University of Northern Iowa
UNI ScholarWorks

Dissertations and Theses @ UNI | Student Work

1987

A comparison of present and future tasks performed by quality engineers of leading and nonleading American manufacturing firms

Zenon Theodore Smolarek
University of Northern Iowa

Let us know how access to this document benefits you

Copyright ©1987 Zenon Theodore Smolarek
Follow this and additional works at: https://scholarworks.uni.edu/etd

 Part of the Operations Research, Systems Engineering and Industrial Engineering Commons

Recommended Citation

Smolarek, Zenon Theodore, "A comparison of present and future tasks performed by quality engineers of leading and nonleading American manufacturing firms" (1987). *Dissertations and Theses @ UNI*. 878.
https://scholarworks.uni.edu/etd/878

This Open Access Dissertation is brought to you for free and open access by the Student Work at UNI ScholarWorks. It has been accepted for inclusion in Dissertations and Theses @ UNI by an authorized administrator of UNI ScholarWorks. For more information, please contact scholarworks@uni.edu.

Offensive Materials Statement: Materials located in UNI ScholarWorks come from a broad range of sources and time periods. Some of these materials may contain offensive stereotypes, ideas, visuals, or language.

INFORMATION TO USERS

The most advanced technology has been used to photograph and reproduce this manuscript from the microfilm master. UMI films the original text directly from the copy submitted. Thus, some dissertation copies are in typewriter face, while others may be from a computer printer.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyrighted material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each oversize page is available as one exposure on a standard 35 mm slide or as a 17″ × 23″ black and white photographic print for an additional charge.

Photographs included in the original manuscript have been reproduced xerographically in this copy. 35 mm slides or 6″ × 9″ black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

Accessing the World's Information since 1938

300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Order Number 8811279

A comparison of present and future tasks performed by quality engineers of leading and nonleading American manufacturing firms

Smolarek, Zenon Theodore, D.I.T.

University of Northern Iowa, 1987

U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

PLEASE NOTE:

In all cases this material has been filmed in the best possible way from the available copy. Problems encountered with this document have been identified here with a check mark __✓__.

1. Glossy photographs or pages _____
2. Colored illustrations, paper or print _____
3. Photographs with dark background _____
4. Illustrations are poor copy _____
5. Pages with black marks, not original copy ✓
6. Print shows through as there is text on both sides of page _____
7. Indistinct, broken or small print on several pages ✓
8. Print exceeds margin requirements _____
9. Tightly bound copy with print lost in spine _____
10. Computer printout pages with indistinct print _____
11. Page(s) _____ lacking when material received, and not available from school or author.
12. Page(s) _____ seem to be missing in numbering only as text follows.
13. Two pages numbered _____. Text follows.
14. Curling and wrinkled pages _____
15. Dissertation contains pages with print at a slant, filmed as received ✓
16. Other _____

_____

_____

U·M·I

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

A COMPARISON OF PRESENT AND FUTURE TASKS PERFORMED BY QUALITY ENGINEERS OF LEADING AND NONLEADING AMERICAN MANUFACTURING FIRMS

A Dissertation Submitted
In Partial Fulfillment
Of the Requirements for the Degree of
Doctor of Industrial Technology

Approved:

Dr. Michael White

Dr. Rex Pershing

Dr. Chandra Das

Dr. Stanley Walljasper

Dr. Douglas Pine

Zenon Theodore Smolarek
University of Northern Iowa
December, 1987

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

©1988

ZENON THEODORE SMOLAREK

All Rights Reserved

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

COMPARISON OF PRESENT AND FUTURE TASKS PERFORMED BY QUALITY ENGINEERS OF LEADING AND NONLEADING AMERICAN MANUFACTURING FIRMS

An Abstract of a Dissertation

Submitted

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Industrial Technology

Approved:

Michael R. Libert
Faculty Advisor

John C. Downey
Dean of the Graduate College

Zenon Theodore Smolarek

University of Northern Iowa

December 1987

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

This study identified and compared the level of importance and frequency of performance of 34 selected quality engineering tasks in the present and five years hence and determined potential catalysts for any expected change between the present and the future. Two sample groups of practicing certified quality engineers working for manufacturing companies in the United States were surveyed in three rounds to obtain the data. Group I consisted of 86 engineers working for companies that had been identified as leaders in product quality in a 1985 Gallup study. Group II consisted of 96 engineers from other companies.

