3.09 for Type-C companies. Consult Table 9. A low-medium level of knowledge could be an obstacle in raising the quality of construction projects and also a reason for the quality problem in current construction projects. This information indicated that education or training about quality assurance for the entire Taiwanese construction industry is an important issue in the future.

10. Generally, the entire group of respondents (N = 62) in this study did not possess a high level of knowledge about ISO 9000 (M = 3.25) and quality assurance programs (M = 3.41). As reported in Table 8 and 9. In addition, Table 10 shows that they did not have a strong belief that ISO 9000 was important (M = 3.81) and ISO 9000 could make a contribution (M = 3.94) to the quality control of construction projects.

11. Since the respondents did not indicate a strong belief concerning the importance of ISO 9000 (M = 3.81), this most likely contribute to the implementation level of ISO 9000 being low, only 0.67%, in the construction

industry of Taiwan. This condition was especially notable in the Type-B and Type-C companies. Refer to Table 10.

12. Generally, if companies had a higher level of ISO 9000 implementation, they had a higher level of recognition about the importance of management involvement. In regard to the implementation level, the percentage level for implementation was 2.42% for Type-A companies, 0.46% for Type-B, and 0.00% for Type-C. In addition, the level of recognition regarding the level of importance was $\underline{M}$ = 4.23 in Type-A companies, $\underline{M}$ = 4.11 in Type-B, and $\underline{M}$ = 3.10 in Type-C. These data are reported in Table 10.

13. The major obstacles noted by the respondents in making a decision to adopt ISO 9000 were (a) the transition to a quality assurance program ($\underline{f}$ = 6), (b) the adjustment or interruption of production processes ($\underline{f}$ = 5), (c) the documentation work ($\underline{f}$ = 4), and (d) the cost of implementation and registration ($\underline{f}$ = 3). Refer to Table 3. These results were similar to those of the research by the Small Business Research Trust conducted in 1992 (Small Business Research Trust, 1992).

14. Total management involvement, which consists of management involvement and employee involvement, is the foundation to successfully achieving the task of continuous

improvement in cost management and any other quality management systems (Cokins, 1996; Goetsch & Davis, 1997). Generally, all the 62 survey respondents recognized the importance of total involvement. Management involvement (M = 4.18), the education of employees (M = 4.10), and employee involvement (M = 3.92), were ranked the top three factors influencing the success of implementing ISO 9000. That meant the respondents had recognized the importance of total involvement. Refer to Table 12.

15. The major factors that affected the success of implementing ISO 9000 were system maintenance (M = 4.11) in the Type-B companies, and the adjustment of working processes (M = 3.86) in the Type-C companies. Consult Table 12.

16. The level of knowledge about ISO 9000 and of a quality assurance or management program depended upon the size of company and the different management levels. A higher level of knowledge about ISO 9000 and quality assurance was positively correlated to a larger company size. Also, the higher the level of management position, the higher the level of retaining that knowledge. Note these values in Table 8 and 9.

17. The 17 factors which influenced the adoption of ISO 9000 were (a) peer competition, (b) internal initiative, (c) customers' expectation or pressure, (d) global competition, (e) management involvement (f) partnership with subcontractors, (g) cost of organizational change, (h) cost of additional manpower, (I) employee education and its cost, (j) cost of system maintenance, (k) the attitudes of government, (l) additional documentation, (m) ISO 9000 prior to QA, (n) implementing and registration cost, (o) adjustment of working process, (p) risk of improperly adopting, and (q) shortage of experienced consulting firms. The factors are listed from most to least according to the ranking of response by the entire respondents and following reorganizations. Refer to Table 11.

a. Factor of changing environment was divided for peer competition and global competition.

b. The attitudes of government consisted of the government requirement, the subsidies from government, and non-financial encouragement of government, and the average of mean scores was 3.64.

c. Customer's expectation or pressure was the combination of customer's expectation and customer's

pressure, and the average of mean scores was 3.99.

18. Based on the analysis on Table 12, the nine factors that influenced the success of implementing ISO 9000 (from most to least influential) were (a) management involvement, (b) the success of employee education, (c) employee involvement, (d) the success of system maintenance, (e) the adjustment of working process, (f) the cost of adopting ISO 9000, (g) the success of QA program, (h) the partnership of subcontractors, and (i) the success of organizational change.

Discussion

The purpose of this study was to investigate the factors that were perceived to influence the intention of adopting ISO 9000 and to affect the success of implementing ISO 9000 in the construction industry of Taiwan. Based upon the review of the literature, the data analysis, and respondents' additional responses or suggestions, the following discussion is offered.

Generally, in order to increase the quality of construction projects, to meet the customers' expectations, to standardize a company, to challenge the peer competition, and to meet the global competition, it is necessary for the Taiwanese construction industry to adopt

ISO 9000 into their quality management system. The additional documentation work, implementation cost of ISO 9000, transition to an auxiliary quality assurance program of ISO 9000, system maintenance, and the adjustment or modification of working processes at construction projects were major obstacles to implementing the ISO 9000 system.

Management involvement, employee involvement, employee education, the success of system maintenance, the adjustment of working processes, the success of auxiliary quality assurance programs, the partnership with subcontractors, and the success of organizational change were the major factors affecting the success of implementing ISO 9000 in the construction industry of Taiwan.

Recommendations

The results of this study suggest the following recommendations.

Recommendations for the Government

1. Since the cost of implementing ISO 9000 was a major obstacle to not adopting ISO 9000 for most respondents, the Taiwanese government could provide a subsidy policy, such as the tax-subsidy and subsidy of adoption cost, to stimulate the adoption and implementation of ISO 9000.

2. A subsidy from the government ($\underline{M}$ = 4.21) was the second most important factor affecting the intention to adopt ISO 9000 in Type-B companies. In order to encourage the implementation of ISO 9000 in the medium and small companies, the government of Taiwan could develop a subsidiary policy to guide the adoption of ISO 9000 for Type-B companies or smaller companies. Consult Table 12.

3. Yates and Aniftos (1996) pointed out that the policy of the government agency would affect the attitude of conducting a management system for an enterprise in that country. In order to urge construction companies to adopt ISO 9000, the Bureau of Inspection of Taiwan, the only local certification body of ISO 9000, can start conducting the task of issuing the ISO 9000 certificates to the construction companies in the future.

