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The Impact of Implementation of ISO9000: 2000 on Technology Improvement: A Case study

Mohammad Shahalizadeh†
Department of Industrial Engineering-Productivity and System Management
Graduate Studies Center, Islamic Azad University, South Tehran Branch, Islamic Republic of Iran
Tel: +98-21-44302004, Fax: +98-21-66437232, E-mail: mshahalizadeh@hotmail.com

Mohammad Mostabseri
Young Researcher's Club
Islamic Azad University, Tehran, Islamic Republic of Iran
Tel: +98-21-77541656, Fax: +98-21-66437232, E-mail: Mostabseri@hotmail.com

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Abstract. ISO9000 set of standards has been widely applied in Iranian Automotive manufacturing industry. Regarding the effects of TQM and ISO9000 set of standards various studies have been conducted and different quantitative conclusions have been made. Due to lack of quantitative information, in many of the cases, using qualitative information becomes the best option. The qualitative nature of data in such cases, requires qualitative analysis methods that might lead to some challenging computational issues.
This paper examines the impact of ISO9000: 2000 certification and its perceived benefits for an automotive manufacturing company. Using an empirical approach, the paper seeks to ascertain if certification has indeed improved the performance of the company. Our null hypothesis rotates around the effect of ISO9000: 2000 on the 4W`s of an enterprise. To carry out the research, first we developed a couple of questionnaires including all criteria of ISO9000 and 4W's. Second, the questionnaires were discussed with two researchers knowledgeable in the field, and then submitted to the quality practitioners and executives of Iran Khodro Enterprise-a leading company in Iranian automotive manufacturing industry. Finally the null hypothesis was tested and the technology improvement dimensions were ranked through nonparametric tests. The results illustrated a reasonable cause and effect relationship, suggesting that ISO9000: 2000 has positive effect on the 4W`s of company result. In this work we investigate the effect as technology improvement viz., the improvement of techno-ware, human-ware, info-ware, and organ-ware.

Keywords: TQM, ISO9000: 2000, Techno-ware, Human-ware, Info-ware, Organ-ware

1. INTRODUCTION

The ISO9000 set of international standards were created in 1987 with the objective of standardizing quality systems. These standards go through a review procedure every five years (Tummala and Tang, 1996).

Many researchers consider ISO9000 as a first step towards Total Quality Management (TQM) (Sun, 2000; Escaniano *et al*., 2001).

The similarities and non-similarities of ISO9000 and TQM elements have been well studied (Lee *et al*., 1999; Gotzamani and Tsiotras, 2001).

The relationship between TQM and company results has been widely analyzed and researchers have generally found a positive effect of TQM on company results (Terziovski and Samson, 2000; Zhang, 2000; Hendricks and Singhal, 2001a, b).

The relationship between ISO9000 and company results also has been analyzed and researchers have found a positive effect of ISO9000 on company results (Withers and Ebrahimpour, 2000, 2001; Santos and Scaniano, 2002; Wayhan *et al*., 2002).

To be fair, ISO9000 certification does not automatically guarantee quality assurance, but rather consistency of procedures to fit into a command and control mentality. While many organizations rush to be ISO9000 certified, whether this brings about better business performance is still an open question (Avery, 1994; Sneddon, 1998). A wide variety of studies have been done on the pros and cons of using such certification instruments (Ebrahimpour

† : Corresponding Author

et al., 1997; Skrabec *et al*., 1997).

In this research we study the impact of implementing ISO9000: 2000 on technology improvement in an Iranian large automotive company which has not adopted TQM before. To assess the effect of adopting this standards, the following question was asked: Has ISO9000 standards compliance benefited the company in fourfold dimensions of improvement? All the organization can use the result of this study to decide for themselves the value of ISO9000 certification and also managing further research on multifaceted effects of ISO9000 driven quality improvement on company result.

The organization of this paper is as follows: in section 2, we present the theoretical framework. Section 3 describes the methodological aspects, Section 4 illustrates the results of conducting the analysis via real data. Conclusions are made in section 5.

2. THEORETICAL FRAMEWORK

The main objective of this section is to review the existing body of knowledge relating to the impact of ISO 9000 certification on company result. According to the significance of TQM as the final step in quality management which provides a basis for evaluation of ISO9000 set of standards, it is necessary to define TQM.

TQM can be defined as a systemic and global approach to firm management based on management by process and continuous improvement of business performance through involving the entire human resources in order to satisfy explicit or implicit expectations of costumers and other stakeholders.

Several writers have attempted to define the key dimensions that constitute TQM. More recently Martinez Lorente *et al*., (2000) categorized these into eight groups:

1. Top management support: Top management commitment is one of the major determinants of successful TQM implementation. Top management has to be the first in applying and stimulating the TQM approach, and they have to accept the maximum responsibility for the product and service offering. Top management also has to provide the necessary leadership to motivate all employees.
2. Quality data and reporting: Quality information has to be readily available and the information should be part of the visible management system. Records about quality indicators have to be kept, including scrap, rework and cost of quality.
3. Workforce management: Workforce management has to be guided by the principles of training, empowerment of workers, and teamwork. Adequate plans of personnel recruitment and training have to be implemented and workers need the necessary skills to participate in the improvement process.
4. Employee attitudes and behavior: Companies have to stimulate positive work attitudes, including loyalty to the organization, pride in work, focus on common organizational goals and the ability to work cross-functionally.
5. Supplier relationship: Quality is a more important factor than price in selecting suppliers. A long-term relationship with suppliers has to be established and the company needs to collaborate with suppliers in order to help improve the quality of products/services.
6. Customer relationship: The employees should always keep in mind the needs of consumers and their satisfaction. It is necessary to identify these needs and their level of satisfaction.
7. Product design process: All departments have to participate in the design process and work together to achieve a design that satisfies the requirements of the customer, according to the technical, technological and cost constraints of the company.
8. Process flow management: housekeeping along the lines of the 5S concept. Statistical and non-statistical improvement methods should be applied as appropriate. Processes need to be mistake proof. Self-inspection undertaken using clear work instructions. The process has to be maintained under statistical control.

A great number of researchers have analyzed the impact of TQM implementation on business performance (Elmuti and AlDiab, 1995; Mohrman *et al*., 1995; Powel, 1995; Hendricks and Singhal, 1996; Forker *et al*., 1997; Choi and Eboch, 1998; Easton and Jarrel, 1998; Adams *et al*., 1999; Dow *et al*., 1999; Terziovski and Samson, 1999; Hua *et al*., 2000; Zhang, 2000; Hendricks and Singhal, 2001a, b; Shetty, 1993).

On one hand a great body of knowledge is dedicated to evaluate ISO9000 in comparison to TQM:

ISO9000:1994 includes in its description elements that could be some of the TQM principles. The process flow management (Lee *et al*., 1999), information and data gathering (Gotzamani and Tsiotras, 2001), and use of statistical tools (Lee *et al*., 1999) could be some of them. In addition to that, the standards include some other elements that could be contrary to the TQM system. The lack of flexibility (Gotzamani and Tsiotras, 2001), the bureaucracy and the large amount of controls required (Tummala and Tang, 1996) could be some of them. There is a large amount of TQM that ISO9000 does not exactly satisfy: The passive focus on continuous improvement (Lee *et al*., 1999), the low customer focus (Lee *et al*., 1999), and giving an ordinary importance to the workforce development and participation (Gotzamani and Tsiotras, 2001) could be some of them.