The study attempted to answer the following research questions:

1. What are the tasks presently performed by quality engineers, how important are they, and how frequently are they performed?

2. Is there a statistically significant difference between tasks performed in leading companies and others at present?

3. Of the selected tasks, how important will they be and how frequently will they be performed, five years hence?

4. Is there a statistically significant difference between the perceptions of the tasks performed within each group between the present and the future?

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

5. Is there a statistically significant difference in the perception of the tasks performed between leading companies and others, five years hence?

6. Is there a statistically significant difference in the perceptions of the tasks performed by both groups combined between the present and the future?

7. What catalysts are anticipated to induce any future changes?

The findings of the first round indicate that the 34 tasks identified in the literature review were inclusive of those performed by quality engineers. The most important and frequently performed task identified in the present was Speak/Discuss Clearly. Of the purely quality related tasks, Relate Specifications to Process was ranked first for importance and Analyze Statistical Data was ranked first for frequency of performance. A chi-square analysis comparison of the two groups showed very little difference between the two groups in the present.

The findings of the second round were very similar to those of the first round relative to the ranking of the tasks. However, the ratings of individual tasks indicate that all tasks were expected to be more important and performed more frequently in the future. A chi-square comparison of the two groups indicated very little difference between the two groups in the future.

A chi-square comparison of Group I present to Group I future found that 11 (32%) of the tasks would become more

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

important in the future, while 23 (68%) would be performed more frequently. The same comparison for Group II found 17 tasks (50%) more important in the future while 20 (59%) would be performed more frequently. A comparison of both groups combined found 27 tasks (79%) more important and 27 tasks (79%) more frequently performed in the future.

The third round identified ten potential catalysts that could induce change between the present and the future. Both groups agreed that the two catalysts An Increase in Consumer Quality Requirements and Increased Quality Offered by Competitors on the International Market were most likely to induce change.

The data gathered in this study indicate that there are only minor differences in the perception of the importance of or the frequency of the performance of the selected tasks between leading and other companies. Those minor differences may be enough to cause a change in the quality of products produced and sold to the ultimate consumer.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

ACKNOWLEDGEMENTS

The researcher would like to express thanks to the following:

1. Dr. Michael White for his perseverance in guiding the researcher through a valuable experience.

2. The "committee," variable though it has been, for contributions of direction.

3. Ms. Gail Wolbert for her moral support and her flexibility in meeting schedules and other demands.

4. The participants in the study for their interest in the quality profession and the commitment of valuable time.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

TABLE OF CONTENTS

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

CHAPTER Page

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

LIST OF TABLES

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

LIST OF FIGURES

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

CHAPTER I

INTRODUCTION

The competitive edge once enjoyed by manufacturers of the United States has been eroded in recent years by foreign competition. As stated by Thurow (1985), Professor of Management and Economics of M.I.T.'s Sloan School of Management,

> We can no longer afford to ignore the fact that U.S. industry is being beaten up in international competition. The hugh technological edge enjoyed by Americans in the 1950s and 1960s has disappeared, and the United States is now faced with foreign competitors who have matched its economic achievements and may be in the process of moving ahead. (p. 27)

The technological developments that have taken place include those in product design, improved manufacturing processes, production and inventory control systems, and quality assurance systems.

