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A Study to Compare the Rejection Rate of Products Received from ISO Registered Vendors to that of Non-registered Vendors by a Manufacturer in Virginia Beach, Virginia During 1996

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A STUDY TO COMPARE THE REJECTION RATE OF PRODUCTS RECEIVED FROM ISO REGISTERED VENDORS TO THAT OF NON-REGISTERED VENDORS BY A MANUFACTURER IN VIRGINIA BEACH, VIRGINIA DURING 1996

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A Research Paper
Presented to the Graduate Faculty
of the Department of Occupational and Technical Studies
at Old Dominion University

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In Partial Fulfillment
of the Requirements for
the Master of Science in Education Degree

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By
Joseph D. Frohwitter
April 1998
This research paper was prepared by Joseph D. Frohwitter under the direction of Dr. John M. Ritz in OTED 636, Problems in Education. It was submitted to the Graduate Program Director as partial fulfillment of the requirements for the Degree of Masters of Science in Education.

Date

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CHAPTER I
INTRODUCTION

American manufacturing must stay competitive with the rest of the trading, economic world in spite of government programs like NAFTA. In order to do this, we need to meet the world’s requirements and, if possible, exceed their expectations. One way to meet our global challenge is for the American manufacturing community to produce quality goods. To generate a quality oriented manufacturing base, the American Society of Quality Control (ASQC) adopted the standards of the International Standards Organization (ISO). This was the first concentrated effort to provide uniform quality in the United States. Prior to this, quality was defined by whomever had direct power over the manufacturer’s quality department. Unfortunately, it was often the production supervisor who had the bottom line at heart and the final say in quality. All too often the bottom line won the tug of war.

With the advent of ISO-9000, the quality world has been refocused to meet these requirements. It has become the trend in manufacturing that ISO-9000 is the only way to prove that your company has an acceptable quality program. ISO-9000 is a major documentation and auditing procedure that can be used to prove the capabilities of a company’s quality program.

But does ISO produce the standards that can increase the company’s expectations of vendor quality? This is what will be investigated in this study.
The planning of a consolidated economic Europe began in the mid-eighties. It was thought that planning standards would have to be set that were uniform for all countries involved. The International Standards Organization (I.S.O.) set about developing and organizing their standards. Within these standards fell the area of quality. The general heading for quality was given the identification of ISO-9000. ISO-9000 titled, "Guidelines for the selection and use of quality management and quality assurance standards," is characterized by the requirements for extensive documentation and regular auditing. (Juran, 1988, p. 9.21) There are thousands of standards covering almost every possible situation or concern. Some of these include: safety, environmental and education.

The ISO-9000 series has become the industry model. In today's industrial market, it is used as an indicator of the company's dedication to the quality goal. Therefore, ISO registration can mean the difference in whether a contract is obtained or lost. It has become the benchmark of the industry.

The significance of this study is, although ISO registration is still relatively new in the United States, is it really needed in a manufacturing quality program. Many owners and Board of Director members feel that ISO registration in required to be competitive among other manufactures regardless of its high cost. In this study we will determine if ISO registration increases quality in the product and reduced rejection rates as compared to non-ISO registered companies.
Limitations

The limitations of this study were as follows:

1. This study was limited to vendors supplying a manufacturer in Virginia Beach during 1996.

2. This study was limited to eighteen vendors in both ISO registered and non-registered categories, due to the limited number of ISO registered vendors available to the manufacturer.

Assumptions

In this study, there were several factors which were assumed to be true and correct. The assumptions were as follows:

1. The study was performed without bias to vendor.

2. All products are inspected to the same standards regardless of vendors registration.

3. All registered vendors held either ISO-9001 or ISO-9002 registrations.

Procedures

The data was collected from the files of a manufacturer based in Virginia Beach, Virginia. The collected data provided information in reference to the number of shipments received and the acceptability of each. As a result of these findings, conclusions were drawn that would further enhance the effectiveness of ISO-9000 registration.
Definition of Terms

For clarification, the following terms should be understood:

Certificate of Compliance- A written statement from the vendor of the product indicating that the product supplied meets all the requirements stipulated on the purchase order and or the blueprints. It is a legal document that must be signed from the vendor.