4. Since professional consulting companies involved with ISO 9000 certification can play a crucial role in guiding the construction companies to adopt and implement ISO 9000 (Tan, 1995), the government agency of Taiwan should encourage their formation.

Recommendations for the Government and Certification Bodies

1. The long period of time needed to adopt ISO 9000 and to be ISO 9000 certified was a major issue causing the adjustment or interruption of working processes, and that would influence the transition and consistency of the quality of construction projects (Elimuti & Kathawala, 1997). In addition, the long period of time would also be the factor in increasing the cost of implementing ISO 9000 (Goetsch & Davis, 1997; Hou, 1997). The Bureau of Inspection of Taiwanese government and international certification bodies in Taiwan could try to shorten the time of certifying ISO 9000 and to curtail or avoid the interruption of working processes for construction projects during the time of auditing the ISO 9000 system. The efforts should consist of providing education or training services and professional consultant work, and also, standardizing the procedure for implementing and auditing the ISO 9000 system.

2. To assure that ISO 9000 is being implemented adequately and consistently in the ISO 9000 certified companies, the government agencies or the international certification bodies need to be more serious about

conducting the certification and monitoring the continuous operation of ISO 9000 system for their clients.

Recommendations for the Government and Taiwanese Construction Association

1. Since the level of implementing ISO 9000 is extremely low in the Taiwanese construction industry, the government of Taiwan and the National Construction Association of Taiwan need to focus more on efforts to develop and promote ISO 9000 in the future.

2. To assist and assure the successful adoption and implementation of ISO 9000, the Taiwanese government and the National Construction Association in Taiwan should develop auxiliary quality assurance programs for the ISO 9000 system, and make the construction companies of Taiwan more familiar with the programs through education.

Recommendations for National Construction Association in Taiwan

1. Since the documentation work is an important issue for the implementation of ISO 9000, the National Construction Association of Taiwan should standardize the format of documentation. That effort might guide the process of implementing ISO 9000 and being ISO 9000

certified more efficiently and consistently for the construction companies of Taiwan.

2. To overcome the shortage of human resources in implementing ISO 9000 and quality assurance programs, the associations of the construction industry of Taiwan can assist their members in educating or training the necessary staffs.

Recommendations for Construction Companies

1. According to the findings, the knowledge levels about ISO 9000 ($\underline{M}$ = 3.24) and quality assurance programs ($\underline{M}$ = 3.41) were both low medium, and that was probably the major reason for the severe quality problems in the construction industry of Taiwan. Consult Table 8. Also, the success of employee education was the second important factor influencing the success of implementing ISO 9000. Refer to Table 12. To meet the need to improve the serious quality problems, the education and development of an ISO 9000 system and a quality assurance program are very important issues for the Taiwanese construction industry in the future.

The education is especially necessary for employees and junior managers, and for Type-B and Type-C companies. First, the knowledge level of ISO 9000 and quality

management possessed by the employee and junior managers was extremely low, refer to Table 8 and 9, and that would influence the quality of projects. Also, the employees' attitude toward managing quality would straightly affect the quality of construction projects, since employees are directly engaged in the on-site works. Furthermore, the attitude toward managing quality of junior managers would influence the performance of employees and subcontractors because they have the primary responsibility for managing quality and leading employees. Therefore, employees and junior managers are the generators needed to perform consistency for the quality of construction projects.

Secondly, the knowledge level about ISO 9000 was low medium ($\underline{M}$ = 3.17) in Type-B companies and medium ($\underline{M}$ = 3.01) in Type-C, and the knowledge level about quality assurance was also low medium ($\underline{M}$ = 3.39) in Type-B companies and medium ($\underline{M}$ = 3.09) in Type-C. Consult Tables 8 and 9. The manner of possessing medium level of knowledge about ISO 9000 and quality assurance would influence the consistency of quality on huge projects, since Type-B and Type-C companies are supposed to be the subcontractors for Type-A companies.

2. The study showed that the attitude of management involvement and employee involvement is very important for companies that have already implemented ISO 9000 or intend to adopt ISO 9000 into their quality management system. So, the education about total quality management and total involvement is necessary for the construction industry in Taiwan in the future. These educational efforts should include conferences, workshops, and cooperative education.

3. Encouraging the subcontractors to adopt ISO 9000 might be a good strategy for the construction companies in Taiwan to improve project quality since the partnership with subcontractors would influence the consistency of project quality.

4. The success of implementing ISO 9000 is based not only on the certification procedure but also on continuous system maintenance (Hou, 1997). Therefore, ISO 9000 certified construction companies need to understand the major theme of the ISO 9000 system and the correct manner for implementing ISO 9000. To maintain the processes and the operation of ISO 9000 system adequately, consistently, and continuously is the major key to implement ISO 9000 successfully and perfectly.

The major theme and correct manner of ISO 9000 system were stated as follows. To adopt the ISO 9000 system and to get the ISO 9000 certificate is only an essential step for implementing the ISO 9000 system, since the certificate of ISO 9000 is the confirmation system of quality management but not the approval system of final products. The approval of ISO 9000 certificate is only a beginning for quality assurance. The success of quality management still relies upon continuously maintaining an ISO 9000 system.

5. To maintain the consistency of quality of construction projects in an appropriate or adequate manner at different stages of operation, the larger size construction companies or the ISO certified companies should motivate or require their subcontractors to adopt ISO 9000.

Recommendations for Additional Perceived Factors

The result of this study suggest that, in addition to the 14 perceived factors defined in the Chapter Two (literature review), three additional factors could affect the intention of adopting and the success of implementing ISO 9000. These are (a) the internal initiative, (b) the

risk of improperly adopting ($\underline{M}$ = 3.41), and (c) the shortage of experienced consultant firm ($\underline{M}$ = 3.34).

Internal initiative comes as a result of internal and external changes that galvanize companies to adopt ISO 9000 system. The mean score of internal initiative was 4.13 for entire 62 respondents, and it was ranked for second place in the Table 11. The higher mean value and leading ranking of internal initiative indicated its significant importance compared to the other factors. Consequently, internal initiative could be an additional factor to affect the intention to adopt ISO 9000.