A large part of the cause of change in the marketplace has been the improved quality of foreign products. As stated by Harwood, President of Signetics Corporation, "We had all started to hear about Japanese quality and productivity, and we began to ponder such statements as 'quality will be the battleground of the future'" (1984, p. 26). In recent years, numerous articles have been written which indicate that the United States manufacturer will have to improve quality and productivity or be forced out of the international marketplace. Olson (1985), President of AT&T states,

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

> As an international player, we are up against very, very highly competent competitors. And the Japanese are high on the list. They have worked hard on quality, and that gives them an advantage. If you're going to be a global player, quality is crucial. (p. 34)

The problem of poor quality is not limited to American markets. Butcher, British Parlimentary Undersecretary of State for Trade and Industry, states that, "goods from Germany and Japan flood across world markets and in many instances leave native products standing" (1983, p. 39). There have also been changes in world market share. "Foreign competitors, primarily the Japanese, moved unbelievably quickly to gain a foothold and then build market share with low-cost high-quality products" (Ripp, 1983, p. 12). Among the markets within which the Japanese are now a dominant factor are automobiles, electronic devices such as televisions, video recorders, radios, stereos, and microwave ovens, as well as recording tape. All of these markets were once dominated by American manufacturers. In the case of European manufacturers, English and German automobiles, once a major competitor on the world market, no longer hold a significant share of that market. One of the primary reasons for these changes in world market share has been the perceived quality of the Japanese product.

The systems used by Japanese competitors to control quality have changed in recent years (Kume, 1985). Among the changes in the quality systems are the use of

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

statistical process control, process capability studies, quality circles, robotics, machine vision, and computer data bases. As well, more of the responsibility for quality has been shifted to the individual worker and away from the "inspector." "The success of Japanese quality control has drawn worldwide attention to the difference between Japanese and western quality control" (Kume, 1985, p. 13).

In describing American quality control systems, P. C. Crosby (1984) states,

> It may already be too late for quality control professionals as they operate today. Because of a stubborn insistence that error is inevitable and a reluctance to learn about management, their credibility is very low. CEOs consider them little help in causing the necessary management style changes, and an actual obstacle when it comes to making quality improvements company-wide. (p. 35)

It appears that changes will have to be brought about in the process of managing quality in American industry. In order to make changes in the process of managing quality, changes have to be made in the education and training of managers and quality assurance personnel. As stated by McDermott (1983), Vice-president for quality and reliability assurance of the Rockwell International Corporation:

> The field of education and training provides us with a major opportunity to provide product quality both near and long-term. To strengthen our education and training programs, we must take a new look at many of our traditional practices and at cooperative efforts by both our educational institutions and industry. (p. 32)

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

To this end, this study attempts to provide information to managers, educators, and training personnel for the purpose of improving the quality technology taught and practiced in the United States.

Statement of the Problem

The problem of this study was to compare the level of the importance and the frequency of performance of selected quality assurance tasks in the present and in the future and to determine potential reasons for any changes between the present and the future. Practicing certified quality engineers working for manufacturing companies in the United States were surveyed to obtain this information.

Purpose of the Study

This study was conducted so the information could be applied to management decision making related to quality, industrial job descriptions, educational programs, and training design and development in industrial settings. This study focused on tasks organized in the following categories which have been identified through a comprehensive review of current related literature. The review included journal articles, textbooks, and the ASQC requirements for qualify engineering certification:

1. Design Review
2. Process Capability

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

3. Process Control
4. Vendor Relations
5. Customer Relations
6. Applications
    a. Communication
    b. Leadership
    c. Management
    d. Statistical
    e. Computer
    f. Technical/Scientific

These categories represent a method of classifying the more specific job responsibilities (tasks) of the quality engineer (Gael, 1983). Specific tasks were identified by analyzing the job descriptions of practicing certified quality engineers.

Objective of the Study

This study attempted to answer a number of important questions. These questions relate to the specific tasks performed by quality engineers in manufacturing firms in the United States, a forecast of the nature of these tasks in the future, and the identification of potential reasons for change between the present and the future. A sample of practicing quality engineers was drawn from firms that had been identified as leaders in product quality in a 1985 Gallup Study, Consumer Perceptions Concerning the Quality

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

of American Products and Services (1985, pp. 5-7). See Appendix A for a list of leading companies. A second sample of quality engineers was drawn from companies other than those identified as being leaders. In an effort to secure cooperation and commitment to the survey procedures, each potential respondent was sent a letter explaining the expected procedures and a post card upon which to indicate whether or not they would participate.