On the other hand from 1987, a great number of papers about motivation for registration, costs and benefits of certification and its effects over the companies performance (Rayner and Porter, 1991; Brecka, 1994; Vloe-

berghs and Bellens, 1996; Ebrahimpour *et al*., 1997; Meegan and Taylor, 1997; Brown *et al*., 1998; Anderson *et al*., 1999; Huarng *et al*., 1999; Hughes *et al*., 2000; Romano, 2000; Sun, 2000; Withers and Ebrahimpour, 2000; Gotzamani and Tsiotras, 2002) have been published.

Chow-Chua *et al*., (2002) conducting a survey among 146 Singapore based companies concluded that: the benefits are multi-faceted and vital for our globalize future. Our data and results have shown that ISO9000 certification allows a firm to experience better internal processes through clearer working instructions or procedures, better bottom line through greater profitability, and stronger export through expansion into international markets. All these factors sharpen the competitive edge of the firm. Hence, for firms with a competitive orientation, the adoption of ISO9000 certification will follow naturally and will be a breeze.

Despite the aforementioned reasons for ISO9000 adoption; there are evidences that quality management impact on firm performance is contradictory.

Many of researchers foresee promising effects on the result by new version of ISO9000 standards. The finding is based on both comparison to TQM principles and business result.

There are some significant differences between ISO 9000: 1994 and ISO9000: 2000 such as the explicit orientation to the market, processes, continuous improvement and learning. These differences have led a number of specialists to state that the new version intends to get close to the EFQM Excellence Model.

The new ISO9000: 2000 includes some dimensions of TQM that were not included in its previous version. Some of these are related with the soft dimensions of TQM (workforce management and customer focus). Therefore, it is possible that this new norm will have a better effect on results than the 1994 version.

The current ISO9001: 2000 is a development-based process model using eight quality management principles. These principles are customer focus, leadership, involvement of people, process management, system approach to management, continuous improvement, factual approach to decision making, and mutually beneficial supplier relationships. Zairi (2002) noted that these principles stress the importance of leadership as a key driver for quality improvement. They focus on customer satisfaction as the end result, and highlight the importance of continuous improvement, measurement, and learning (Lin, C, and Wu, C. 2005).

Lin, C, and Wu, C. (2005) have studied the interrelationships between knowledge management and ISO9001: 2000 according to the prevailing ISO9001: 2000 guidelines and processes.

2.1 The Necessity of Study

On one hand, a deficient understanding of the standards provokes that firms consider the quality assurance implementation process as a project which ends up with the certification (Lee and Palmer, 1999), instead of viewing it as a continuous process of normalization, formalization and improvement (Conti, 1993). This fact would lead to mistaken expectations and attitudes in managers and workers, which acts as a source of conflicts and causes the rejection of the system.

In reference to the broad studies of Lloyd's Register of Quality Assurance (1993), Institute of Quality Assurance (1993), and Breka (1994) the greatest gain from quality certification is widening market opportunities rather than improvement in quality itself.

On the other hand, inferred in pursuit of quality certification is the assumption that it is associated with good quality systems, leading to better quality, improved business performance and hence better profitability. The improved quality management system brings an increased emphasis on quality, which leads to less waste or duplication of effort, and improved quality (Heras *et al*., 2002a).

As for country specific studies, Casadesus and Gimenez (2000) have reported that 65 percent of the certified companies in Spain have experienced high levels of internal (human resources management, operations management), external (external customer satisfaction, less complaints, repeat purchases), and financial benefits (e.g. market shares, sales per employee, return on sales and return on assets). This is consistent with results of Kaye (2000) who has also reported benefits such as better documentation, greater quality awareness of employees, better internal communication, and an increase in operational efficiency.

Hence, due to contradictory evidences relating internal effects of ISO9000 set of standards on company result, in this research we examine internal quality improvement in fourfold area of technology improvement.

2.2 Technology Improvement Model

Different models have been proposed to evaluate technological level of an industrial entity. Our perspective to investigate technology improvement is based on technological assessment model proposed by APCTT (1988). This model classifies technology in fourfold category:

Facilities namely the hardware; Abilities namely the human resources abilities; Facts namely the document; Framework namely the organization. We may name the fourfold category respectively Techno-ware, Human-ware, Info-ware, and Organ-ware.

The model is based on a specific questionnaire. A similar technological assessment model has been generally applied in Iranian automotive industry under the instructions of UNIDO since 1989. In this study we define the fourfold category as following:

Techno-ware category considers such indicators as complexity, safety regulations, and material transportation methods.

Info-ware category considers indicators such as its being up-to-date, totality, and networking of information in regard with departments.

Human-ware category considers indicators including innovation, willingness to group work, and accountability in regard with personnel position.

Organ-ware category looks for measures of motivation and leadership in supervisors and complexity of organization.

Due to our research objective viz., provide a preliminary evaluation of ISO9000: 2000 effects on internal quality improvement; on one hand we employ the 4W's questionnaire approach to evaluate the ISO9000: 2000 effect, and on the other hand an ISO9000: 2000 based questionnaire approach according to fourfold classification. We expect to achieve merely general findings.

2.3 Effect of Size

A number of studies revealed that company size was one of the factors responsible for deriving benefits from ISO9000 certification. For example, Tsekauras *et al*. (2002) found that in the Greek manufacturing and service sectors the main adopters of ISO9000 quality assurance standards were larger companies producing intermediate goods. In another study conducted by Elmuti and Kathawala (1997), in two manufacturing plants, one ISO9000 certified and the other non-ISO9000 certified, owned by a large corporation in the USA, it was found that the ISO 9000 quality program improved the participants' quality of work life. In addition, there was a positive impact on employee productivity and export sales. A follow-up interview with the management of the corporation indicated that ISO9000 supported the organizational objectives of productivity, quality of products, increased export sales, and quality of work life. Chittenden *et al*. (1998) found that, in the UK, firms that adopted ISO9000 tended to be large, multi-product and manufacturing based. These firms had customers that were larger than themselves or from government departments. These firms also had a formal management structure. On the other hand, the firms which did not adopt ISO9000, tended to be smaller businesses that dealt with domestic customers and serving the local market. The authors concluded that a high majority of ISO9000 users felt that the advantages of using ISO9000 outweighed the disadvantages. Manufacturing firms that implemented ISO9000 were primarily motivated by the desire to improve internal processes, while small firms were motivated by marketing and competitive advantages.

The following question is extracted from the previous literature review:

Has ISO9000: 2000 standards compliance benefited the company in fourfold category of technology improvement?

As we have found out from the literature, the answer to the question might be "yes, it has."

Therefore, the following (null) hypotheses have been developed:

H1: ISO9000: 2000 implementation does not have significant impact on the extent of Techno-ware improvement.

H2: ISO9000: 2000 implementation does not have significant impact on the extent of Human-ware improvement.

H3: ISO9000: 2000 implementation does not have significant impact on the extent of Info-ware improvement.

H4: ISO9000: 2000 implementation does not have significant impact on the extent of Organ-ware improvement.

3. METHODOLOGY

The benefits of ISO9000 certification have been determined using different approaches. They include structured interviews (Hill *et al*., 2001), questionnaire administration (Gotzamani and Tsiotras, 2002; Lee, 1998; Singels *et al*., 2001), case study research (Withers and Ebrahimpour, 1996), factor analysis (Gotzamani and Tsiotras, 2002), cluster analysis (Casadesus and Gimenez, 2000) and content analysis on secondary sources (Aarts and Vos, 2001).

3.1 Research Design

There are several different ways for research: case study, field experiment, panel study, focus group and survey (Yin, 1994). Comparing with other qualitative research strategies, case studies are intensive descriptions and analysis of a single unit or bound system. In here, we choose to use the case study method. We think that the case study approach will give us the best opportunity to understand the impact of implementation of ISO9000: 2000 on Technology Improvement in target company.

