

# A Study on Cost of Quality System Implementation Status of Taiwan's Manufacturers

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## Abstract

Cost of Quality (COQ) reporting emphasizes that through cost relevance reporting the performance and management of QC-related operations will be more effectively evaluated and audited. COQ helps business to reach higher quality economy and efficiency, which in turn, helps to reduce business cost without sacrificing the business quality. While the COQ system has long been recognized by the industries in Europe and the United States, it has also received attentions from Taiwan business.

This research uses the Empirical Study method to survey 500 business organizations in Taiwan to reveal and discuss their 1) COQ implementation status, 2) COQ information collection and compilation methods, and 3) COQ management system operation status, with a hope to establish a standard to evaluate COQ-related issues for local industry.

**Keywords:** Cost of Quality System, COQ Implementation Pattern, COQ Management System, Quality Management Performance

## 1. Introduction

Cost of Quality management system stresses that a business is able to reduce its cost without suffering a quality loss. This emphasis breaks the traditional myth of “high quality means high cost” and wins the hearts of many European and American enterprises. Internationally, there have been many researches in COQ implementations. The academia in Taiwan has also contributed reasonable local research effort in this area and has provided local enterprises with the results that can serve as references for COQ implementations. Table 1 summarizes the international research findings about the COQ implementation status. This

research team uses questionnaire to conduct a wider and deeper survey regarding current COQ implementation status among top 500 manufacturers in Taiwan.

Table 1. COQ Implementation Status

| Nation  | Researcher               | Method Used             | No. of Samples | Research Object                                  | Response Rate | COQ Implementation Rate |
|---------|--------------------------|-------------------------|----------------|--|---------------|-------------------------|
| Britain | Plunkett & Dale (1983)   | In-depth Interview      | 12             | Pressured Boiler Plants                          | 100%          | < 50.0%                 |
|         | Allen & Oakland (1989)   | Mailed Questionnaires   | 400            | Textile Industries                               | 46.00%        | <50.0%                  |
|         | Singer et. al. (1989)    | In-depth Interview      | 13             | Nuclear Facility Suppliers                       | 100%          | <50.0%                  |
|         | Sohal et. al. (1990)     | Mailed Questionnaires   | NA             | British Quality Control Association Members      | 26.60%        | 63%                     |
|         | Lascelles & Owens (1990) | Mailed Questionnaires   | 1,160          | Automobile Suppliers                             | 32%           | 42%                     |
| US      | Sullivan & Owens (1983)  | Magazine Questionnaires | 35,000         | Quality Control Magazine Subscribers             | <0.2%         | NA                      |
|         | Gilmore (1983)           | Mailed Questionnaires   | 35             | COQ Enterprises                                  | 49%           | NA                      |
|         | GAO (1991)               | Individual Interview    | 22             | Enterprises Receiving National Quality Award     | 100%          | 22.73%                  |
|         | Chen (1993)              | Mailed Questionnaires   | 375            | Small Businesses with revenue over US\$1,000,000 | 35%           | 38%                     |
| Japan   | Kano (1986)              | Mailed Questionnaires   | 680            | Japanese Quality Control Association Members     | 32%           | 1.91%                   |
| Germany | Nlouw & During (1990)    | Interview               | 98             | Business with over 10 Employees                  | 100%          | 13%                     |
| Taiwan  | 洪孟靖 (1991)               | Mailed Questionnaires   | 100            | Top 100 Manufacturers                            | 76%           | 52.60%                  |
|         | 陳正恭 (1995)               | Mailed Questionnaires   | 100            | Top 100 Manufacturers                            | 56%           | 58.90%                  |
|         | 王銘宗與邱文亮(1999)            | Mailed Questionnaires   | 203            | Top 500 Hi-tech Manufacturers                    | 41.40%        | 37.40%                  |
|         | 林正明 (1999)               | Mailed Questionnaires   | 300            | Site and Management Magazine Subscribers         | 38.30%        | 60.00%                  |
|         | 王銘宗與董玉麟(2000)            | Mailed Questionnaire    | 500            | Top 500 Manufacturers                            | 24.00%        | 30.00%                  |

Note 1: The table is arranged chronically and in alphabetic order of nations

Note 2: Sources : [Shah 1998], [王銘宗與董玉麟 2000]

## 2. Literature Review

Besides Juran's consumer aspect COQ and Morse et. al's provider aspect COQ, there is Ortrenge's added value COQ. This added value COQ can be deemed as a business's tool for resource distribution. When comes to added values, except for the prevention cost that can add value to the business, all the other costs such as those induced by assessment, internal failure, and external failure have no added value.