Even though, the mean values of all 62 respondents were only low medium on the factors of improperly adopting and experienced consulting firms, several respondents demonstrated a higher degree of concern about these two factors. Several companies that were ISO 9000 certified especially expressed strong anxiety about the professional consulting firm's lack of expertise in assisting them in implementing ISO 9000. Refer to respondent comments.

Furthermore, since the mean value of this item was 3.53 in Type-B companies and 3.48 in Type-C, as compared with only 3.24 for Type-A companies, both Type-B and Type-C companies showed greater concern with the risk of

improperly adopting ISO. So, the risk of improperly adopting ISO 9000 was the perceptional item in making the decision to adopt ISO 9000 for both Type-B and Type-C companies. This situation reflected sensitivity to smaller companies because improperly adopting ISO 9000 must seriously harm the quality of projects through interruption or adjustment of construction processes and the large cost and obligation of adoption. Therefore, the risk of improperly adopting ISO 9000 could be another important factor for the medium to small size construction companies. Consult Table 11.

Recommendation for A Model of Decision Making

In their study, Anderson, Daly, and Johnson (1999) pointed out that country accrediting agencies, registrar companies, and individual auditors are three components of the infrastructure to develop and implement the ISO 9000 system. In this study, Figure 8 can be a model of decision making for a construction company that intends to adopt and implement the ISO 9000 system into its quality management system. The factors in the Figure 8 were listed according to their significance of mean scores (from most to least) in Table 11 and 12.

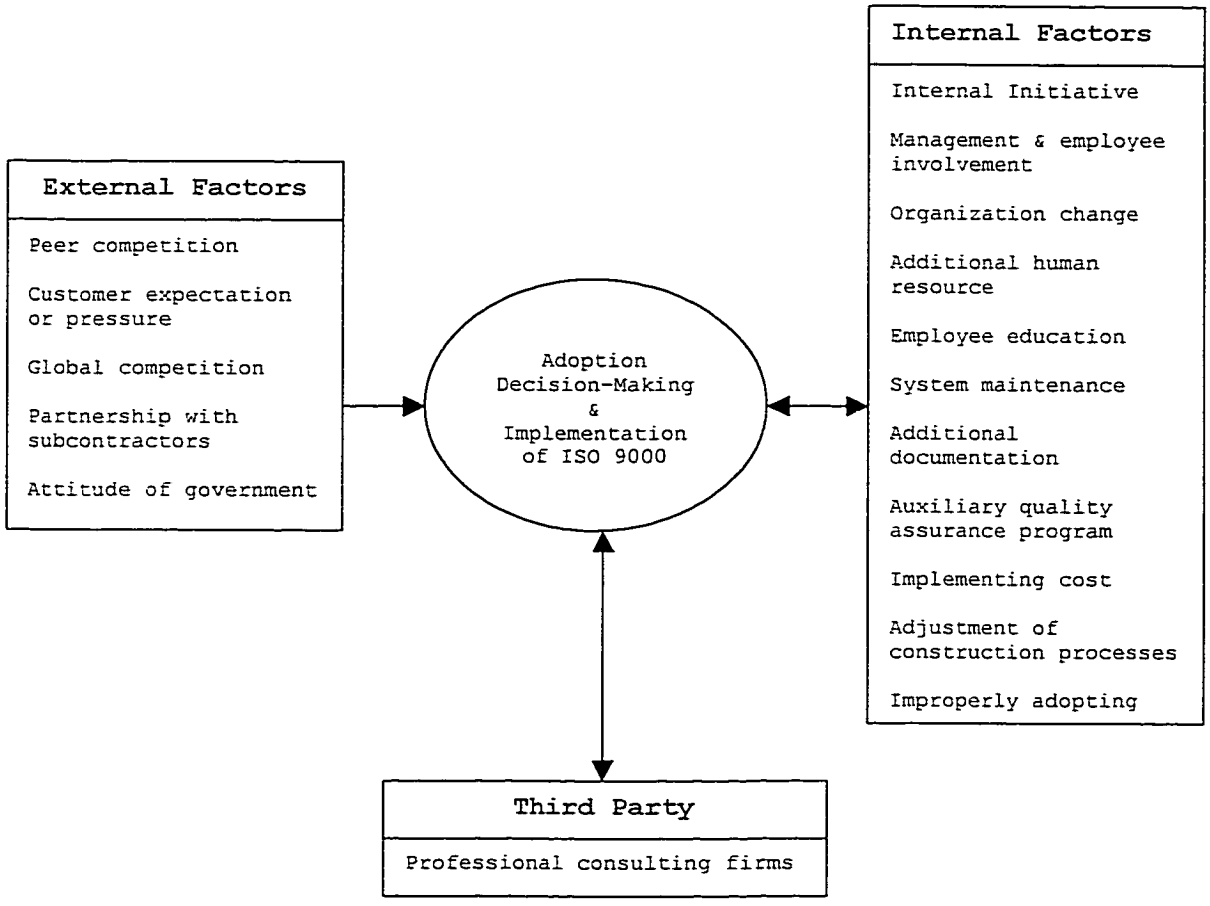

Figure 8. Model of Decision-Making for Adopting and Implementation of ISO 9000 in a construction company.

Recommendations for Future Study

1. A future study should focus on investigating and verifying the practical problems the ISO 9000 certified companies encounter in implementing ISO 9000.

2. A comparative study of the experience of adopting and implementing ISO 9000 between other Taiwanese

industries and the construction industry of Taiwan could be conducted.

3. A future study could investigate the current documentation process and establish a standard format so the ISO 98000 system can be efficiently adopted and implemented.

4. A comparative study could be done of construction industries in the geographic region where Taiwan is located, or a comparison of Taiwan with another countries with designated similarities.

5. A study to determine the leading countries adopting ISO 9000 could be done to ascertain the reason for adopting, to measure levels and practices, and to compare the significant similarities and/or differences.

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Appendix A

Cover Letter

The University of Northern Iowa

May 1, 1998

Dear Sirs:

It is our pleasure to send this questionnaire to your company, and we will appreciate your cooperation, response, and comments.

The title of this study is "The Consideration of ISO 9000 Related to Taiwan's Construction Industry". The purpose this study is to identify and investigate the factors affecting the adoption and implementation of ISO 9000 for the construction industry in Taiwan. We hope this study can provide the necessary and valuable information regarding the adopting and implementing ISO 9000 for the Taiwanese construction companies in order to enhance quality management and trade competitiveness.