These two groups were surveyed in an effort to identify and/or forecast the importance of and the frequency of performance of selected quality engineering tasks. The survey involved three steps. Step 1 considered the present, Step 2 forecasted the future, and Step 3 identified anticipated catalysts for any expected change.

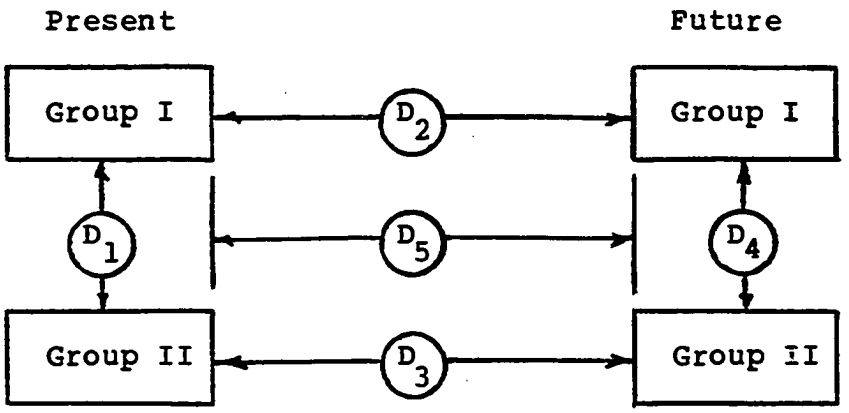
In modeling terms, the study was basically a four cell study (McGrath & Watson, 1970, pp. 86-8). Figure 1 is a model of this study.

The study attempted to answer the following research questions:

1. What are the tasks presently performed by quality engineers, how important are they, and how frequently are they performed?

2. Is there a statistically significant difference between tasks performed in leading companies and others at present?

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.



Group I = Quality engineers from the top 43 companies.

Group II = Quality engineers from companies other than top 43.

D_1 = Difference in responses between Group I and Group II in the present.

D_2 = Difference between the present and the future within Group I.

D_3 = Difference between the present and the future within Group II.

D_4 = Difference between Group I and Group II in the future.

D_5 = Difference of combined groups between the present and the future

Figure 1

Model of the Study

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

3. Of the selected tasks, how important will they be and how frequently will they be performed, five years hence?

4. Is there a statistically significant difference between the perception of the tasks performed within each group between the present and the future?

5. Is there a statistically significant difference in the perception of the tasks performed between leading companies and others, five years hence?

6. Is there a statistically significant difference in the perceptions of the tasks performed by both groups combined, treating the two groups as if they were one, between the present and the future?

7. What catalysts are anticipated to influence any future changes?

Importance of the Study

In order for the United States to regain its former position as a leader in world markets, the managers of its industries must learn to more effectively control the quality of products. As stated by P. C. Crosby (1984),

> Many executives talk about quality but very few are really effective in causing it to happen. Most of the executives who use it as part of their speeches are sincere but misinformed. They think that just putting in a quality system will fix things, but it doesn't, and then they are confused and disappointed. If they had been educated on the subject, they would not have been under such a delusion. (p. 36)

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

In further explaining the situation, P. C. Crosby (1984) states, "Upper managers need something solid in the way of specific deeds to be done, and they themselves have to be part of the doing of those deeds" (p. 36).

Support for the idea that managers do not understand the function of quality systems was indicated in an American Society for Quality Control (ASQC) study conducted in 1981. The ASQC task group leader, Hagan (1984) states that,

> The survey clearly shows that while senior business executives recognize quality as being somewhat important, they normally do not become involved in quality management, do not sponsor formal quality statements or policy, and do not understand the potential effect of quality on key business objectives. (p. 44)

The importance of management's role in improving quality is presented by Dorsky (1984), when he states that "American industry and particularly American quality have lost their way and that they are in trouble" (p. 16). He goes on to say that there are two areas of management failure:

> 1. Quality control people generally have failed to evaluate each new professional development against the perspective of true business objectives. Their lack of success in obtaining management commitment is often simply a reflection of this fact.
>
> 2. Nonquality control management generally has abdicated its responsibility in the quality area to the specialists. Having done so, they actually have created a vacuum in this area. (p. 16)

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

There are many potential issues to be considered if quality is to be improved. "One of these issues involves the general adequacy of education and training, not only within industrial concerns but throughout the educational infrastructure that supports them" (McDermott, 1983, p. 30).