Questionnaire Survey is often used to verify the connectivity among COQ values reported by research objects [Chauvel and Andre 1985], [Plunkett and Dale 1988], [Krishnamoorthi 1989], [Ponemon, etc 1994], [Ittner 1996]. It is also used to explore whether different COQ categories are mutually substitutable, although the empirical analysis in this regard has not reached a common conclusion.

## 3. Research Design and Research Method

This section will describe the tools used in this research in addition to research structure, questionnaire variable design and sampling method.

### 3.1 The Survey Tool

The researchers decided that questionnaire survey is the best tool for acquiring:

1. universal and general factors that affect the COQ implementation
2. the proof of benefits for business to implement COQ

### 3.2 Research Structure

For the purpose of constructing a COQ System Reference Indicator, this research is structured as shown in Figure 1.

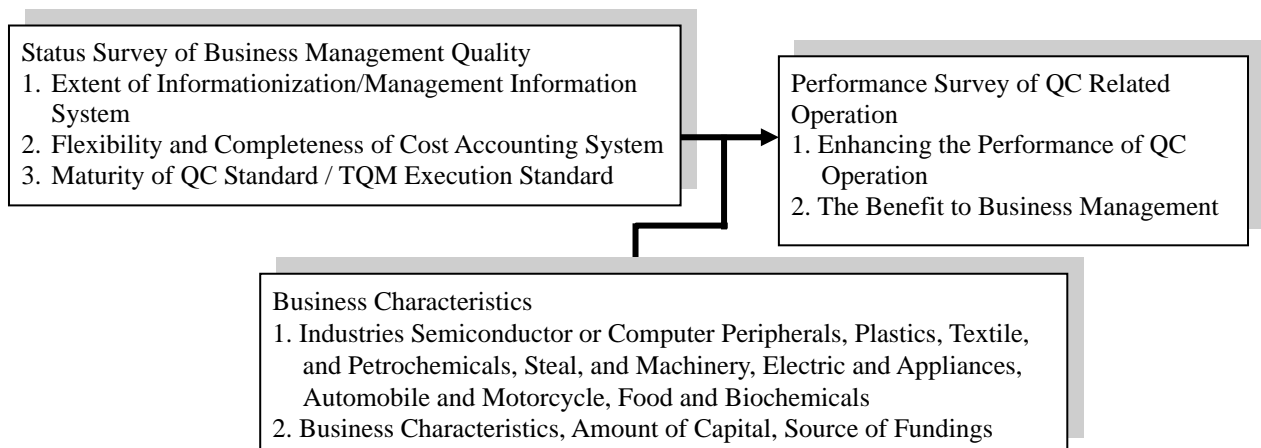


Figure 1. Survey Structure

### **3.3 Question Variables**

#### **3.3.1 Business Management Quality**

Business Management Quality is a variable that identifies the type of businesses that are fittest for COQ implementation. The contents of this variable is compiled from international literatures and extracted from the local empirical surveys.

##### **3.3.1.1 Informationization Extent**

The concept of Informationization Extent comes primarily from Sullivan [1983] and Tsiakals [1983], which indicates that using computerized information system can not only simplify the current accounting system workflow, but also help in COQ construction and implementation. Therefore, the informationization extent is deemed an important factor that affect the COQ implementation.

The operation variable is designed as per five development stages of an information system:

1. Initial Operation Stage
2. System Design Stage
3. System Integration Stage
4. Network Connection Stage
5. Operation and Renovation Stage

##### **3.3.1.2 Cost Accounting System Category**

The concept of Cost Accounting System Category comes primarily from Plunkett and Dale [1988], in which the authors, after reviewing related papers published in Europe and the US, emphasize that the success of COQ implementation is dependent upon how a company's QC department cooperates with its accounting department, and how to make proper adjustment to the current accounting system to simplify COQ information acquisition.

The operation variable is designed, primarily, as per 蔡文賢與江胤源 [1997], in which the authors, after reviewing cost accounting literatures, grouped the cost and the management accounting system into the following categories:

6. Traditional Costing Methods (e.g. Step Costing, Batch Costing, Standard Costing, etc.)
7. Improved Costing Methods (e.g. Induction Costing, Regression Costing, and Dynamic Costing, etc.)
8. Revolution Costing Methods (e.g. Activity Based Costing, Target Costing, Life Cycle Costing, etc.)