Please submit this questionnaire to your company's manager or supervisor who is in responsible for the quality or operational management, or to the executive officer of the company, since we need their assistance and input to answer this questionnaire.

If you have any questions regarding this study, please do not hesitate to call Dr. Fecik, telephone number (319) 273-2489 or Fax number (319) 273-5818 in the United States, or Mr. Hung, telephone number (02) 2579-8869 or Fax number (02) 2577-1366 in Taipei. We and the construction industry in Taiwan will appreciate your response, since it will contribute to improving the industry. Thank you for your assistance, and

Sincerely yours,

Chuan-Chen Hung
D.I.T. Candidate

John T. Fecik
Dr. John T. Fecik
Dissertation Advisor

Department of Industrial Technology
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美國北愛荷華州立大學產業科技系　函

1998年5月1日

敬啟者：

久仰貴公司業績卓著，爲業界之光，極爲敬佩。因爲本研究之需要能得貴公司之協助以完成本問卷，甚爲榮幸。茲將有關細節說明如后：

一、此份問卷調查，係本系博士候選人洪全成爲完成其博士論文『ISO 9000在台灣建築業』所需之資料，所以貴公司的支持與合作對本研究有正面積極的貢獻。

二、貴公司所提供的資料，僅用作學術研究及統計分析之用，保證不對外發表個別資料。

三、麻煩將此份問卷轉呈貴公司負責品質管制或現場作業之經理級以上之主管，請其協助完成本份問卷之作答。

四、爲感謝貴公司之支持與合作，貴公司如需要未來完成的論文結論，我們可以免費寄送。

五、問卷請於87年　　月　　日前以回郵信封寄回，或傳真(02)2577-1366

謝謝合作！

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Appendix B

Questionnaires

Questionnaire

Part I. Demographic & Implementing Information. Please circle the answer of following questions, or write down the answer in right blank.

1. Who is your company's major customer?	1. Government __% 2. Private Sectors __%
2. What is the major type of business (construction or engineering) of your company?	1. Heavy & Highway 2. Industry & Commercial 3. Residential 4. Civic Engineering 5. Electrical Engineering 6. Plumbing & Line 7. Others ( )
3. What was the total annual income of your company in 1997?	
4. What was the total expenditure for quality assurance of your company in 1997?	NT$
5. How many employees are involved in the quality assurance program in your company?	NT$
6. How many subcontractors does your company utilize?	
7. How many subcontractors of your company have already adopted the ISO 9000?	
8. How many upstream contractors or customers does your company own?	
9. How many upstream contractors or customers of your company have already adopted the ISO 9000?	
10. Has your company adopted ISO 9000 quality standards system? **Notice:** (a) If the answer is **"Yes"** or **"In the process"**, please answer the questions form **a to i**. (b) If the answer is **"No"**, **"Failed"**, or **"No longer using"** please answer the questions from **j to k**.	1. Yes 2. In the process 3. No 4. Failed to meet adoption standards 5. No longer using
a. Please circle the category, which was adopted.	1. 9001 2. 9002 3. 9003
b. What was the total cost of obtaining the ISO 9000 certification?	NT$
c. Please circle the year when the adoption of ISO 9000 was started?	1991 1992 1993 1994 1995 1996 1997 1998

d. Please circle the year when your company became ISDO 9000 certified.	1992 1993 1994 1995 1996 1997 1998
e. How many months did it take for your company to be the ISO 9000 certified? Remark: M = month or months	3M 6M 9M 12M 15M 18M 21M 24M 27M 30M 33M 36M 39M 42M 45M 48M more than 48M (M)
f. Please rank order, from 1(most) to 10 (least), the reasons your company is using ISO 9000.	__Global competition __Local competition __Standardize company __Improve documentation __Reduce cost __Meet legal regulation __Client's demand __Internal initiative __Not sure __Others ( )
g. What was the major obstacle in making the decision to adopt ISO 9000 in your company? (Check only 1)	1. Cost of implementing 2. Additional manpower 3. Documentation work 4. Transition of quality assurance program 5. Interruption or adjustment of projects 6. Company structure or organizational change 7. Others( )
h. Will your company continue the implementation of ISO 9000?	1. Yes 2. No 3. Not sure
i. Please rank order, from 1 (most) to 6(least), the effectiveness of the following items after adopting ISO 9000.	__Increase market share __Increase productivity __Improve quality __Increase profits __Customer satisfaction __Others ( )
j. Please circle the reason for "not", "failed", or "no longer using" adopting ISO 9000. (Check only 1) Remark: QA--quality assurance QM--quality management	1. Cost is prohibitive 2. Not interesting 3. Minimum benefits 4. Not necessary 5. No human resource 6. Organizational change 7. Failure of QA or QM 8. Others ( )
k. How willing is your company to adopt ISO 9000?	1. Strongly unwilling 2. Unwilling to adopt 3. Not sure 4. Willing to Adopt 5. Strongly willing

Part II. The Conducting of Quality Assurance Program & ISO 9000

11. Is your company conducting any quality assurance or management program beyond ISO 9000?	1. Yes 2. No 3. In the process 4. Failed to conduct
12. What is the current quality assurance or management program in your company? Remarks: TQM--total quality management IQM--integrated quality management SQM--strategic quality management QCC--quality control circle MBNQA-Malcolm Baldridge National Quality Award	1. TQM 2. QCC 3. IQM 4. SQM 5. MBNQA 6. Others ( )
13. Is your company adopting ISO 9000 and conducting a quality assurance or management program at same time? *QA--quality assurance	__ Only ISO 9000 __ Only a QA __ ISO 9000 & a QA __ Others
14. Please rank order, from 1 (most) to 10 (least), the following factors in terms of their influence over the quality of projects.	__Legal regulation __The attitude of government agencies __ISO 9000 __Partnership with subcontractors __Teamwork __External competition __Customers' demand __Benefits of company __Internal initiative __Others ( )

Part III. The Advantage & Disadvantage of Adopting ISO 9000

15. Please rank order, from 1 (most) to 8 (least), the advantages of adopting ISO 9000.	__Increase market share __Increase profits __Increase productivity __Increase quality __Increase efficiency __Customer satisfaction __Increase QM grid __Others( )
16. Please rank order, from 1(most) to 6 (least), the disadvantages of adopting ISO 9000.	__Implementing cost __Modifying working processes __Additional Manpower __Regulating quality assurance program __Company structure or organizational change __Others( )

Part IV. Level of Knowledge about ISO 9000 & QA.
Please circle the level of knowledge for different groups in your company. Using the following ratings: (5) Very High, (4) High, (3) Medium, (2) Low, (1) Very Low, and (0) None.