According to Yin (1994), there are four types of designs for case study: single-case holistic, single-case embedded, multiple-case holistic, and multiple-case embedded design. Yin (1994) describes that three major rationales for a single case are critical case, extreme or unique case, and revelatory case. As our research task is to investigate the impact of ISO9000: 2000 certification and its perceived benefits for a leading automotive manufacturing company in respective country, the conclusion can be drawn through getting adequate data from the case company. Therefore, we choose single-case study to capture a complete picture in the area of our research problem.

The next step is to choose a holistic versus an embedded approach. Embedded analysis pays its attention to sub-units, embedded units. In contrast, a holistic method is conducted when the case study solely investigates the global nature of a program or an organization. In our research, we try to get a holistic view of the effectiveness of ISO9000: 2000 and the extent of improvement in fourfold category by using embedded approach to study sub-issues involved in the ISO9000: 2000 execution process. It involves investigating different processes, and so on. There-

fore, the study takes single-case embedded character.

3.2 Data Collection

Data collection is a crucial step in research. Through this process, researchers accumulate empirical material on which their research is based. According to Yin (1994), there are six important sources: documentation, archival records, interviews, direct observation, participant-observation, and physical artifacts. They can be generally divided into two categories: primary data and secondary data. Primary data is collected for fulfilling the needs of specific research. Primary data does not yet exist and must be collected. Secondary data is, on the other hand, previously published data not collected for this specific research. In this study, primary data is included.

3.2.1 Questionnaire

Questionnaire is a method of data collection that can be used with paper questionnaires that have been administered in face-to-face interviews; mail surveys or surveys completed by an interviewer over the telephone. It is highly structured but can have both open-ended and closed-ended questions in the three basic types of questions: multiple choice, numeric open end and text open end. A good questionnaire design is very important, enabling a respondent to respond with the willingness attitude, and giving an accurate answer.

3.3 Qualitative and Quantitative

A study can be qualitative, quantitative or a combination of both. The qualitative method permits the researcher to study selected issues in depth and detail. It facilitates the compiling of in-depth information about a smaller number of people and cases. Therefore, it increases the understanding of the cases and situations studied. The major drawback with the qualitative approach is that it reduces possibilities of generalization. The quantitative approach, on the other hand, requires the use of standardized measures so that the varying perspectives and experiences of people can be fit into a limited number of predetermined response categories to which numbers are assigned. It becomes possible to measure reactions of many respondents to a limited set of questions, thus facilitating comparison and statistical aggregation of the data. This means that a set of broad generalizable findings can be presented succinctly and parsimoniously (Patton, 1990). Some researcher claim that the two methods, qualitative and quantitative, are complementary and cannot be used in isolation from each other (Ghauri and Gronhaug, 2002). They argue that although most researchers emphasize on one or the other, both methods can be combined and used in the same study. In this study, we obtained data through couple of structured questionnaires. However, A qualitative type of measure was used to capture the information on the effectiveness of ISO 9000: 2000 and the extent of improvement in fourfold category. The authors used qualitative research method in qualitative instances, together with statistical method to explore critical points. Our study is to some extent a combination of qualitative and quantitative.

3.4 Quality of the Methods

In here, we discuss whether the chosen method and the collected data are valid and whether the results are reliable.

Validity: Validity refers to the degree to which a study accurately reflects or assesses the specific concept that the researcher is attempting to measure. It can be divided into following types (Yin, 1994): construct validity; external validity; and internal validity.

Construct validity means establishing correct operational measures for the concepts being studied. In this study, a way of establishing correct operational measures is to obtain constant feed-back from the involved experts.

External validity means establishing the domain to which a study's findings can be generalized. For this case study, we tried to expand the data source, and generalize the findings of research. The focus is on drawing a conclusion suitable for any company in a similar situation.

Internal validity is for explanatory or causal studies only, and not for descriptive or exploratory studies, as a result this study will not deal with internal validity.

Reliability: Reliability is concerned with the extent to which research findings can be replicated. As Yin (1994) mentions the objective is to ensure that if a researcher follows exactly the same procedures described by an earlier researcher and conducts the same case study, he/she would come to the same conclusions. The goal is to minimize the errors and biases in a study. We attempted to make as many operational steps as possible and conduct research as if someone were always looking over your shoulder (Yin, 1994). We studied the processes over and over. All these are to have our research findings get a high reliability. This can be also achieved by creating a stepwise logic and building up the study on a rigid foundation of documents. In addition, the reliability for the ISO9000: 2000 effectiveness questionnaire and the technology improvement questionnaire was measured using Cronbach's Alpha criteria.

3.5 Selection of Business Case

In the selection of single investigation firm some guide criteria have been utilized: exclusively those large and well known automotive manufacturing firms which already implemented ISO9000 were considered and the target firm was selected out of them due to implementing the revised–new 2000-version of ISO9000.

3.6 Sample

Data were gathered by couple of structured questionnaires. Each questionnaire was made up of four sec-

tions; each section containing certain questions in connection with the respective category (see Appendix A).

The questionnaires were discussed with two researchers knowledgeable in the field. These respondents were requested to comment on the content as well as the clarity of the questionnaires. The questionnaires' items were subsequently amended as per the comments received during the previous discussions.

The questions in the questionnaires were aimed at capturing the information on the effectiveness of ISO 9000: 2000 and the extent of improvement in fourfold category.

The number of concerning questions multiplied by the number of respondents formed the volume of sample in each statistical hypothesis test.

3.7 Respondents

Because the experts needed for this research must be familiar with technology improvement and the ISO9000, concept and evidence. The respondents were composed of individuals whom we believe have relevant practical knowledge of both these fields. For this reason, two kinds of experts were chosen: quality assurance practitioners with profound experience in quality management systems and technology improvement practices; and production and operations executives who also have background in implementing quality management systems (QMS). Due to the difficulty in finding such experts, 22 and 53 people were involved in respective groups of this study.

To bring attention of executives and practitioners to the space of the research, we had about five explanatory sessions with involved people. Each session lasted about two hours.

3.8 Variables

A subjective measure was used for this research: the respondents' opinions. The subjective measure tried to assess the fourfold company results.

The question had to be responded in a 1 to 5 scale-1 strongly disagree; 5 strongly agree. Reliability of this measure was measured using Cronbach's Alpha criteria. It was 0.97 and 0.88 respectively for the ISO9000: 2000 effectiveness questionnaire and the technology improvement questionnaire, higher than 0.6 which is the minimum acceptable level for new scales (Nunnally, 1978).

4. EXECUTION OF RESEARCH

The respondents were invited to fill the response sheets at the forum. At the forum the questionnaires were distributed among attendees and after explaining the research objectives by the research team, they filled them individually. Hence, the respondents were not affected by one another's standpoint.

4.1 Organization of Collected Data

Collected data was organized in connection with developed (null) hypotheses. The distribution of responses, in 1 to 5 scale-1 strongly disagree; 5 strongly agree- for both questionnaires-questionnaire of ISO (Q1) and questionnaire of Tech. (Q2)-and fourfold hypotheses (4Hs) is presented in Table 1 and Table 2:

Table 1. Distribution of responses, in 1 to 5 scale, for Q1- 4 Hs.

Frequency \ Scale	1	2	3	4	5	Total
Frequency of responses (H1) [17 * 22 = 374]	1	24	55	175	119	374
Frequency of responses (H2) [17 * 22 = 374]	-	7	49	166	152	374
Frequency of responses (H3) [17 * 22 = 374]	1	27	53	150	143	374
Frequency of responses (H4) [17 * 22 = 374]	-	6	40	177	151	374

Table 2. Distribution of responses in 1 to 5 scale for Q2-4Hs.