ISO-9000-Titled, “Guidelines for the selection and use of quality management and quality assurance standards,” is characterized by the requirements for extensive documentation and regular auditing and broken down into four sub-categories, three of which an organization may be registered to ISO-9001, ISO-9002 and ISO-9003. (Juran, 1988, p. 9.21)

ISO-9001-Titled, “Quality assurance for design, development, production, installation and servicing,” is the most difficult to obtain as it contains 20 different aspects of quality assurance. (Juran, 1988, p. 9.21)

ISO-9002-Titled, “Quality assurance for production, installation and servicing,” has all the areas of ISO-9001 with the exception of the area of design, still making it a difficult registration to achieve. (Juran, 1988, p. 9.21)

ISO-9003-Titled “Quality assurance for final inspection and testing,” has even fewer requirements than the preceding qualifications and is directed toward the service industry. (Juran, 1988, p. 9.21)


Third Party Registrar- This is an internationally recognized group of auditors that perform in depth audits and reviews of a company’s quality system. Their findings and recommendations decide if the audited company has a functional quality system. If a successful audit is obtained then the third party registers the audited company to the rest of the world.
Overview of Chapters

Registration with ISO-9000 can be the investment that can save a company from slumping sales in this quality knowledgeable consumer world. This study was limited to companies providing vendor goods to a manufacturing company. These companies were reviewed for the rejection rate of their products and compared to non-registered companies supplying similar types of products. The results of this study could become important information to the companies that are ISO registered and to those considering registration.

The investigation was needed in order to identify the positive and negative attributes of ISO-9000 registration and to determine if registration had any effect on product quality. If so, “How do we assess the effect?”

Chapter II includes information on the establishment of ISO-9000 and the system requirements and compared. Following this is the explanation of how the research was conducted and the methods and procedures used. The last two chapters present the data as well as a summary, conclusions and recommendations that would further improve the effectiveness of the ISO-9000 quality product program.
CHAPTER II

REVIEW OF LITERATURE

In the years just prior to 1979, the United European Technical Committee was formed and designated as ISO/TC 176 (International Standards Organization/Technical Committee). Quality was a rapidly emerging emphasis in the commercial and industrial communities. Various national and multinational quality standards had been developed in the quality systems of commercial, industrial, military or nuclear power needs. Some of the standards were guidance documents, while others were standards for contractual use between purchaser and supplier organizations. Although there were some commonality in their design, there were often significant differences. They were not compatible for widespread use throughout all industries. Terminology in these standards and in commercial and industrial practice also was inconsistent and confusing.

After eight years of work, a series of standards were developed and implemented. These standards were designated as the ISO 9000 series. The publication of the ISO 9000 series in 1987, together with the accompanying terminology standard (ISO 8402), has brought harmony on an international scale and has supported the growing impact of quality as a factor in international trade. Many nations and regional bodies have quickly adopted the ISO 9000 series and is rapidly replacing prior national and industry-based standards. (Stevenson, 1993, p. 8)
The ISO 9000 series embodies comprehensive quality management concepts and guidance, together with several models for external quality assurance requirements. The series is put together in an easy to read and memorize format. These features have high value for the commercial and industrial needs of current international trade. The series was published in time to meet the growing needs for international standardization in the wide adoption of third party quality systems certification schemes.

ISO 9000 Quality System Requirements

The following paragraphs, numbered as they appear in the standard, summarize each area of concentration that is addressed in the ISO-9000 guidelines.

4.1 Management Responsibility. The supplier’s management with executive responsibility shall define and document its policy for quality including objectives for quality and its commitment to quality. The quality policy shall be relevant to the supplier’s organizational goals and the expectations and needs of its customers. The supplier shall ensure that this policy is understood, implemented and maintained at all levels of the organization.

4.2 Quality System. The supplier shall establish, document and maintain a quality system as a means of ensuring that products conform to specified requirements. The supplier shall prepare a quality manual covering the requirements of this International Standard. The quality manual shall include or make reference to the quality system procedures and outline the structure of the documentation used in the quality system.