17. What is the level of knowledge about the ISO 9000 in your company?						
a. Among your company's employee.	5	4	3	2	1	0
b. Among the junior managers.	5	4	3	2	1	0
c. Among the senior managers.	5	4	3	2	1	0
18. What is the level of knowledge about any quality assurance program, such as TQM, in your company?						
a. Among your company's employee.	5	4	3	2	1	0
b. Among the junior managers.	5	4	3	2	1	0
c. Among the senior mangers.	5	4	3	2	1	0

Please circle your response to following questions (from #19 to #55). Using the following ratings: (5) Strongly Agree, (4) Agree, (3) Uncertain, (2) Disagree, (1) Strongly Disagree.

Part V. ISO 9000 & Quality Management

19. Do you agree that the ISO 9000 is important and necessary to your company's quality management system?	5	4	3	2	1
20. Do you agree that ISO 9000 can contribute to the improvement of quality control?	5	4	3	2	1
21. Do you agree that, in order to improve quality control, conducting a quality assurance program, such as TQM, TQC, IQN, CWQC, and MBNQA, is necessary for a construction company?	5	4	3	2	1
22. Do you agree that adopting ISO 9000 and conducting a quality assurance program, such as TQM, at the same time are necessary for a construction company?	5	4	3	2	1
23. Do you agree that cost of managing quality is more important than quality of project?	5	4	3	2	1
24. Do you agree that activity costing can be a good tool for managing the cost of quality?	5	4	3	2	1

Part VI. Do your company agree the following perceived **factors** will **influence** the **intention** to **adopt ISO 9000**? Please circle your response.

25. Government requirement that construction companies adopt ISO 9000.	5	4	3	2	1
26. Government provided subsidies, such as tax deduction, to encourage the adoption of ISO 9000.	5	4	3	2	1
27. Non-financial encouragement from government for the adoption of ISO 9000.	5	4	3	2	1
28. The global competition after Taiwan has gained membership in the WTO.	5	4	3	2	1
29. The adoption of ISO 9000 of other construction companies.	5	4	3	2	1
30. The huge volume of internal cost for implementing ISO 9000. (According to relative researches that will be from NT$ 800,000 to 6,000,000).	5	4	3	2	1
31. The expensive registration cost. (According to relative researches that will be from NT$ 300,000 to 600,000).	5	4	3	2	1
32. The internal initiative or self-assessment necessary to improve the quality of projects.	5	4	3	2	1
33. The pressure of customers on your company to adopt ISO 9000.	5	4	3	2	1
34. The expectation of company's customers to adopt ISO 9000.	5	4	3	2	1
35. Because your company wants to conduct a quality assurance or management program prior to adopting ISO 9000.	5	4	3	2	1
36. To achieve a better partnership with subcontractors, and lead the subcontractors to adopt ISO 9000.	5	4	3	2	1
37. The large volume of documentation needed for the accreditation of ISO 9000.	5	4	3	2	1
38. The interruption and adjustment for the construction processes during the time of adopting ISO 9000.	5	4	3	2	1
39. The education and training needed by the entire employee before adopting ISO 9000.	5	4	3	2	1

40. The additional cost of employee training and education.	5	4	3	2	1
41. The necessity of the management involvement.	5	4	3	2	1
42. The cost of future system maintenance and continuous assessment in the future.	5	4	3	2	1
43. The cost of additional manpower.	5	4	3	2	1
44. The cost of organizational and structure change of your company.	5	4	3	2	1
45. The shortage of reliable consulting firms.	5	4	3	2	1
46. Additional cost resulting from failure to adopt ISO 9000.	5	4	3	2	1

Part VII. If your company decide to adopt ISO 9000, whether the following **factors** will affect the **success** of **implementing ISO 9000**? Please circle your responses.

47. The high additional cost for implementing ISO 9000.	5	4	3	2	1
48. The attitude of employees toward the implementation of ISO 9000.	5	4	3	2	1
49. The attitude of all level of managers regarding the involvement of the implementation of ISO 9000.	5	4	3	2	1
50. The cooperation of subcontractors regarding to the adoption of ISO 9000.	5	4	3	2	1
51. The cost and consequence of interruption and adjustment of construction processes.	5	4	3	2	1
52. The success of company's structure and organizational change.	5	4	3	2	1
53. The success of auxiliary quality assurance and quality management program.	5	4	3	2	1
54. The success of system maintenance and continuous assessment.	5	4	3	2	1
55. The success of employee training/education.	5	4	3	2	1

Thank you again! Please write down your comments in the blank.