##### **3.3.1.2 QC Awareness Maturity / TQM Execution Standard**

QC Awareness Maturity / TQM Execution Standard is being used as an independent variable for it has been verified by 陳正恭[1993] and 邱文亮[1999] via an empirical study, which indicates that the implementation of COQ and the execution of TQM are positively

relevant.

This research also aims to identify, within a company, the extent of QC execution that will call for the COQ implementation. So the variable is further divided into two phases:

- 1 Internal Value of Quality (including the rank of quality manager's position, the maturity of quality awareness, and the extent of TQM execution.)
- 2 Explicit Maturity of Quality (including whether or not pass the ISO or any other certification, whether or not awarded with quality related award)

### **3.3.2 Business COQ Implementation Status**

The measuring of Business COQ Implementation Status is based on the COQ classify standard issued by American Society for Quality Control (ASQC). The research team lists all the cost items and classify the items with cost of process COQ model. And then, ask the survey participants to answer the questions based on his or her company's practical execution status using a five-point Likert Scale.

### **3.4 Sampling Method**

The questionnaires are distributed to the top 500 manufacturers (as per Business Week's "1999 Top 1000 Manufacturers in Taiwan") for a comprehensive survey in the following six major industries:

1. Integrated Circuits
2. Computer Peripherals
3. Electrics and Electronics
4. Plastics and Petrochemicals
5. Steel and Machineries
6. Automobiles and Motorcycles

### **3.5 Data Analysis Method**

This research uses SPSS (Statistical Package for Social Science) and Excel for data analysis. The basic information gathered from the Surveyed manufacturers are also compiled and analyzed with descriptive statistics.

## **1. Study Results**

The results of this study as presented in the followings include:

- 1 COQ implementation status in Taiwan
- 2 The patterns of COQ information gathering and compilation
- 3 Current execution status of COQ management system

### **4.1 COQ implementation status in Taiwan**

This research is concentrated in the study of COQ implementation status among top 500 Taiwan Enterprises. For the Surveyed businesses, this paper will discuss:

1. their COQ implementation status,
2. their purpose for implementing COQ,
3. their reasons for not implementing COQ,
4. their COQ implementing patterns,
5. the department that conduct their COQ implementation,
6. the basis for their annual COQ goal , and
7. the amount they invest in COQ-oriented education and trainings.

### **Finding 1: The automobile and motorcycle industry tops the list in implementing COQ.**

Table 2 illustrates the COQ implementation status by industries. It shows that the automobile and motorcycle industry scores top in implementing COQ, followed by electrics and appliance group and then food, animal feed, and biochemical group. While the steel,

cement, and machinery group has the lowest implementation rate among traditional industries.

**Table 2. COQ Implementation Status**

| Variable | Group                                   | Implemented | Not Yet Implemented | Total | Implementation Percentage |
|----------|---|-------------|---------------------|-------|---------------------------|
| Industry | Semiconductors and Computer Peripherals | 8           | 17                  | 25    | 32.00%                    |
|          | Textile, Plastics, and Petrochemicals   | 9           | 22                  | 31    | 29.03%                    |
|          | Steel, Cement, and Machineries          | 6           | 28                  | 34    | 17.65%                    |
|          | Electric and Appliances                 | 6           | 10                  | 16    | 37.50%                    |
|          | Automobiles and Motorcycles             | 4           | 2                   | 6     | 66.67%                    |
|          | Food, Animal Feed, and Biochemical      | 3           | 5                   | 8     | 37.50%                    |
|          | Total                                   | 36          | 84                  | 120   | 30.00%                    |

**Finding 2: In-house demand is the major driving force for businesses to implement COQ.**

When a business implements COQ, most likely it is trying to meet the demand from its higher management, to improve the production, to evaluate performance, or to classify the cost levels and characteristics. Table 3 lists a business's purposes for implementing COQ. Among these purposes, "to voluntarily maintain an effective management quality standard" top the list, followed by "to improve the production." While "to comply with the authorities" and "to classify the cost levels and characteristics" fall on the bottom of the list.