Frequency \ Scale	1	2	3	4	5	Total
Frequency of responses (H1) [5 * 53 = 265]	5	21	60	136	43	265
Frequency of responses (H3) [4 * 53 = 212]	-	4	16	84	108	212
Frequency of responses (H2) [6 * 53 = 318]	3	44	78	148	45	318
Frequency of responses (H4) [7 * 53 = 371]	5	38	97	161	70	371

The median response, in 1 to 5 scale, for both questionnaires-questionnaire of ISO (Q1) and questionnaire of Tech. (Q2)-and fourfold hypotheses (4 Hs) is computed according to Nonparametric statistics (Conover, 1980) and presented in Table 3.

Table 3. The median response for Q1-4 Hs and Q2-4 Hs.

Q1-4 Hs	Q1-H1 (Techno – ware)	Q1-H2 (Info – ware)	Q1-H3 (Human – ware)	Q1-H4 (Organ – ware)
Median	4	4	4	4
Q2-4 Hs	Q1-H1 (Techno – ware)	Q2-H2 (Info – ware)	Q2-H3 (Human – ware)	Q2-H4 (Organ – ware)
Median	4	4	4	4

In order to conduct one-sample sign-test for each hypothesis of aforementioned questionnaires (Q-H), the responses were dichotomized and rated as either a "success", or a "failure." In here, "Agree" which includes scales of 1, 2, and 3 is labeled as "success"; and "Not Agree" which includes scales of 4 and 5 is labeled as "failure." A distribution of scores on dichotomized variables is presented in Table 4.

Table 4. Scores on dichotomized variables for Q1-4 Hs and Q2-4 Hs.

Q1-4 Hs	Q1-H1 (Techno – ware)	Q1-H2 (Info – ware)	Q1-H3 (Human – ware)	Q1-H4 (Organ – ware)
AGREE	294	318	293	328
NOT AGREE	80	56	81	46
Q2-4 Hs	Q1-H1 (Techno – ware)	Q2-H2 (Info – ware)	Q2-H3 (Human – ware)	Q2-H4 (Organ – ware)
AGREE	179	193	192	231
NOT AGREE	86	125	20	140

In order to rank the effects of ISO9000: 2000 certification on fourfold category of technology improvement, The mean response, in 1 to 5 scale, for both questionnaires- questionnaire of ISO (Q1) and questionnaire of Tech. (Q2)- and fourfold hypotheses (4 Hs) is computed according to Fridman–rank test (Conover, 1980) and presented in Table 5.

Table 5. The mean response for Q1-4 Hs and Q2-4 Hs.

Q1-4 Hs	Q1-H1 (Techno – ware)	Q1-H2 (Info – ware)	Q1-H3 (Human – ware)	Q1-H4 (Organ – ware)
Mean	4.03	4.24	4.09	4.26
Q2-4 Hs	Q2-H1 (Techno – ware)	Q2-H2 (Info – ware)	Q2-H3 (Human – ware)	Q2-H4 (Organ – ware)
Mean	3.72	4.49	3.59	3.68

4.2 Test of Hypotheses

First, paired median test-which is a substitute for paired mean *t*-test in qualitative scale-between similar sections of questionnaires, was conducted. The difference between the responses concerning the ISO9000: 2000 effectiveness questionnaire and the responses concerning the technology improvement questionnaire were significantly meaningless (p-value < 0.001).

The result shows that both groups of respondents (with reference to respective questionnaire) roughly agree that the implementation of the ISO9000: 2000 has significantly improved the fourfold classes of technology in target company.

Second, one-sample *sign*-test was conducted for each hypothesis of aforementioned questionnaires respectively. Summary results are described bellow:

H1: Impact on Techno-ware; based on the both samples, a significant improvement in Techno-ware after ISO9000: 2000 certification was noted (p-value < 0.001).

H2: Impact on Info-ware; based on the both samples, a significant improvement in Info-ware after ISO9000: 2000 certification was noted (p-value < 0.001).

H3: Impact on Human-ware; based on the both samples, a significant improvement in Human-ware after ISO9000: 2000 certification was noted (p-value < 0.001).

H4: Impact on Organ-ware; based on the both samples, a significant improvement in Organ-ware after ISO9000: 2000 certification was noted (p-value < 0.001).

In summary, all the (null) hypotheses are rejected, which indicates that ISO9000: 2000 does have some impacts on technology improvement of the company.

Third, *Fridman*-rank test was conducted to identify the significance of difference between ranks. Based on both samples, a significant difference between ranks was noted (p-value < 0.001).

According to Table 5-the impact of ISO9000: 2000 certification on fourfold category of technology improvement is ranked and presented in Table 6.

Table 6. The ranks of fourfold category of technology improvement in connection with samples.

Category of technology	Rank of affective factors on the basis of sample one (Q1-H)	Rank of effected components on the basis of sample two (Q2-H)
Techno–ware	4	2
Info–ware	2	1
Human–ware	3	4
Organ–ware	1	3

However, the results seem controversial, but in fact they do not address a paradox.

Indeed, descriptive results may cause to understand the impact of ISO9000: 2000 certification on fourfold category of technology improvement more clearly. Hence, the probability of occurrence of dichotomized variables for Q1-4 Hs and Q2-4 Hs, in Table 4, is computed and presented in Table 7.

Table 7. Descriptive results.

Q1-4 Hs	Techno – ware	Info – ware	Human – ware	Organ – ware
Probability of "AGREE"	0.79	0.85	0.78	0.88
Probability of "NOT AGREE"	0.21	0.15	0.22	0.12
Q2-4 Hs	Techno – ware	Info – ware	Human – ware	Organ – ware
Probability of "AGREE"	0.68	0.61	0.91	0.62
Probability of "NOT AGREE"	0.32	0.39	0.09	0.38

To gain an in-depth understanding on the subject, a Pareto analysis (15%~85%) is conducted. This analysis is intended to identify the most important factors of ISO 9000: 2000 certification on technology improvement. Here, the mean of scores on each factor (F)-say question is computed and the results are presented in table 8 (raw data is presented in Appendix B).

Since the first question in fourfold category of questionnaire 1 and the first question of the first category of questionnaire 2 indicate the overall effect of ISO9000: 2000 certification on technology improvement, those are excluded in Pareto analysis.

Table 8. Pareto analysis based on factors (Fs).

4Ws	Techno – ware	Info – ware	Human – ware	Organ – ware
Q1	F2; Mean: 4.23	F19; Mean: 4.50	F40; Mean: 4.64	F55; Mean: 4.50
	F3; Mean: 4.18	F25; Mean: 4.45	F37; Mean: 4.32	F68; Mean: 4.50
Q2	F4; Mean: 3.94	F8; Mean: 4.49	F11; Mean: 3.83	F19; Mean: 4.17

4.3 Research Findings

The study was aimed to develop an overall view of the different aspects of the investigated phenomenon.

1. Descriptive results, presented in Table 7, indicate that the entire respondents do agree that technology improvement by means of ISO9000: 2000 certification has been realized.
2. Total mean of responses with reference to Q1 is much greater than total mean of responses with reference to Q2 (excluding general questions, as mentioned previously). The difference can be explained due to the nature of samples. The cases of sample one are composed of the ISO practitioners' attitudes who are proponents of ISO and may exaggerate the effects, whilst the cases of sample two are composed of operational practitioners' attitudes who are directly involved in technological issues. Hence, they might observe the cause of technology improvement more clearly, and might have less preconceived opinion on all sides of the subject. In addition, it must be emphasized that the contents of the questionnaires are different in detail. On the whole, Questionnaire 1 considers the causes item by item while questionnaire 2 considers the effect in the same way. Such differences might have affected the results. To overcome controversy and achieve a more realistic result, the average of twofold ranking will be useful. This yields the overall ranking as following:
   - Info–ware
   - Organ–ware
   - Techno–ware
   - Human–ware

   Another way to overcome controversy is to develop a unique and detailed questionnaire through aggregating both questionnaires. However, this may not be worth the consequent complication.
3. According to *H1,* maintenance, monitoring, and control of data and information as well as the quality orientation of management have had the most impact on Techno–ware improvement.