美國北愛荷華州立大學產業科技系
問 卷 調 查

Ⅰ. 背景資料：請圈選或回答下列問題。

1. 貴公司主要客戶來源？	1. 政府單位 % 2. 私人企業 %
2. 貴公司主要業務形態？	1. 公路及各類重大土木工程 2. 工業用廠房及商用建築 3. 一般住宅建築 4. 各類土木營造工程 5. 機電工程 6. 水電消防工程 7. 其他（ ）
3. 貴公司民國86年的總營業收入？	NT$
4. 貴公司民國86年有關品質保證的總支出爲多少？	NT$
5. 貴公司直接投入品管工作的員工人數？	人
6. 貴公司目前共有多少下游承包商？	
7. 貴公司的下游承包商中有多少已持有ISO 9000認證？	
8. 貴公司目前共有多少上游供應商（廠商）？	
9. 貴公司的上游供應商(廠商)中有多少已持有ISO 9000認證？	
10. 貴公司是否已持有ISO 9000認證？ 回答本問題后，請注意： (a)請回答問題a～i，假如您的回答是1或2 (b)請回答問題j～k，假如您的回答是3. 4. 5	1. 已持有 2. 申請中 3. 未持有 4. 曾申請但失敗 5. 曾持有但不再繼續使用
a. 貴公司所持有的ISO 9000認證類別？	1. 9001 2. 9002 3. 9003
b. 貴公司用於申請ISO 9000認證的總支出？（申請中者，請估列）	NT$
c. 貴公司何時開始申請ISO 9000認證？	1991 1992 1993 1994 1995 1996 1997 1998
d. 貴公司何時成爲ISO 9000認證廠商？（申請中者，請預估）	1991 1992 1993 1994 1995 1996 1997 1998
e. 貴公司從申請到被認證的時間爲多長？ 備註：M＝月數	3M 6M 9M 12M 15M 18M 21M 24M 27M 30M 33M 36M 39M 42M 45M 48M 超過48M（ M）
f. 右列爲申請ISO 9000認證的理由，請依照貴公司對其感受的強弱程度予以排序，排序時請由1(最強)到10(最弱)予以排列。	_____國際競爭壓力 _____本國競爭壓力 _____將公司予以標準化 _____改善公司品管文件 _____降低工程成本 _____配合法律要求 _____客戶的要求 _____自我覺醒或意識 _____不確定 _____其他（ ）
g. 什麼是貴公司在申請ISO 9000認證時的最主要考量的因素？請圈選其中一項。	1. 實施ISO 9000成本 2. 需投入額外人力 3. 品管文件工作 4. 與其他品質保證工作的配合問題 5. 工程的配合或中斷 6. 公司組織或結構改變 7. 其他（ ）

h. 貴公司將來還會繼續申請ISO 9000認證？	1. 繼續 2. 不要 3. 不確定
i. 右列爲ISO 9000認證后可能的效益，請依貴公司對其感受程度的強弱予以排序，排序時請用1(最強)到6(最弱)的方式排列。	_____提高市場佔有率 _____提高生產效能 _____改善品質 _____提高利潤 _____滿足客戶要求 _____其他 ( )
j. 請圈選貴公司未申請ISO 9000認證的理由（圈選一項即可） ＊回答爲"曾申請但失敗"或"曾持有但不再繼續使用"亦請回答此題。	1. 成本考量 2. 無興趣持有 3. 效益很小 4. 沒必要持有 5. 沒有專業人才 6. 影響公司組織結構改變 7. 相關的品質保證工作失敗 8. 其他 ( )
k. 貴公司申請ISO 9000認證的意願？	1. 非常無意願 2. 無意願 3. 不確定 4. 有意願 5. 意願很高

II. ISO 9000及品保制度之引進及執行

11. 除了持有ISO 9000外，貴公司還引進及執行其他的品管制度？	1. 是 2. 沒有 3. 引進中 4. 引進失敗
12. 貴公司所引進執行的品管制度是什麼？	1. TQM(全面品管) 2. QCC(品管圈) 3. IQM(複合式品管) 4. SQM(策略品管) 5. MBNQA 6. 其他 ( )
13. 貴公司是否同時執行品質管制制度及ISO 9000認證？	_____僅有ISO 9000 _____僅有品保制度 _____品保制度及ISO 9000 _____其他 ( )
14. 右列爲影响工程品質的要素，請依貴公司對它們的感受強弱的程度予以排序，排序時請由1(最強)到10(最弱)予以排列。	_____法律規定 _____政府官員執法態度 _____ISO 9000認證 _____下游承包商合作態度 _____公司團隊精神 _____公司外部競爭壓力 _____顧客的要求 _____公司的利益 _____自我意識的覺醒 _____其他 ( )

III. 引進ISO 9000認證的優缺點

15. 右列爲引進ISO 9000認證制度的好處，請依照貴公司對其感受的強弱程度予以排序，排序時請由1(最強)到8(最弱)予以排列。	_____提高市場佔有率 _____提高利潤 _____提高產能 _____提高工程品質 _____提高工程效益 _____提高顧客滿意度 _____提高品管效度 _____其他 ( )
16. 右列爲引進ISO 9000認證制度的壞處，請依照貴公司對其感受的強弱程度予以排序，排序時請由1(最強)到6(最弱)予以排列。	_____執行ISO 9000成本 _____工程執行程序改變 _____增加人力資源 _____改變品管制度 _____公司組織結構改變 _____其他 ( )

IV. 對ISO 9000及品保制度的認知程度

請依照 (5)非常高 (4)高 (3)一般 (2)低 (1)非常低 (O)全無 的順序予以圈選下列問題

17. 貴公司各階層對ISO 9000的認識程度爲何？						
a. 一般員工	5	4	3	2	1	0
b. 中低階經理人	5	4	3	2	1	0
c. 高階經理人	5	4	3	2	1	0
18. 貴公司各階層的品質保證(管制)制度的認識程度爲何？						
a. 一般員工	5	4	3	2	1	0
b. 中低階經理人	5	4	3	2	1	0
c. 高階經理人	5	4	3	2	1	0

請圈選下列問題(從# 19到# 55)圈答時請依
(5)非常同意 (4)同意 (3)不確定 (2)不同意 (1)非常不同意 的順序予以回答。

V. ISO 9000及品質管理制度

19. ISO 9000對貴公司的品管制度是必要且重要的	5	4	3	2	1
20. ISO 9000對品質控制的改善有所貢獻	5	4	3	2	1
21. 對一個公司之品質保證的改善而言，執行一項品保制度，如：TQM、TQC、IQM、CWQC & MBNQA是必要的	5	4	3	2	1
22. 對提高工程品質而言，同時執行品管制度及引進ISO 9000認證是必要的	5	4	3	2	1
23. 品質管制的成本比工程的品質重要	5	4	3	2	1
24. Activity-Costing是管理品質成本的重要工具	5	4	3	2	1

VI. 下列因素可能影响貴公司引進ISO 9000的意願請圈選貴公司對其同意的程度。

25. 政府要求引進ISO 9000	5	4	3	2	1
26. 政府以補貼(如：稅額扣抵)方式鼓勵引進ISO 9000	5	4	3	2	1
27. 政府以非補貼方式鼓勵引進ISO 9000	5	4	3	2	1
28. 台灣加入WTO后的國際競爭壓力	5	4	3	2	1
29. 其他同業的競爭壓力(因爲同業已引進ISO 9000)	5	4	3	2	1
30. 執行ISO 9000制度的成本(大約從NT$800,000到6,000,000)	5	4	3	2	1
31. ISO 9000的註册成本(大約爲NT$300,000到600,000)	5	4	3	2	1
32. 公司自我覺醒或意識要改進工程品質	5	4	3	2	1
33. 顧客或上游廠商的要求及壓力	5	4	3	2	1
34. 顧客或上游廠商的希望	5	4	3	2	1
35. 引進一個品保制度前而先引進ISO 9000以提高其成效	5	4	3	2	1