This indicates that business in Taiwan implement COQ to resolve practical quality issues instead of being demanded by authorities or just wanting to claim the title of having the COQ. This finding implies that COQ system does have its practical value for Taiwan business and the acceptance of COQ is expected to increase once the implementation difficulties are overcome.

**Table 3. The Purpose for Implementing COQ**

| Purpose of Implementation  | No. of Hits | Ratio  | Rank |
|--|-------------|--------|------|
| To Voluntarily Maintain an Effective Management Quality Standard | 27          | 75.00% | 1    |
| To Improve the Production Process                                | 17          | 47.22% | 2    |
| To Evaluate Performance  | 16          | 44.44% | 3    |
| To Meet the Demand of Higher Management                          | 11          | 30.56% | 4    |
| To be Complied with the Authority                                | 7           | 19.44% | 5    |
| To Classify the Cost Levels and Characteristics                  | 7           | 19.44% | 6    |

Total Number of Samples that Have Implemented COQ: 36

**Finding 3: The primary barrier for COQ implementation is the absence of a systematic implementation mechanism.**

Among the factors that keep a business from implementing the COQ system, as shown in Table 4, “without sufficient knowledge of COQ” top the list (35.71%), followed by “information gathering difficulty” (33.33%). Right after them, “difficulty in classifying COQ”(30.95%) and “the absence of an influential promoter” (30.95%) go side by side. Then, “current system is capable to identify effective quality improving methods” takes a share of 28.57%. Among these top five, “without sufficient knowledge of COQ,” “Difficult to gather information,” “difficult to classify COQ,” and “the absence of an influential promoter” can be collectively placed under the category of “in need of a systematic implementation mechanism.”

For a business that is evaluating its COQ implementation feasibility, “a systematic implementation mechanism” tends to imply that the process could be problematic and the cost could be high. In addition, some businesses are impractically confident about their current system. They thought their cost and quality system is sufficient for them to identify effective quality improvement measure. To these businesses, COQ becomes a tough sale.

**Table 4. The Reasons for not Implementing COQ**

| Factor  | Ratio  | Rank |
|---|--------|------|
| without sufficient knowledge of COQ                                       | 35.71% | 1    |
| Information Gathering Difficulty  | 33.33% | 2    |
| difficulty in classifying COQ   | 30.95% | 3    |
| the absence of an influential promoter                                    | 30.95% | 4    |
| Current System Is Capable to Identify Effective Quality Improving Methods | 28.57% | 5    |
| Quality is not Easy to Measure or Assess with Money                       | 15.48% | 6    |
| Without Support from Higher Management                                    | 8.33%  | 7    |
| Other   | 5.95%  | 8    |
| COQ Implementation Is not Cost Effective                                  | 4.76%  | 9    |
| Employees Are Reluctant to Support  | 3.57%  | 10   |

**Finding 4: Most businesses tend to develop their COQ system in-house.**

For those businesses that claim to have implemented COQ in Table 5., this research surveys their COQ status and compiles the results. “using an internally developed system” takes a share of 77.78% to top the list. As for the pattern generally agreed to be more feasible, “purchasing an off-the-shelf software package,” barely make the list. This finding indicates that industry and academia should be up to speed in development of a proper COQ information system.

**Table 5. The COQ Implementing Patterns**

| Implementation Pattern   | Ratio   |
|--|---------|
| Using a System Developed in-house                              | 77.78%  |
| Implementing Jointly with Academic or Research Institutes      | 8.33%   |
| Implementing with the Assistance from Private Consulting Firms | 8.33%   |
| Purchasing an Off-the-shelf Software Package                   | 5.56%   |
| Total  | 100.00% |

**Finding 5. Within a company, the unit that first carries out the COQ is usually its QC departments.**

The implementation of COQ should start small. The system should be initiated and tested within a unit or an department in the company and not to be applied to the entire organization until it reaches its maturity. Previous researches show that QC department is usually the unit that carry out the COQ within a company. As shown in Table 6, this research found that 69.44% of the businesses that have implemented COQ have their implementation conducted by QC department, which confirms the previous findings. Other than that, the accounting department, which take a share of 19.44%, has a role as well. Nevertheless, a US Accountant Atkinson stated that the joint force of QC and accounting is still the best partnership for carrying out COQ. As the operation of COQ become more mature, accounting department should assume the duty to carry out the system and integrate it to the company's overall COQ so as to assure its efficiency.