   The performance characteristics of the manufacturing and operations facilities and equipments have been the most affected component of this category.
4. According to *H2,* maintenance, monitoring, and control of data and information as well as communicating with customer, and considering the customer's viewpoints on product were the main effective factors in this category.

   Updating information within the organization has been the most affected component in this category.
5. According to *H3,* distinguishing the skills, and merits of employees along with providing training and development programs as well as the quality orientation of management have had the most impact on Info-ware improvement.

   Dynamic and eagerness of the human resource to success and acquire knowledge seems to be the most affected component in this category.
6. According to *H4,* adopting the process oriented approach and defining the responsibility and authority as well as systematic dealing with inconsistency within the organization and analysis of that have had the most impact on Organ-ware.

   Control activities on the organizational plans have been the most affected component in

this category.

7. Distinguishing the skills, and merits of employees along with providing training and development programs, regarding to Info-ware related aspect of ISO9000-as identified in this study-has had the most impact on technology improvement.
8. Adopting the process oriented approach and defining the responsibility and authority, regarding to Techno-ware related aspect of ISO9000-as identified in this study-has had the least impact on technology improvement.
9. The updating of information within the organization has been the most affected component of technology.
10. The technical characteristics of the manufacturing and operations facilities and equipments; the time-saving characteristic of the human resource; and the innovation atmosphere and creativity spirit within the organization have been the least affected components of technology.
11. On the whole, information and organization related aspects of ISO have had the most impact, while hard ware related, say technical aspect of technology has been the least affected component of technology.

4.4 Research Limitations

This study is limited in its research methodology. It is considered as only one empirical illustration of many other possible implementation processes. It is not assumed that this company is a paradigm or that its specific situation is applicable to all other business enterprises.

5. CONCLUSION AND DIRECTION FOR FUTURE RESEARCH

This exploratory study examined the impact of ISO 9000: 2000 certification on the technology improvement indicators of a company. This is a proof of quality growth.

We illustrate that ISO9000 implementation is associated with fourfold Ware improvement. However, given the research limitations, it is not possible to generalize and as a result it should be interpreted with caution.

This research shows a preliminary investigation to propose a consequent research to investigate aspects of ISO9000 implementation including strategic orientation, strategic tools application, and financial performance. This study is evidence to positive affect of ISO9000 registration on company result. This illustrates positive perceptions of experts in favor of positive result, and suggests a multifaceted further study in the automotive manufacturing industry.

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REFERENCES

Aarts, F. and Vos, E. (2001), The impact of ISO registration on New Zealand firms' performance: a financial perspective**,** *The TQM Magazine***, 13**, 180-191.

Adams, G., McQueen, G., and Seawright, K. (1999), Revisiting the price impact of quality awards, *Omega*, **27**, 595-604.

Anderson, S. W., Daly, J. D., and Johnson, M. F. (1999), Why firms seek ISO9000 certification: regulatory compliance or competitive advantage?, *Production and Operations Management*, **8**, 28-43.

APCTT (1988), *Asian and Pacific centre For Transfer of Technology United Nations Economic and Social Commission for Asia and the Pacific*, Bangkok, Thailand, *http:/www.unescap.org*.

Avery, S. (1994), ISO certification: does it help or hinder?, *Purchasing*, **116** , 101-105.

Brecka, J. (1994), Study finds that gains with ISO9000 registration increase over time, *Quality Progress*, May, 20-21.

Brown, A., Van der Wiele, T., and Loughton, K. (1998), Smaller enterprises' experiences with ISO9000, *International Journal of Quality & Reliability Management*, **15**, 273-285.

Casadesu´s, M. and Jime´nez, G. (2000), The benefits of the implementation of the ISO9000 standard: empirical research in 288 Spanish companies, *The TQM Magazine*, **12**, 432-441.

Chow-Chua, C., Goh, M., and Wan, T. B. (2002), Does ISO9000 certification improve business performance?, *IJQRM,* **20**, 2.

Chittenden, F., Poutziouris, P., and Muhktar, S. M. (1998), ISO9000 and small business quality management: empirical evidence from the UK, *International Small Business Journal*, **17**, 73-88.

Choi, T. Y. and Eboch, K. (1998), The TQM paradox: relations among TQM practices, plant performance, and customer satisfaction, *Journal of Operations Management*, **17**, 59-75.

Conti, T. (1993), *Building Total Quality*: *A Guide for Management,* Chapman and Hall, London.

Conover, W. J. (1980), *Practical Nonparametric Statistics*, John Wiley and Sons.

Dow, D., Samson, D., and Ford, S. (1999), Exploding the myth: do all quality management practices contrib-

ute to superior quality performance?, *Production and Operations Management*, **8**, 1-27.

Easton, G. S. and Jarrell, S. L. (1998), The effects of total quality management on corporate performance: an empirical investigation, *Journal of Business*, **71**, 253 -307.

Ebrahimpour, M., Withers, B., and Hikmet, N. (1997), Experiences of US and foreign-owned firms: a new perspective on ISO9000 implementation, *International Journal of Production Research*, **37**, 567-576.

Elmuti, D. and AlDiab, T. F. (1995), Improving quality and organizational effectiveness go hand in hand through Deming management system, *Journal of Business Strategies*, **12**, 86-98.

Elmuti, D. and Kathawala, Y. (1977) An investigation into the effects of ISO9000 on participants' attitudes and job performance, *Production and Inventory Management Journal*, **38**, 52-57.

Escanciano, C., Fernandez, E., and Vazquez, C. (2001), Influence of ISO9000 certification on the progress of Spanish industry towards TQM, *International Journal of Quality and Reliability Management*, **18**, 481-494.

Forker, L. B., Mendez, D., and Hershauer, J. C. (1997), Total quality management in the supply chain: what is its impact on performance?, *International Journal of Production Research*, **35**, 1681-1701.

Ghauri, P. and Gronhaug, K. (2002), *Research Methods in Business Studies, a practical guide*, Prentice Hall.

Gotzamani, K. D. and Tsiotras, G. D. (2001), An empirical study of the ISO9000 standards' contribution towards total quality management, *International Journal of Quality and Reliability Management*, **21**, 1326-1342.

Gotzamani, K. and Tsiotras, G. (2002), The true motives behind ISO9000 certification, *International Journal of Quality and Reliability Management*, **19**, 151-169.

Hendricks, K. B. and Singhal, V. R. (1996), Quality awards and the market value of the firm: an empirical investigation, *Management Science*, **42**, 415-436.

Hendricks, K. B. and Singhal, V. R. (2001a), Firm characteristics, total quality management and financial performance, *Journal of Operations Management*, **19**, 269-285.

Hendricks, K. B. and Singhal, V. R. (2001b), The long-run stock price performance of firms with effective TQM programs, *Management Science*, **47**, 359-368.

Heras, I., Dick, G., and Casadesus, M. (2002a), ISO 9000 registration's impact on sales and profitability, *International Journal of Quality and Reliability Managemen*t, **19**, 774-791.

Hill, F. M., Hazlett, S., and Meegan, S. (2001), A study of the transition from ISO9000 to TQM in the context of organizational learning, *International Journal of Quality and Reliability Management*, **18**, 142-168.