36. 鼓勵公司下游廠商引進ISO 9000以提高整體工程的銜接品質	5	4	3	2	1
37. 引進ISO 9000后所增加繁多的品保文件	5	4	3	2	1
38. 執行ISO 9000引起的工程執行程序的中斷及調整	5	4	3	2	1
39. 執行ISO 9000前，對所有員工的教育訓練工作	5	4	3	2	1
40. 執行員工的教育訓練所增加的成本	5	4	3	2	1
41. 各管理階層的全面參與及執行ISO 9000	5	4	3	2	1
42. ISO 9000引進后，其將來的系統維護及繼續引進的成本。	5	4	3	2	1
43. 增加人力資源所增加的成本。	5	4	3	2	1
44. 公司組織與結構改變所增加的成本。	5	4	3	2	1
45. 缺乏可信賴的顧問公司以輔導引進ISO 9000。	5	4	3	2	1
46. 引進ISO 9000失敗所造成的額外負担。	5	4	3	2	1

VII. 下列因素可能影响ISO 9000認證制度的成敗。請圈選貴公司對其同意的程度

47. 執行ISO 9000認證制度所帶來的額外執行成本。	5	4	3	2	1
48. 員工對執行ISO 9000的配合態度。	5	4	3	2	1
49. 管理階層對執行ISO 9000的配合態度。	5	4	3	2	1
50. 下游廠商對執行ISO 9000的配合態度。	5	4	3	2	1
51. 工程施工程序的中斷及調整所帶來的影响及額外成本。	5	4	3	2	1
52. 公司組織與結構改變的成敗。	5	4	3	2	1
53. 並行或輔助的品管制度之成敗。	5	4	3	2	1
54. ISO 9000制度的系統維護及繼續引進的成敗。	5	4	3	2	1
55. 員工教育訓練工作的成敗。	5	4	3	2	1

謝謝合作！並請寫下貴公司的建議，需要研究結論者請留連絡方式！

Appendix C

1. Listing of International Certification bodies in Taiwan.
2. Listing of the Taiwanese Construction Companies that were ISO 9000 Certified.

International Certified Bodies in Taiwan

Certified Bodies	ISO 9000	QS 9000	Service for Construction Industry	Telephone Number
BVQi	V	V		02-27417307 07-3337096
BSI	V		V	02-25979955
DNV	V	V		02-27576817
Entela	V	V	V	02-28221715
Inchcape	V			02-25979955
LRQA	V	V		02-25140884
SGS	V	V		02-22993226
TUV-Essen	V	V		
TUV-PS	V			02-27051338
RWTUV	V		V	02-28324192
TUV-Rheinland	V	V	V	02-25166040
UL	V	V		02-27186671(UL Mark) 04-5288761 (ISO9000)

Note. This information was provided by China National Accreditation Board.

07/15/98 WED 16:48 FAX 02 7034883 RWTUV TAIWAN 001

RWTUV

TELEFAX

Phone: 00886-2-2703 6561
Fax: 00886-2-2703 4883

Please notice our new address!

To	: 13707 NW 47th Ave. Vancouver, WA 98685	*From*	: Jack Yeh RWTÜV Far East Ltd Taiwan Branch
Fax no.	: 360-571-9231		
Phone no.	: 360-571-9249	*Certificate no.*	:
Attention	: Mr. Chuan-Chen Hung	*File no.*	:
Date	: 15.07.98		
Pages incl. cover	: 2	*Document:*	C:\FAXFORM.doc

Re: your letter dated on Jul., 05, 1998

Dear Mr. Hung,

thank you very much for your letter.

Enclosed please find the list of construction companies which have been already certified ISO 9000 by RWTÜV.

If you still need any help, please feel free to contact me again and I wish you success.

Sincerely yours,

Jack Yeh
General Manager

RWTÜV Far East Ltd.; 5 F. No. 57, Sec. 2; Tun - Hua South Road; Taipei 106; Taiwan, R. O. C.

今大營造有限公司 Jing Ta Construction Co., Ltd.	鑫園建設股份有限公司 Golden Garden Construction Co., Ltd.
高立營造股份有限公司 Gaoli Construction Co., Ltd.	長太營造有限公司 Evertop Construction Corporation
互利營造股份有限公司 Huli Construction Co., Ltd.	林同棪工程顧問股份有限公司 T.Y.Lin Taiwan Consulting Engineers Inc.
福太建設股份有限公司 Fu Tai Development Co., Ltd.	立旺營造工程有限公司 Liwan Construction Co., Ltd.
萬發營造有限公司 Wang Fa Construction Co., Ltd.	泰業營造股份有限公司 Thai Yea Construction Co., Ltd.
冠鈞營造股份有限公司 Champion Contruction Co.	偉大建設股份有限公司 Wei Ta Construction Co., Ltd.
九達營造工程股份有限公司 Chiu Ta Construction & Engineering Co., Ltd.	

Note: This information was provided by RWTUV in Taiwan.

ISO 9000 Certified Construction Companies
by Entela in Taiwan

Company(公 司 名 稱)	Address (地 址)
Fu-Lee Construction Co 复立營造股份有限公司	43, Alley 26, Lane 442, KaiYuan R, Tainan 台南市開元路 442 巷 26 弄 43 號
Mun-Fe Construction Co 猛揮營造股份有限公司	A5, 14F, No 289-70, Chi-Tong Road, Yan-Kung, Tainan 台南縣永康市小東路 289-70 號 14 樓 A5
Chiao-Kuo Construction Co. 喬國營造股份有限公司	11F, 200, Chong-Ming Raod, Taichung 台中市忠明路 200 號 11 樓

Note: This information was provided by Entela in Taiwan.