**Table 6. The Units/Departments that Lead the COQ Implementation**

| Leading Organization  | Ratio  |
|-----------------------|--------|
| QC Department         | 69.44% |
| Accounting Department | 19.44% |

|                       |       |
|-----------------------|-------|
| COQ Project Committee | 2.78% |
| Others                | 8.33% |
| Total                 | 100%  |

**Finding 6. COQ Annual Goal is still controlled by the company higher management.**

COQ Annual Goal can be used as a COQ management plan measuring criterion. As shown in Table 7, among surveyed businesses, this goal is either set by their higher management (47.22% of the surveyed) or is not explicitly set (30.56% of the surveyed). This is mainly because the annual COQ amount has not been standardized in Taiwan. For those business that have not set their annual target, they use something similar to Statistical Process Control charting techniques to measure their COQ. As long as the amount falls within a reasonable range, these companies will not take any measure for improvement. Only 5.56% of businesses choose to refer to the standard set by same business. That the COQ amount is considered confidential by some companies and therefore is difficult to obtain might be the reason for such a subjective method not being more widely used.

**Table 7. COQ Annual Goal Setting Method**

| Goal Setting Method                            | Ratio   |
|--|---------|
| Set by Higher Management                       | 47.22%  |
| No Explicit Goal                               | 30.56%  |
| Set by COQ Project Committee                   | 16.67%  |
| Referring to the Standard Set by Same Business | 5.56%   |
| Total  | 100.00% |

**Finding 7. The business's investment to COQ-related training still falls at the lower end.**

Table 8 shows that less than 60% of the surveyed businesses conduct regular COQ trainings, which means business, leaving behind the teaching that the concept of quality is

deeply related to education and training, does not invest enough money in that aspect.

The participants of COQ trainings are mostly limited to COQ-related project personnel (30.56%), which indicates that the industry is influenced by the concept of matrix organization management system and consider the COQ implementation a project rather than a program.

The statistics also shows that among the surveyed businesses that provide their staff with COQ-related trainings, 42.86% of the them choose to have their staff trained outside by professional training organizations out of the three training options. The remaining two training options are both in-house, which add up to 57.14%.

No matter what statistics show in the survey, there is a reason to believe that the web-based training will prevail as time goes by.

**Table 8. COQ Oriented Training Condition**

| Analysis Item                          |   | Ratio  |
|--|---|--------|
| Training<br>Object                     | COQ-related Personnel                                     | 30.56% |
|  | QA and Accounting Departments                             | 13.89% |
|  | All Employees   | 13.89% |
| Training<br>Form                       | Trained Externally by Professional Training Organizations | 25.00% |
|  | Trained In-house by the Company QA Specialists            | 19.44% |
|  | Trained In-house by the Hired Specialist                  | 13.89% |
| Never Implemented Any Training Session |   | 41.67% |

#### **4.2 COQ information gathering and compilation**

The pattern of COQ information gathering and compilation is the key that assures a business to succeed in COQ execution after its implementation. For the survey businesses that have successfully implemented COQ, this survey explore their:

1. COQ cost compilation organization
2. COQ categorization methods
3. COQ information compilation operation patterns

Hopefully, the following findings will serve as a good reference for the business that intends to implement COQ.

**Finding 1. QC department is still the leading organization that gather and compiles COQ cost information**

As shown in Table 9, 30.56% of the surveyed companies use their accounting department to collect and compile COQ information, while for 52.78% of the businesses; their QC department is responsible for information gathering. This seems to defy the usual practice in which the accounting department is put in charge to gather and compile cost related information. Such uncommon practice might have been caused by the reason that the area of COQ is not covered by the traditional accounting system.

There have been cost and accounting specialists who suggest to integrate the information cost of the COQ-related operation within the accounting management system. This will allow the accounting department to gradually pick up the responsibility of the COQ implementation and execution so as to assure the accuracy and the efficiency of COQ information.

**Table 9. Who Compiles the COQ Cost?**

| Department in Charge  | Ratio  |
|-----------------------|--------|
| QC Department         | 52.78% |
| Accounting Department | 30.56% |
| Others                | 11.11% |

|                       |         |
|-----------------------|---------|
| COQ Project Committee | 5.56%   |
| Total                 | 100.00% |

**Finding 2. The traditional COQ 4-class Classification is still the primary mechanism for compiling COQ information.**

How the COQ information is classified will certainly affect the way how OCQ information is presented. If the information is compiled via standard COQ classification, the report will present four cost categories (e.g. prevention, assessment, internal failure and external failure costs). This is undoubtedly the most prevailing (91.67%) method as illustrated in Table 10.