4.3 Contract Review. The supplier shall establish and maintain documented procedures for contract review and for the coordination of these activities.
4.4 **Design Control.** The supplier shall establish and maintain documented procedures to control and verify the design of the product in order to ensure that the specified requirements are met.

4.5 **Document and Data Control.** The supplier shall establish and maintain documented procedures to control all documents and data that relate to the requirements of this International Standard including, to the extent applicable, documents of external origin such as standards and customers drawings.

4.6 **Purchasing.** The supplier shall establish and maintain documented procedures to ensure that purchased products conform to specified requirements.

4.7 **Material Supplied by Customers.** The supplier shall establish and maintain documented procedures for the control of verification, storage and maintenance of customer-supplied products provided for incorporation into the supplies for the related activities. Any such product that is lost, damaged or is otherwise unsuitable for use shall be recorded and reported to the customer.

4.8 **Product Identification and Traceability.** Where appropriate, the supplier shall establish and maintain documented procedures for identifying the product by suitable means from receipt and during all stages of production, delivery and installation. Where and to the extent, that traceability is a specified requirement, the supplier shall establish and maintain documented procedures for unique identification of individual products or batches. The identification shall be recorded.

4.9 **Process Control.** The supplier shall identify and plan the production, installation and servicing processes that directly affect quality and shall ensure that these processes are carried out under controlled conditions. The process shall be recorded.

4.10 **Inspection and Testing.** The supplier shall establish and maintain documented procedures for inspection and testing activities in order to verify that the specified requirements for the product are met. The required inspection and testing, and the records to be established, shall be detailed in the quality plan or documented procedures.
4.11 **Control of Inspection, Measuring and Testing Equipment.** Generally the supplier shall establish and maintain documented procedures to control, calibrate and maintain inspection, measuring and testing equipment used by the supplier to demonstrate the conformance of product to the specified requirements. Inspection, measuring and test equipment shall be used in a manner, which ensures that the measurement uncertainty is known and is consistent with the required measurement capability.

4.12 **Inspection and Testing Status.** The inspection and test status of a product shall be identified by suitable means, which indicates the conformance or nonconformance of product with regard to inspection and test performed. The identification of inspection and test status shall be maintained as defined in the quality plan and/or documented procedures, through production, installation and servicing of the product to ensure that only products that have passed the required inspections and tests is dispatched, used or installed.

4.13 **Control of Nonconforming Product.** Generally the supplier shall establish and maintain documented procedures to ensure that product that does not conform to specified requirements are prevented from unintended use or installation. This control shall provide for identification, documentation, evaluation, segregation and disposition of nonconforming product, and for notification to the functions concerned.

4.14 **Corrective and Preventative Action.** The supplier shall establish and maintain documented procedures for implementing corrective and preventative action.

4.15 **Storage, Handling, Packaging, Preservation and Delivery.** The supplier shall establish and maintain documented procedures for handling, storage, packaging, preservation and delivery of the product.

4.16 **Control of Quality Records.** The supplier shall establish and maintain documented procedures for identification, collection, indexing, access, filing, storage, maintenance and disposition of quality records.

4.17 **Internal Quality Audits.** The supplier shall establish and maintain documented procedures for planning and implementing internal audits to verify whether quality activities and related results comply with planned arrangements and to determine the effectiveness of the quality system.
4.18 **Training.** The supplier shall establish and maintain documented procedures for identifying needs and provide for the training of all personnel performing activities affecting quality. Personnel performing specific assigned tasks shall be qualified on the basis of appropriate education, training and/or experience, as required. Appropriate records of training shall be maintained.

4.19 **Servicing.** Where servicing is a specified requirement, the supplier shall establish and maintain documented procedures for performing and reporting that the servicing meets the specified requirements.

4.20 **Statistical Methods.** The supplier shall identify the need for statistical techniques required for the establishing, controlling and verifying process capability and product characteristics.

The standards were designed to be user-friendly. They are generic in nature and follow a logical, easily understood format. However, each company is unique and there may be wide differences in companies' readiness to implement the standards. The answer really depends on how developed their present system is and the implementation strategy they adopt. It can take a corporation six months to two years to achieve registration. It all depends how committed the corporation is to achieving registration.