Education and training can have a significant impact on how management and quality professionals view their responsibilities. As stated by McDermott (1983):

> Most of our current quality assurance personnel were not trained for this field of work through a formal educational program. Their formal education was usually in some other basic discipline, such as chemistry, biology, or engineering, and they obtained knowledge of the quality sciences from on-the-job experience, seminars and short courses, and extensive reading in professional publications devoted to this subject. We are now reaching a point where the sophistication of this science demands a more formal approach through the educational infrastructure. . . My personal experience indicates that, despite what we often hear, quality problems stem more from lack of knowledge or training than from workers' indifference. It would appear then that improvement in education and training offers one of the most promising opportunities for quality improvement. (p. 32)

In order to reduce and eliminate confusion about what quality engineers need to do to significantly improve the quality of American products, this study was conducted to identify and determine the level of importance and the frequency of performance of selected quality engineering tasks in the present and in the future and to determine factors that might influence any anticipated change.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

This information will assist managers and administrators in the process of designing and developing:

1. Job description for quality related positions.
2. Academic curricula for two year, four year, and postgraduate education programs.
3. Academic courses of study for two year, four year, and postgraduate education programs.
4. Industrial training programs.
5. Organizational development.

Limitations of the Study

The tasks included in this study were derived from the outline of the body of knowledge included in the American Society for Quality Control, Quality Engineer-in-Training Certification Program (1984, pp. 5-12), an analysis of quality engineer job descriptions obtained from leading manufacturing firms, and a review of related literature.

The population of this study was the practicing certified quality engineers of manufacturing firms in the United States.

Definition of Terms

Function:

A broad subdivision of a job composed of a group of tasks that are somewhat related because of the nature of the work or the behavior involved, such as acquiring information. There appear to be two types of functions: (1) supervisory (organizing, planning, directing, developing, and so on) and (2) direct work

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

(maintaining, repairing, operating, and so on). Functions are generally expressed with action words ending in "ing." Examples of functions include performing preventive maintenance, collecting data, and developing subordinates. (Gael, 1983, p. 9)

Group I: The sample selected from leading manufacturing companies.

Group II: The sample selected from nonleading manufacturing companies.

Job: "An amalgam of functions performed by individual employees. When the same group of functions is performed by a set of employees, they are said to have the same job" (Gael, 1983, p. 10).

Quality Engineering:

Quality engineering is that specialty branch of professional engineering which requires such education and experience as to master the unique body of knowledge of substantial intellectual content which makes up the quality sciences and to understand and apply the principles of product and service quality evaluation and control. This body of knowledge and applied technologies include, but are not limited to: development and operation of quality control systems; application and analysis of testing and inspection procedures; the ability to apply metrology and statistical methods to diagnose and correct improper quality control practices which assure product and service conformity to prescribed standards, an understanding of human factors and motivation; facility with quality cost concepts and techniques; the knowledge and ability to develop and administer management information systems and to audit quality systems for deficiency identification and correction. (American Society for Quality Control, 1984, p. 5)

Task:

A discrete organized unit of work, with a definite beginning and end, performed by an individual to accomplish the goals of a job. A task is described by a statement that starts with an action verb and includes the object of that verb. Tasks performed by

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

job incumbents can be divided into finer and finer segments. As a general rule, tasks should be stated at a level and in a form suitable to meet the job analysis objectives at hand. Greater degrees of task specificity and detail are usually reserved for specialized technical purposes--for example, preparing training materials or maintenance manuals. Some examples of tasks are to solder leaks in a radiator, to schedule basic input for a manual data system, and to operate a paper tape punch and reader. (Gael, 1983, p. 9)

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

CHAPTER II

REVIEW OF RELATED LITERATURE

To assist in determining the list of selected tasks performed by quality engineers and to help determine the design of the study to be implemented, a review of related literature was conducted. The review also identified any other studies that have been conducted in an attempt to identify tasks performed by similar professionals.