Hua, H., Chin, K. S., Sun, H., and Xu, Y. (2000), An empirical study on quality management practices in Shangai manufacturing industries, *Total Quality Management*, **11**, 1111-1122.

Huarng, F., Horng, C., and Chen, C. (1999), A study of ISO9000 process, motivation and performance, *Total Quality Management*, **10**, 1009-1025.

Hughes, T., Williams, T., and Ryall, P. (2000), It is not what you achieve it is the way you achieve it, *Total Quality Management*, **11**, 329-340.

Institute of Quality Assurance (1993), *Survey on the Use and Implementation of BS5750*, *IQA*.

Kaye, P. J. (2000), *ISO9000: should your company seek certification?*, *Pennsylvania CPA Journal*, **70**, 7-8.

Lee, T. Y. (1998), The development of ISO9000 certification and the future of quality management: a survey of certified firms in Hong Kong, *International Journal of Quality & Reliability Management*, **15**, 54-60.

Lee, K. S. and Palmer, E. (1999), An empirical examination of ISO9000 registered companies in New Zealand, *The TQM Magazine*, **10**, 887-899.

Lee, T. Y., Leung, H. K. N., and Chang, K. C. C. (1999), Improving quality management on the basis of ISO 9000, *The TQM Magazine*, **11**, 88-94.

Lin, C. and Wu, C. (2005), Managing knowledge contributed by ISO9001: 2000, *JQRM*, **22**, 9.

Lloyd's Register of Quality Assurance (1993), *Setting standards for better business, Report of Survey Findings*, Lloyd's Register of Quality Assurance London.

Martı´nez Lorente, A. R., Dewhurst, F. W., and Gallego Rodrı´guez, A. (2000), Relating TQM, marketing and business performance: an exploratory study, *International Journal of Production Research*, **38**, 3227-3246.

Meegan, S. T. and Taylor, W. A. (1997), Factors influencing a successful transition from ISO9000 to TQM, *International Journal of Quality and Reliability Management*, **14**, 100-117.

Mohrman, S. A., Tenkasi, R. V., Lawler, E. E. III, and Ledford, G. E. Jr (1995), Total quality management practice and outcomes in the largest US firms, *Employee Relations*, **17**, 26-41.

Nunnally, J. C. (1978), *Psychometric Theory*, McGraw-Hill, New York, NY.

Patton, M. Q. (1990), *Qualitative Evaluation and Research Methods*, 2nd ed. Sage Publications, Newbury Park, California.

Powell, T. C. (1995), Total quality management as competitive advantage: a review and empirical study, *Strategic Management Journal*, **16**, 15-37.

Rayner, P. and Porter, L. J. (1991), BS5750/ISO9000-the experience of small and medium-sized firms, *International Journal of Quality and Reliability Management*, **8**, 16-28.

Romano, P. (2000), ISO9000: what is its impact on performance?, *Quality Management Journal*, **7**, 38-56.

Santos, L. and Escanciano, C. (2002), Benefits of the ISO 9000: 1994 system, *International Journal of Reliability and Quality Management,* **19**, 321-334.

Shetty, Y. K. (1993), The quest for quality excellence: lessons from the Malcom Baldrige National Quality Award, *SAM Advanced Management Journal*, **58**, 34-40.

Singels, J., Ruel, G., and van de Water, H. (2001), ISO 9000 series certification and performance, *International Journal of Quality & Reliability Management*, **18**, 62-75.

Skrabec, Q. R., Ragu-Nathan, T. S., Rao, S. S., and Bhatt, B. T. (1997), ISO9000: do the benefits outweigh the costs?, *Industrial Management*, 26-30.

Sneddon, J. (1998), Quality at the crossroads, *Quality World*, March, 30-31.

Sun, H. (2000), Total quality management, ISO9000 certification and performance improvement, *International Journal of Quality and Reliability Management*, **17**, 168-179.

Terziovski, M. and Samson, D. (1999), The link between total quality management practice and organizational performance, *International Journal of Quality and Reliability Management*, **16**, 226-237.

Terziovski, M. and Samson, D. (2000), The effect of company size on the relationship between TQM strategy and organizational performance, *The TQM Magazine*, **12**, 144-148.

Tsekouras, K., Dimara, E., and Skuras, D. (2002), Adoption of a quality assurance scheme and its effect on firm performance: a study of Greek firms implementing ISO9000, *Total Quality Management*, **13**, 827-841.

Tummala, V. M. and Tang, C. L. (1996), Strategic quality management, Malcolm Baldrige and European quality awards and ISO9000 certification: core concepts and comparative analysis, *International Journal of Quality and Reliability Management*, **13**, 8-38.

Vloeberghs, D. and Bellens, J. (1996), Implementing the ISO9000 standards, *Quality Progress*, June.

Wayhan, V. B., Kirche, E. T., and Khumawala, B. M. (2002), ISO9000 certification: the financial performance implications, *Total Quality Management,* **13**, 217-231.

Withers, B. E. and Ebrahimpour, M. (1996), An examination of ISO9000 certification practices of American, German and Japanese firms operating in the USA, *International Journal of Quality and Reliability Management*, **13**, 8-22.

Withers, B. and Ebrahimpour, M. (2000), Does ISO9000 affect the dimensions of quality used for competitive advantage?, *European Management Journal*, **18**, 431 -443.

Withers, B. E. and Ebrahimpour, M. (2001), Impact of ISO 9000 registration on European firms: a case analysis, *Integrated Manufacturing Firms*, **12**, 139-151.

Yin, R. K. (1994), *Case Study Research – Design and Methods*, Sage Publications, Inc., London, UK.

Zairi, M. (2002), *Synchronization of TQM*, *The TQM Magazine*, **14**, 5-6.

Zhang, Z. (2000), Developing a model of quality management methods and evaluating their effects on business performance, *Total Quality Management*, **11**, 129-137.

<APPENDIX>

<Appendix A>

Table 1. Q1-Techno-ware.

The effective factors of ISO9000: 2000 certification (ISO9000: 2000 effectiveness questionnaire):	1	2	3	4	5
1. Coordinating the organizational processes in connection with ISO requirements has caused to improve the technological conditions.					
2. Maintenance, monitoring, and control of data and information- in accordance with ISO requirements- has improved the technological conditions.					
3. The quality orientation of management-in accordance with ISO requirements- has improved the technological conditions.					
4. Adopting the process oriented approach and defining the responsibility and authority-in accordance with ISO requirements-has improved the technological conditions.					
5.Developing the appropriate processes for the transmission of information within the system-in accordance with ISO requirements-has improved the technological conditions.					
6. Distinguishing the skills, and merits of employees along with providing training and development programs-in accordance with ISO requirements-has improved the technological conditions.					

Table 1. Q1-Techno-ware (Continued).

The effective factors of ISO9000: 2000 certification (ISO9000: 2000 effectiveness questionnaire):	1	2	3	4	5
7. Applying the planned maintenance-in accordance with ISO requirements-has improved the technological conditions.					
8. Communicating with customer, and considering the customer's viewpoints on product-in accordance with ISO requirements-has improved the technological conditions.					
9. Appropriate planning of design and development team-in accordance with ISO requirements-has improved the technological conditions.					
10. Appropriate usage of the contributions of design and development team-in accordance with ISO requirements-has improved the technological conditions.					
11. Controlling and monitoring of purchase process within the system-in accordance with ISO requirements-has improved the technological conditions.					
12. Appropriate planning of the operations (in regard with production) and service provision-in accordance with ISO requirements-has improved the technological conditions.					
13. Provision of appropriate operational processes for preserving the product, from row material processing phase to delivery stage-in accordance with ISO requirements-has improved the technological conditions.					
14. Controlling the measurement and monitoring instruments-in accordance with ISO requirements-has improved the technological conditions.					
15. Assessment of customer satisfaction-in accordance with ISO requirements-has improved the technological conditions.					
16. Promoting the effectiveness of quality system-in accordance with ISO requirements-has improved the technological conditions.					
17. Systematic dealing with inconsistency within the organization, and analysis of that-in accordance with ISO requirements-has improved the technological conditions.					