ISO 9000 Certified Construction Companies
by BSI in Taiwan

忠泰建設公司	長聯營造公司	大城建設公司
鄉林建設公司	上源營造公司	全鋒建設公司
兢誠建設公司	松暉營造公司	中城營造公司
玄洲建設公司	森成營造公司	龍億營造公司
全友建設公司	長虹工程公司	美富營造公司
昌溢建設公司	建高工程公司	總營建設公司
順天建設公司	東憲工程公司	
巨瀚營造公司	展立營造公司	
尚禹營造公司	旭佳建設公司	
良達營造公司	巨國建設公司	

Note: This information was provided by BSI in Taiwan.

Appendix D

Respondents Comments

In order to acquire the additional information or the other concerns about this study, which were not covered in the questionnaire, the respondents were asked to write their comments. Seven of the respondents have written down their comments about this study, and the comments are listed as follows.

---

1. The implementation of ISO 9000 will bring additional documentation work to the ISO 9000 certified companies.

2. The purpose of adopting the ISO 9000 system is not only to get the certificate of ISO 9000 but also need to honestly and adequately conduct the ISO 9000 system and the continuous maintenance as well as the auxiliary system of quality management.

3. It is ridiculous to be ISO 9000 certified 9000 only for the purpose of got the certificate of ISO 9000 or to continuously get the certificate by the way of using the imitative documentation.

4. The internal initiate of employees, managers, and owners is the most important factor of efficiently and consistently implementing ISO 9000.

5. For the purpose of adequately conducting the ISO 9000 system in an ISO 9000 certified company, a qualified supervisor of quality management or quality assurance system is a primary requirement.

6. In order to practice the ISO 9000 system effectively, the Taiwan's construction companies, the Taiwanese government agencies, the professional consulting firms, and the international certification bodies of ISO 9000 must fully posses the knowledge of ISO 9000.

7. In order to retain the performance of implementing ISO 9000 in an excellent condition, the government agencies and certification bodies of ISO 9000 must honestly and seriously perform their work of inspecting and auditing.

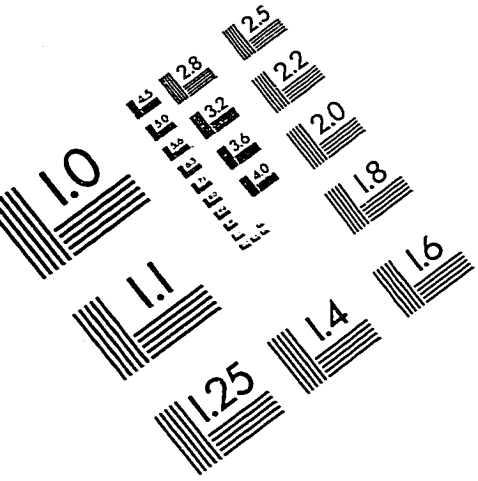
8. If the certification bodies and auditors are not qualified, and that will bring additional obligation to the companies of adopting ISO 9000.

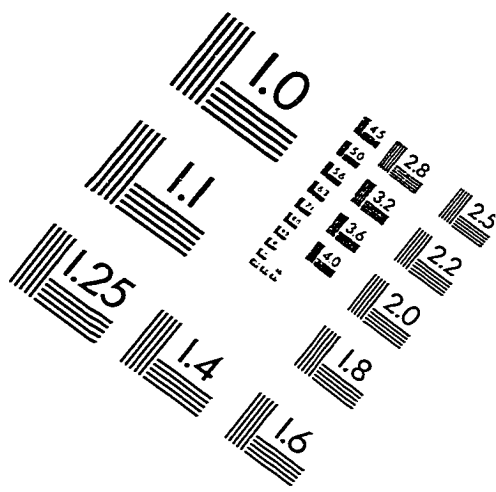
9. Currently, the auditors of certification bodies in Taiwan do not posses the sufficient ability of auditing and the professional knowledge of ISO 9000. Those factors has caused that the companies of adopting ISO 9000 do not know how to follow the auditing work in process of ISO 9000 certification.

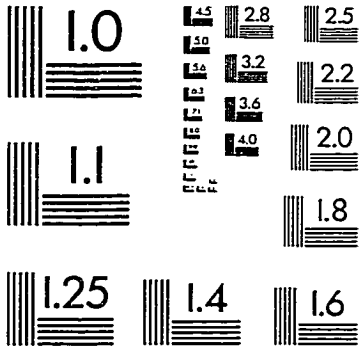
10. The character of internal auditors of quality assurance program or quality management system will influence the implementation of ISO 9000.

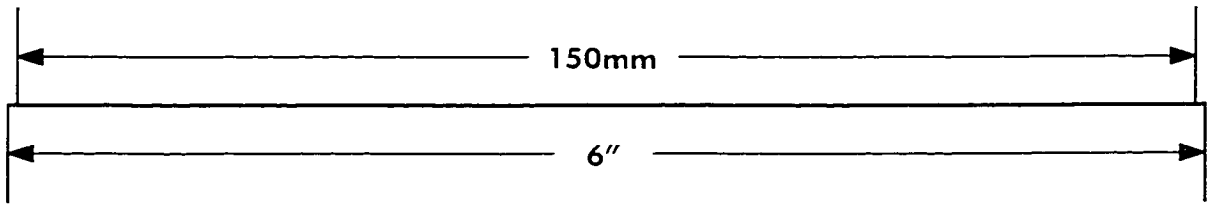
11. The partnership with subcontractors is an important issue influencing the consistency of a project quality, and which will also affect the success of whole construction project.

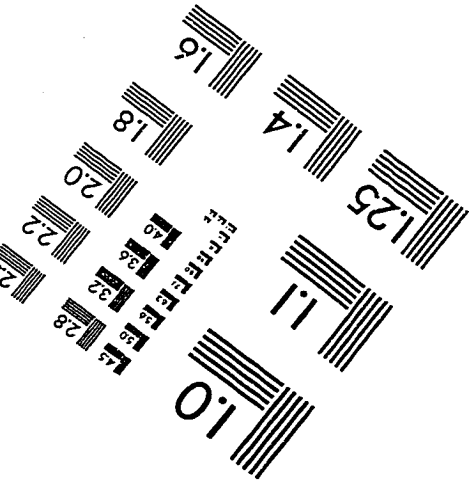
IMAGE EVALUATION
TEST TARGET (QA-3)











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1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
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