**Global Competition**

Globalization has become, at present, reality in the few years since the ISO 9000 series was published. Today, all but the smallest or most local commercial and industrial enterprises are finding that their competitors include companies that are headquartered in countries other than their own. This has caused product development and marketing strategies to be done with global competition in mind.
International quality awareness continues to grow in importance as a factor in the global market place. The implementation of the European Community single market arrangement that was targeted for 1992, which now is anybody’s guess when it will happen, was a major driving force in the early days of the standardization.

A large area of standardization was in quality because it instills new market place pressures on all producers worldwide that wish to trade with European companies or to compete with European companies in other markets. The unified European plan rests on the use of the ISO/TC produced standards as the required documents for its third party certification plan for quality systems registration and for auditing compliance to the requirements. (Juran, 1994, p. 3.5)

Under the third party plan, the company arranges to be audited by an accredited independent (third-party) registrar organization. If the company’s quality systems documentation and implementation are found to meet the requirements of the applicable ISO series international standard, the registrar grants certification and lists the company in its register of companies with a certified quality system. All purchasers of the company’s products can then accept the third party certification as evidence that the company’s quality system meets the applicable ISO 9000 series requirements. The third party certification plan provides a number of benefits. Certification demonstrates that a company has implemented an adequate quality system for the products or service that it offers. By this, better internal commitment, as well as enhanced purchaser’s confidence, may be achieved. (Vision 2000, 1994, p. 3)
Quality as a Competitive Weapon

Quality assurance continues to be a competitive weapon for companies, even where there is a third party certification process in place. The competitive edge has been achieved by those that have gone one step more. A prime example of this has been the American big three automobile manufacturers. They have developed a quality system that has higher expectations in quality than other car manufacturers. All this research and implementation of quality requirements has been done in the name of more sales to foreign manufacturers and consumers. This type of system can also be carried to another step by bringing manufacturer and supplier into a partnership in quality. Such partnerships focus on mutual efforts toward continuous quality improvement and the use of innovative quality technology. It is a system of growing and gaining together for the betterment of both.

Growth of the Standards

The ISO 9000 standards are being used in many industries for many different kinds of products and services. Some groups are adapting the standard for auditing, documentation and for guidance. These developments are indicators of the success of the ISO 9000 series. This growth has reason to cause concern with the ISO/TC 176 which must be addressed. The ISO 9000 series was intended to be the nucleus of local standards. This would then have provided a constant worldwide standardization.
The growth of many localized certification schemes would provide complications in standardization. This would once again cause wide chasms in a unified quality system throwing all that has been achieved in upheaval and lose all that has been gained in standardization of the quality system.

Plans regarding growth of supplementary or secondary standards must face up to a political and market place reality check. ISO/TC 176 cannot legislate that industry groups or other standards organizations will not produce supplementary documents. This implies that to continue to influence the market place it serves, ISO/TC must design its products and provide them in a timely manner. This will prevent the unhealthy growth of the industrial sectors' use of supplementary documents. Fortunately, the current global trends are driving many standards users toward international recognition that they need and should conform to the international standards. This makes it appear that the market place will resist supplementary documentation unless the ISO/TC fails to meet the needs of the market place in a timely manner. ISO 9000's generic structure gives motivation to the industrial and economic market place to build their own supplementary documentation within the recommended guidelines.

Recognizing can minimize growth of supplementary documentation criteria that segment the markets for standardization in quality management and external quality assurance. These market segmenting criterion are: generic product
categories, complexity of purchaser needs and process characteristics and contractual vs. non-contractual goods and products. The inclusion of these areas in future ISO considerations will suppress the growth of supplementary documentation. (Vision 2000, 1994, p. 6)