Table 2. Q1- Human-ware.

The effective factors of ISO9000: 2000 certification (ISO9000: 2000 effectiveness questionnaire):	1	2	3	4	5
18. Coordinating the organizational processes in connection with ISO requirements has caused to improve the skills and knowledge of the human resource.					
19. Maintenance, monitoring, and control of data and information-in accordance with ISO requirements-has improved the skills and knowledge of the human resource.					
20. The quality orientation of management-in accordance with ISO requirements-has improved the skills and knowledge of the human resource.					
21. Adopting the process oriented approach and defining the responsibility and authority-in accordance with ISO requirements-has improved the skills and knowledge of the human resource.					
22.Appropriate processes for the transmission of information within the system-in accordance with ISO requirements-has improved the skills and knowledge of the human resource.					
23. Distinguishing the skills, and merits of employees along with providing training and development programs-in accordance with ISO requirements-has improved the skills and knowledge of the human resource.					
24. Applying the planned maintenance-in accordance with ISO requirements-has improved the skills and knowledge of the human resource.					
25. Communicating with customer, and considering the customer's viewpoints on product-in accordance with ISO requirements-has improved the skills and knowledge of the human resource.					
26. Appropriate planning of design and development team-in accordance with ISO requirements-has improved the skills and knowledge of the human resource.					
27. Appropriate usage of the contributions of design and development team-in accordance with ISO requirements-has improved the skills and knowledge of human resource of the organization					

Table 2. Q1- Human-ware (Continued).

The effective factors of ISO9000: 2000 certification (ISO9000: 2000 effectiveness questionnaire):	1	2	3	4	5
28. Controlling and monitoring of purchase process within the system-in accordance with ISO requirements-has improved the skills and knowledge of the human resource.					
29. Appropriate planning of the operations (in regard with production) and service provision-in accordance with ISO requirements-has improved the skills and knowledge of the human resource.					
30. Developing appropriate processes for preserving the product from the first stage of receiving the semi-manufactured components to the last stage of delivery-in accordance with ISO requirements-has improved the skills and knowledge of the human resource.					
31. Controlling the measurement and monitoring instruments-in accordance with ISO requirements-has improved the skills and knowledge of the human resource.					
32. Assessment of customer satisfaction-in accordance with ISO requirements-has improved the skills and knowledge of the human resource.					
33. Promoting the effectiveness of quality system-in accordance with ISO requirements-has improved the skills and knowledge of the human resource.					
34. Systematic dealing with inconsistency within the organization, and analysis of that-in accordance with ISO requirements-has improved the skills and knowledge of the human resource.					

Table 3. Q1- Info-ware.

The effective factors of ISO9000: 2000 certification (ISO9000: 2000 effectiveness questionnaire):	1	2	3	4	5
35. Coordinating the organizational processes in connection with ISO requirements has caused to improve the information flow system of the organization.					
36. Maintenance, monitoring, and control of data and information- in accordance with ISO requirements-has improved the information flow system of the organization.					
37. The quality orientation of management-in accordance with ISO requirements-has improved the information flow system of the organization.					
38. Adopting the process oriented approach and defining the responsibility and authority-in accordance with ISO requirements-has improved the information flow system of the organization.					
39.Developing the appropriate processes for the transmission of information within the system-in accordance with ISO requirements-has improved the information flow system of the organization.					
40. Distinguishing the skills, and merits of employees along with providing training and development programs-in accordance with ISO requirements-has improved the information flow system of the organization.					
41. Applying the planned maintenance-in accordance with ISO requirements-has improved the information flow system of the organization.					
42. Communicating with customer, and considering the customer's viewpoints on product-in accordance with ISO requirements-has improved the information flow system of the organization.					
43. Appropriate planning of design and development team-in accordance with ISO requirements-has improved the information flow system of the organization.					
44. Appropriate usage of the contributions of design and development team-in accordance with ISO requirements-has improved the information flow system of the organization.					
45. Controlling and monitoring of purchase process within the system-in accordance with ISO requirements-has improved the information flow system of the organization.					
46. .Appropriate planning of the operations (in regard with production) and service provision-in accordance with ISO requirements-has improved the technological conditions.					
47. Provision of appropriate operational processes for preserving the product, from row material processing phase to delivery stage-in accordance with ISO requirements-has improved the information flow system of the organization.					
48. Controlling the measurement and monitoring instruments-in accordance with ISO requirements-has improved the information flow system of the organization.					

Table 3. Q1- Info-ware (Continued).

The effective factors of ISO9000: 2000 certification (ISO9000: 2000 effectiveness questionnaire):	1	2	3	4	5
49. Assessment of customer satisfaction-in accordance with ISO requirements-has improved the information flow system of the organization.					
50. Promoting the effectiveness of quality system-in accordance with ISO requirements-has improved the information flow system of the organization.					
51. Systematic dealing with inconsistency within the organization, and analysis of that-in accordance with ISO requirements-has improved the information flow system of the organization.					

Table 4. Q1-Organ-ware.

The effective factors of ISO9000: 2000 certification (ISO9000: 2000 effectiveness questionnaire):	1	2	3	4	5
35. Coordinating the organizational processes in connection with ISO requirements has caused to improve the information flow system of the organization.					
36. Maintenance, monitoring, and control of data and information-in accordance with ISO requirements-has improved the information flow system of the organization.					
37. The quality orientation of management-in accordance with ISO requirements-has improved the information flow system of the organization.					
38. Adopting the process oriented approach and defining the responsibility and authority-in accordance with ISO requirements-has improved the information flow system of the organization.					
39. Developing the appropriate processes for the transmission of information within the system-in accordance with ISO requirements-has improved the information flow system of the organization.					
40. Distinguishing the skills, and merits of employees along with providing training and development programs-in accordance with ISO requirements-has improved the information flow system of the organization.					
41. Applying the planned maintenance-in accordance with ISO requirements-has improved the information flow system of the organization.					
42. Communicating with customer, and considering the customer's viewpoints on product-in accordance with ISO requirements-has improved the information flow system of the organization.					
43. Appropriate planning of design and development team-in accordance with ISO requirements-has improved the information flow system of the organization.					
44. Appropriate usage of the contributions of design and development team-in accordance with ISO requirements-has improved the information flow system of the organization.					
45. Controlling and monitoring of purchase process within the system-in accordance with ISO requirements-has improved the information flow system of the organization.					
46. Appropriate planning of the operations (in regard with production) and service provision-in accordance with ISO requirements-has improved the technological conditions.					
47. Provision of appropriate operational processes for preserving the product, from row material processing phase to delivery stage-in accordance with ISO requirements-has improved the information flow system of the organization.					
48. Controlling the measurement and monitoring instruments-in accordance with ISO requirements-has improved the information flow system of the organization.					
49. Assessment of customer satisfaction-in accordance with ISO requirements-has improved the information flow system of the organization.					
50. Promoting the effectiveness of quality system-in accordance with ISO requirements-has improved the information flow system of the organization.					
51. Systematic dealing with inconsistency within the organization, and analysis of that-in accordance with ISO requirements-has improved the information flow system of the organization.					

Table 5. Q2-Techno-ware.