If the information is classified using Accounting Subject Classification, then the report will present the general operation items. The system will retrieve and sum up the required items from accounting information system only when an overall COQ information analysis is necessary.

Quality loss method uses product quality information to construct external failure cost estimate model.

The cost of process method, which is little used (only by 2.78% of the surveyed businesses), is a cost accounting system that categorizes COQ into two classes (i.e. cost-effective and non-cost effective) via company's overall quality operation process structure. The two classes are then summed and compiled as needed at wherever the quality related costs incurs.

**Table 10. COQ Classification Methods**

| COQ Classification Method                                    | Ratio  |
|--|--------|
| Standard COQ Classification (Prevention, Appraisal, Internal | 91.67% |

| COQ Classification Method  | Ratio  |
|--|--------|
| Failure and External Failure Costs)  |        |
| Accounting Subject Classification (Classify Based on Accounting Subjects)  | 19.44% |
| Quality Loss Method (Based on Taguchi's quadratic quality loss function)   | 5.56%  |
| Cost of Process Method (Based on conformance and non-conformance to Classify the COQ Incurred in the Production Process) | 2.78%  |

**Finding 3. Most businesses still acquire their COQ related information from accounting information system on needed basis.**

For the businesses that have implemented COQ, Table 11 illustrates the survey results of their information compilation pattern. As shown in the table that 27.78% of the businesses surveyed have to acquire related information from accounting information system when needed. Side by side with the “traditional manual reporting operation” is “use only the office automation software for information compilation”, which takes a 22.22% share and falls in the second place. Summing up these three items to reveal a fact that 72.22% of the businesses with COQ do not have an integrated management information system suitable for compiling COQ information.

This finding indicates that the COQ information systemization is yet an area to work on.

**Table 11. Operation Patterns of COQ Information Compilation**

| Operation Pattern  | Ratio  |
|--|--------|
| Acquire Related Information from Accounting Information System when Needed | 27.78% |
| Traditional Manual Reporting Operation                                     | 22.22% |
| Use Only the Office Automation Software for Information Compilation        | 22.22% |

|   |        |
|---|--------|
| Being Part of the Complete Business Information Management System Structure | 19.44% |
| Has COQ-exclusive Computer Information System for Information Maintenance   | 8.33%  |

### 4.3 Execution Status of COQ Management System

The quality of COQ management system is the key factor that decides the role the COQ information plays in the business. Only when a business is equipped with a well suited COQ management system can it use the COQ information to improve the quality of business culture, cut the wasteful operation, and thereby enhance the competency. This research surveyed the businesses that have implemented COQ to identify their:

1. interdepartmental meeting frequency
2. COQ-to-sales ratio
3. key success factors for COQ implementation

The following findings should help business to benefit more from its COQ information.

**Finding 1. For most COQ business their interdepartmental COQ meeting frequency is weekly.**

Although 27.78% of the companies surveyed indicate that they have not establish a mechanism for interdepartmental COQ-related meetings, 50% of them have establish a schedule to meet weekly, if it is not an over-kill(Table 12). As literatures point out, monthly or weekly meetings of such kind are necessary only during the first few years of COQ implementation. As the system reaches its maturity and as the learning curve of the system become less steep, the meeting frequency can be reduced to quarterly or semiannually fulfill the function of COQ system.

**Table 12. The Interdepartmental Meeting Frequency**

| Meeting Frequency | Ratio | Rank |
|-------------------|-------|------|
|-------------------|-------|------|

|                            |        |   |
|----------------------------|--------|---|
| Less than Annually or None | 27.78% | 2 |
| Semiannually               | 8.33%  | 4 |
| Quarterly                  | 2.78%  | 5 |
| Monthly                    | 11.11% | 3 |
| Weekly                     | 50.00% | 1 |

**Finding 2. The COQ businesses in Taiwan perform equally well as their Europe and the US counterparts when it comes the COQ maintenance.**

This research has fulfill its primary objective of obtaining reference materials to serve as the COQ analysis indicator for Taiwan area business (Table 13). Via comparing the data in Taiwan with what have been reported in the US, this research also helped to find, in the COQ performance aspect, where Taiwan business stands.