Inadequacies of ISO 9000

Study of ISO 9000 series standards by certain users have identified a number of needs that are not easily met with the ISO 9000 series standards in their present form. One example of such users or potential users is large companies, such as electric power providers or military organizations that purchase complex products to a specific functional design. They have a requirement for a quality plan that shadows the ISO 9000 series in documentation and auditing. These types of suppliers and purchasers, due to their size, can hinder or expedite worldwide implementation of a unified external quality assurance standards. There also appears to be a large number of users who would optionally want some changes to the standards. At the same time, it is important to preserve the simplicity of ISO 9000 series application for smaller companies. These issues have been addressed and are being corrected and adjusted. The unfortunate part is that they have been in the works since October 1990. The ISO/TC obviously does not make any rushed decisions.
Summary

Organizations supply products intended to satisfy customers needs or requirements. Increased global competition has led to increasingly more stringent customer expectations with regards to quality. To be competitive and to maintain good economic performance, manufactures and suppliers need to employ increasingly effective and efficient quality systems. These systems represent continual improvements in quality and increased customer satisfaction. The establishment of the ISO 9000 series has provided the foundation for these continuing improvements. As with anything, there are some limitations and areas that need improvement in the ISO 9000 series. With continued vigilance the ISO/TC 176 will unite and prevent the reversion to supplementary documentation and the lack of structured quality systems which would provide a worldwide quality system that will provide the assurance the consumer demands.
CHAPTER III
METHODS AND PROCEDURES

This research is a experimental study seeking to determine whether or not an ISO quality company provides a lower rejection rate of products than those received from non-ISO registered supplying vendors. A description of the population studied, research instrument used, type of statistical analysis performed, and summary of the research methodology follow.

Population

In April 1997, there were 207 companies providing parts for a manufacturer located in Virginia Beach, Virginia. Of these 207 suppliers, only 18 were registered to the ISO 9000 requirements. These eighteen vendors will be the experimental group. The remaining 189 companies were reviewed and those that did not provide any supplies during 1996 were eliminated, which further reduced the population to 124 vendors.

A random method of selection was used to determine the participants of the non-registered companies. The remaining population of 124 vendors was assigned individual numbers. A random number chart was used to select 18 non-registered companies to compare to the experimental group. Each company, whether registered or not, will participate only once even though they may provide more than one part for the manufacturer.
With companies that supply more than one part, the part that was last entered in the Certificate of Compliance folder was the part chosen for this study. All parts that were received require a Certificate of Compliance from the vendor.

Collection of Data

Data was collected from the files of a local manufacturing company. The researcher personally reviewed each vendor product received during 1995-1996. This information was located on the company’s quality control inspection record card. It can be compared with the vendor’s Certificate of Compliance which is included in every purchase from the vendor. The vendors ISO registration number and certifying third party organization was also listed on the Certificate of Compliance.

Treatment of Data

After the companies were selected, the information or data were analyzed. Responses were tabulated, reviewed and applied to a Chi-Square comparison. This information was then assembled into the table form. The tables provided a review of the responses in numerical value. The data was analyzed for significance of correlation.
Summary

Of the 207 companies available, only thirty-six participated in this study. Eighteen were randomly chosen to participate in this study; the other eighteen were ISO registered companies. The study compared the number of shipments received and the rejection rate between the experimental group and the non-ISO registered companies. The collected data were tabulated and evaluated. The following chapter will present and address the findings resulting from the study.
CHAPTER IV
FINDINGS

In this chapter the findings of this study are presented. The study's purpose was to compare the rejection rate of products received from ISO registered vendors to that of a non-registered vendors by a Virginia Beach manufacturer. This was accomplished by reviewing the company's inventory records.

The research data were available in the files of the manufacturer. In reviewing the files the researcher used the certification records and crossed referenced the findings with the quality control cards as an indicator of the acceptability of each shipment that had been received during 1996.

Reporting the Data

The grouping in this study were those that were ISO registered and the other group were the non-registered ISO vendors. There are eighteen registered vendors that supplied parts to the manufacturer during 1996. The non-registered companies numbered eighteen. Random samples were taken to select eighteen corresponding non-registered vendors. No other information about the vendors such as size of the company or gross annual income was taken into consideration in these findings.

The ISO registered vendors supplied 77 shipments of material. Four of the 77 shipments were rejected for non-compliance to the manufacture's specifications.
The non-registered vendors supplied 82 shipments during the same time frame. Their rejection quantity was 28, for non-compliance to manufacturer’s specification. The relationship between each grouping is displayed in Figure 1 below.