The effect area of ISO9000: 2000 certification (Technology improvement questionnaire):	1	2	3	4	5
1. Implementation of ISO9000: 2000 standards has caused to improve the manufacturing and operations facilities and equipments.					
2. Implementation of ISO9000: 2000 standards has caused to improve the accuracy of the manufacturing and operations facilities and equipments.					
3. Implementation of ISO9000: 2000 standards has caused to improve the physical characteristics (such as flexibility and perfectibility) of the manufacturing and operations facilities and equipments.					
4. Implementation of ISO9000: 2000 standards has caused to improve the performance characteristics of the manufacturing and operations facilities and equipments.					
5. Implementation of ISO9000: 2000 standards has caused to improve the technical characteristics of the manufacturing and operations facilities and equipments.					

Table 6. Q2- Infoware –ware.

The effect area of ISO9000: 2000 certification (Technology improvement questionnaire):	1	2	3	4	5
6. Implementation of ISO9000: 2000 standards has caused to improve the accessibility of inside-collected information within the organization.					
7. Implementation of ISO9000: 2000 standards has caused to improve the required information systems for control of the manufacturing operations.					
8. Implementation of ISO9000: 2000 standards has caused to improve the updating of information within the organization.					
9. Implementation of ISO9000: 2000 standards has caused to improve the exchange of information between the organizational units.					

Table 7. Q2- Human-ware.

The effect area of ISO9000: 2000 certification (Technology improvement questionnaire):	1	2	3	4	5
10. Implementation of ISO9000: 2000 standards has caused to improve the initiative and contributions of the human resource.					
11. Implementation of ISO9000: 2000 standards has caused to improve the dynamic and eagerness of the human resource to success and acquire knowledge.					
12. Implementation of ISO9000: 2000 standards has caused to improve the participative and team work spirit of the human resource.					
13. Implementation of ISO9000: 2000 standards has caused to improve the commitment of the human resource to work.					
14. Implementation of ISO9000: 2000 standards has caused to improve the self-governing and adaptation ability of the human resource.					
15. Implementation of ISO9000: 2000 standards has caused to improve the time-saving characteristic of the human resource.					

Table 8. Q2- Organ-ware.

The effect area of ISO9000: 2000 certification (Technology improvement questionnaire):	1	2	3	4	5
16. Implementation of ISO9000: 2000 standards has caused to improve the leadership and motivation level within the organization.					
17. Implementation of ISO9000: 2000 standards has caused to improve the innovation atmosphere and creativity spirit within the organization.					
18. Implementation of ISO9000: 2000 standards has caused to improve the self-governing and autonomic ability of the organizational units.					
19. Implementation of ISO9000: 2000 standards has caused to improve the control activities on the organizational plans.					
20. Implementation of ISO9000: 2000 standards has caused to improve the level of the employee empowerment.					
21. Implementation of ISO 9000: 2000 standards has caused to improve the orientation of the organization to the expectations of the customers, shareholders, and the entire stakeholders.					
22. Implementation of ISO 9000: 2000 standards has caused to improve the honesty in business activities of the organization.					

<Appendix B>

Table 1. Scores on Q 1- Techno-ware.

Factor/Scale	1	2	3	4	5	Mean
1	0	1	5	7	9	4.09
2	0	1	2	10	9	4.23
3	0	1	3	9	9	4.18
4	0	2	8	7	5	3.68
5	0	2	2	11	7	4.05
6	1	3	4	7	7	3.73
7	0	2	2	9	9	4.14
8	0	3	3	8	8	3.95
9	0	0	4	11	7	4.14
10	0	1	3	14	4	3.95
11	0	1	2	15	4	4.00
12	0	2	1	13	6	4.05
13	0	2	3	8	9	4.09
14	0	0	4	11	7	4.14
15	0	2	1	11	8	4.14
16	0	1	3	14	4	3.95
17	0	0	5	10	7	4.09
Total	1	24	55	175	119	4.03

Table 2. Scores on Q 2-Techno-ware.

Factor/Scale	1	2	3	4	5	Mean
1	1	1	8	33	11	3.96
2	1	6	10	29	8	3.69
3	1	4	13	29	6	3.66
4	1	1	8	34	10	3.94
5	1	9	21	11	8	3.32
Total	5	21	60	136	43	3.72

Table 3. Scores on Q 1- Info-ware.

Factor/Scale	1	2	3	4	5	Mean
18	0	0	0	11	11	4.50
19	0	0	1	9	12	4.50
20	0	0	5	6	11	4.27
21	0	0	6	5	11	4.23
22	0	0	1	11	10	4.41
23	0	1	2	8	11	4.32
24	0	2	3	9	8	4.05
25	0	0	1	10	11	4.45
26	0	0	5	13	4	3.95
27	0	0	6	7	9	4.14
28	0	1	4	11	6	4.00
29	0	0	5	9	8	4.14
30	0	1	1	14	6	4.14
31	0	1	1	10	10	4.32
32	0	1	3	9	9	4.18
33	0	0	3	13	6	4.14
34	0	0	2	11	9	4.32
	0	7	49	166	152	4.24

Table 4. Scores on Q 2- Info-ware.

Factor/Scale	1	2	3	4	5	Mean
6	0	2	2	19	30	4.45
7	0	1	5	23	24	4.32
8	0	1	4	16	32	4.49
9	0	0	5	26	22	4.32
Total	0	4	16	84	108	4.40

Table 5. Scores on Q 1- Human-ware.

Factor/Scale	1	2	3	4	5	Mean
35	0	1	1	10	10	4.32
36	0	1	3	10	8	4.14
37	0	0	4	7	11	4.32
38	0	0	4	9	9	4.23
39	0	2	3	8	9	4.09
40	0	0	0	8	14	4.64
41	0	2	6	7	7	3.86
42	0	3	1	9	9	4.09
43	0	1	7	8	6	3.86
44	0	2	7	6	7	3.82
45	0	4	5	4	9	3.82
46	1	2	2	8	9	4.00
47	0	3	2	10	7	3.95
48	0	2	2	11	7	4.05
49	0	3	3	10	6	3.86
50	0	0	2	13	7	4.23
51	0	1	1	12	8	4.23
Total	1	27	53	150	143	4.09

Table 6. Scores on Q 2- Human-ware.

Factor/Scale	1	2	3	4	5	Mean
10	0	8	16	21	9	3.57
11	0	4	8	28	8	3.83
12	0	5	9	28	9	3.80
13	0	5	14	29	5	3.64
14	0	8	23	19	7	3.44
15	3	14	8	23	7	3.31
Total	3	44	78	148	45	3.59

Table 7. Scores on Q 1- Organ-ware.

Factor/Scale	1	2	3	4	5	Mean
52	0	0	0	8	14	4.64
53	0	0	2	13	7	4.23
54	0	0	2	8	12	4.45
55	0	0	1	9	12	4.50
56	0	0	2	8	12	4.45
57	0	0	1	12	9	4.36
58	0	2	5	9	6	3.86
59	0	0	2	11	9	4.32
60	0	0	4	11	7	4.14
61	0	0	6	11	5	3.95
62	0	4	3	10	5	3.73
63	0	0	2	13	7	4.23
64	0	0	4	13	5	4.05
65	0	0	1	13	8	4.32
66	0	0	2	10	10	4.36
67	0	0	3	7	12	4.41
68	0	0	0	11	11	4.50
Total	0	6	40	177	151	4.26

Table 8. Scores on Q 2- Organ-ware.

Factor/Scale	1	2	3	4	5	Mean
16	0	8	12	24	9	3.64
17	2	8	21	15	7	3.32
18	0	4	24	19	6	3.51
19	0	2	4	30	17	4.17
20	0	8	18	20	7	3.49
21	1	3	3	29	17	4.09
22	2	5	15	24	7	3.55
Total	5	38	97	161	70	3.68