**Table 13. COQ Survey Data by Industry**

| Surveyed Item                              |                | The Ratio of | Prevention Cost | Assessment | Internal Failure | External     |
|--|----------------|--------------|-----------------|------------|------------------|--------------|
| Industry                                   |                | COQ Total to | Ratio           | Cost Ratio | Cost Ratio       | Failure Cost |
|  |                | Sales Cost   |                 |            |                  | Ratio        |
| Semiconductors and Computer<br>Peripherals | Percentage     | 3.02%        | 23.81%          | 36.33%     | 30.60%           | 9.11%        |
|  | No. of samples | 6            | 6               | 6          | 6                | 6            |
| Textile, Plastics, and<br>Petrochemicals   | Ratio          | 3.79%        | 25.81%          | 29.10%     | 37.77%           | 7.33%        |
|  | No. of samples | 7            | 7               | 7          | 7                | 7            |
| Steel, Cement, and Machineries             | Ratio          | 4.06%        | 25.80%          | 27.00%     | 25.60%           | 21.20%       |
|  | No. of samples | 5            | 5               | 5          | 5                | 5            |
| Electric and Appliances                    | Ratio          | 1.30%        | 30.39%          | 33.30%     | 23.58%           | 12.89%       |
|  | No. of samples | 5            | 5               | 5          | 5                | 5            |
| Automobiles and Motorcycles                | Ratio          | 1.93%        | 27.95%          | 30.75%     | 19.07%           | 32.86%       |
|  | No. of samples | 5            | 5               | 5          | 5                | 5            |
| Food, Feed, and Biochemical                | Ratio          | 0.72%        | 35.69%          | 38.06%     | 20.93%           | 5.33%        |
|  | No. of samples | 2            | 2               | 2          | 2                | 2            |
| Top 500 Manufacturers in<br>Taiwan, Total  | Ratio          | 2.73%        | 25.99%          | 31.84%     | 28.32%           | 13.77%       |
|  | No. of samples | 27           | 28              | 28         | 28               | 28           |

|   |                |       |        |        |        |        |
|---|----------------|-------|--------|--------|--------|--------|
| The US Tool Machine Industry*             | Ratio          | 4.44% | 11.00% | 23.70% | 39.60% | 25.70% |
|   | No. of samples | NA    | NA     | NA     | NA     | NA     |
| The US Transportation Equipment Industry* | Ratio          | 3.89% | 8.70%  | 45.30% | 33.20% | 12.80% |
|   | No. of samples | NA    | NA     | NA     | NA     | NA     |

**Finding 3. Support from Higher Management is the key factor for a successful COQ Implementation**

The key factors for a successful COQ implementation is, no doubt, the support from higher management. The interdepartmental cooperation (especially from production and accounting) is ranked the second. While COQ-related knowledge is the factor to which businesses pay less attention.

**Table 14. The Key Successful Factors for COQ Implementation**

| Key Factors for COQ Implementation Success                                     | Response | Weight Score |
|--|----------|--------------|
| Support from Higher Management   | 66.67%   | 171          |
| Interdepartmental Cooperation (Especially from Production and Accounting)      | 72.22%   | 163          |
| Integrated COQ and QA  | 61.11%   | 122          |
| Realization of Quality Education for Employees to Gain Common Knowledge of COQ | 55.56%   | 110          |
| A Comprehensive Information System to Assure the Information Integrity         | 52.78%   | 91           |
| An Clear QC System that Functions Smoothly                                     | 44.44%   | 87           |
| A Thorough Implementation Plan with Regular Discussions to Improve             | 47.22%   | 86           |
| COQ -related Knowledge   | 55.56%   | 78           |

**5. Conclusion**

Despite the COQ research effort contributed by the academia, business in Taiwan has failed to match their European and the US counterparts in either valuing or implementing COQ system. The possible reasons are:

1. the absence of satisfactory COQ implementation and execution guidelines (e.g. ISO-9000)
2. the absence of incentive (such as government funding or encouragement)

It is fortunate, however, the ISO 9000 series 2000 has integrated in its guidelines the Quality Economy System (one of the COQ applications). This inclusion has greatly enhanced the visibility of COQ and will in turn endorse the implementation of COQ in Taiwan. With the number of COQ success stories growing steadily, the future of COQ in Taiwan will surely brighten.

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