Figure- 1 Acceptance and Rejection Bar Chart

Statistical Chi-Square Calculations

To effectively evaluate the acceptance data of each group, a 2 x 2 Chi-Square table was used.

<table>
<thead>
<tr>
<th></th>
<th>Acceptable</th>
<th>Rejected</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO reg</td>
<td>73 = a</td>
<td>4 = b</td>
</tr>
<tr>
<td>NON ISO</td>
<td>54 = c</td>
<td>28 = d</td>
</tr>
<tr>
<td></td>
<td>127 = a+c</td>
<td>32 = b+d</td>
</tr>
</tbody>
</table>

Table1

In Table 1, the acceptable and rejected data were placed in cells and calculated using the Chi-Square formula. The number of sub-sets was 159. Using the data in Table 1, the Chi-Square value was calculated. Chi-Square, $\chi^2$, was calculated to be +41.63.
\[ \chi^2 = 41.63 \text{ Accept } H_1; \text{ significant} \]

Comparing our calculated Chi-Square value of 41.63 against the critical value of 3.84 for an alpha error level of .05 and 6.64 for an alpha error level of .01 shows that the calculated Chi-Square exceeds both the .05 and .01 levels of significant. The statistical decision must be an acceptance of the hypothesis, \( H_1: \) Vendors that are registered with ISO-9000 provide a better quality product based on a lower rejection rate than non-registered vendors.

Summary

The findings of the research study, obtained by statistically calculating the Chi-Square, have been presented in this chapter. In Chapter V of this study the research will be summarized, a conclusion of the data gathered will be presented and a recommendation of how the research can be valued will be discussed.
CHAPTER V
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The problem of this study was to compare the rejection rate of products received from ISO registered vendors to that of non-registered vendors by a manufacturer in Virginia Beach, Virginia. This chapter will summarize the preceding chapters, offer conclusions based on the findings of the research and present recommendations as to how this study can be useful to future studies.

Summary

This research has addressed a problem that is critical to manufacturers in industry. To stay competitive, it is important to provide a quality product that is acceptable. To insure that products are of quality, standards have been established and met. These standards were formed by the International Standards Organization and have been adopted by most industrial nations as an acceptable measure of quality.

The history leading to the establishments of the ISO standards reflects an industry that was more interested in the bottom line and not the quality of the product. The standards were originally designed to be used for the unification of Europe on manufacturing. They proved to be applicable to most industrial needs, hence they are now the accepted standards for quality in manufacturing.
The data researched was collected from the files of a local manufacturer. All registered vendors that were found in the files were used in the registered group. From the non-registered group, a matching number of companies were randomly selected to represent that group.

In Chapter IV, Findings, of this research study, the actual calculations from the data gathered were presented. These figures showed a relationship that exceeded the significance at .05 and .01 from the calculated Chi-Square. There is a significant difference between the quality of ISO registered vendors to that of non-registered vendors.

Conclusions

The hypothesis of this study was:

H$_1$: Vendors that are registered with ISO-9000 provide a better quality product based on a lower rejection rate than non-registered vendors.

Comparing our calculated Chi-Square value of 41.63 against the critical value of 3.84 for an alpha error level of .05 and 6.64 for a alpha error level of .01 shows that the calculated Chi-Square exceeds both levels of a significant. The statistical decision must be to accept the hypothesis, H$_1$: Vendors that are registered with ISO-9000 provide a better quality product based on a lower rejection rate than non-registered vendors.
Recommendations

This study supports that the effectiveness of purchasing ISO registered vendor's products is an advantage. Therefore, the following recommendations are made:

1. Manufacturers should attain ISO registration in order to remain competitive in both the international and domestic markets.

2. Manufacturers not in the international markets should register with an ISO-9000 registrar to show the company's commitment to quality. This commitment will be recognized in the domestic market.

3. Manufacturers not desiring to register with an ISO-9000 registrar should form their own quality program to follow one of the ISO-9000 concepts. It will provide a quality base for further or possible registration at a later date.