The review is organized as follows:

1. Body of quality engineering knowledge.
2. Descriptions of quality related careers.
3. Definitions and characteristics of tasks.
4. Writing task statements.
5. Research methodology.
6. Related studies.
7. Quality technology curricula.

Body of Quality Engineering Knowledge

The American Society for Quality Control (ASQC) (1984) has identified an inclusive body of knowledge for quality engineering. That body of knowledge was identified for the purpose of generating questions to be asked as part of the quality engineering certification examination. Eight subdivisions are included as follows:

1. Fundamental concepts of probability, statistical quality control, and design of experiments.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

2. Quality planning, management, and product liability.

3. Metrology, inspection, and testing.

4. Quality cost analysis.

5. Quality auditing.

6. Reliability, maintenance, and product safety.

7. Quality information systems.

8. Motivation and human factors.

This outline serves as the means of organizing the quality engineering certification examination. The questions on the examination are grouped into these subdivisions.

The complete outline includes five levels. The five levels start with those listed above and include four levels below those listed above. Because of the comprehensive nature of the complete outline, it can serve as a means of identifying quality engineering tasks and as a potential means for categorizing those tasks for the purposes of this study.

Authors of texts in the field of quality technology have devised various means of organizing the concepts of the field of quality technology. Sinha & Willborn (1985) have organized it as follows:

I. Background of Modern Quality Assurance

1. Concepts and Definitions

2. Assurance of Quality

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

3. The Human Aspects
4. Managerial Dimensions

II. Planning and Controlling of Quality

5. Planning and Control Through Statistical Data
6. Probability and Statistics in Management Decisions
7. The Planning Interface: Quality and Production
8. Quality of Design: Product and Services
9. Quality of Design: Production and Operations
10. Quality of Design: Resources and Supplies
11. Quality of Conformance: Inspection and Process Control
12. Quality of Conformance: Acceptance Sampling Techniques
13. Quality of Performance: Customer Relations and Liability

III. Managing Quality Assurance

14. Objectives and Strategies
15. Organization: Design and Development
16. Quality Information Systems and Decisions
17. Quality Cost Accounting and Performance Control
18. Quality Program: Design and Development

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

19. Quality Audit and Corrective Actions

20. Public Concern in Quality (pp. ix-xv)

This organization provides a systematic means of organizing the knowledge related to quality technology. It is then a less difficult task to determine and organize the job functions of a quality engineer. This organization presents both management and engineering functions. For purposes of this study it was necessary to extract those most closely related to the quality engineering function, yet maintain those management skills which are required of quality engineers.

In studying this and 19 other outlines of this body of knowledge (see Appendix B), it becomes apparent that the authors in this area of study agree on a majority of the functional areas of knowledge that make up quality technology. Following is a potential organization of that knowledge into functional areas.

Design review is the process of relating design specifications to the process capabilities available in the plant to determine if it can be produced to the desired quality with the processes available or if it might be necessary to update those processes. This examination also includes the identification of potential future quality problems by assessment of the variables related to the production of the item. A third objective is to establish

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

tentative quality control procedures which will be tested in a pilot-run situation.

Process capability refers to the determination of the variation inherent in a given process. Statistical techniques are applied to the output of the process and a determination is made of the variation to be expected from that process. Statistical variation is compared to specification tolerances to determine if the process is capable of producing the desired quality. To perform this task, an engineer must identify the potential controlling variables, develop and/or select statistical procedures, collect the data, and analyze it. Most frequently the data are analyzed through the use of computer technology.

Process control includes the application of statistical techniques to the output of a process to determine if there are changes in variables that can be assigned a cause. This application involves the development and implementation of inspection and audit procedures, the development and implementation of control chart procedures, the establishment of control limits, and reporting procedures. Because of the extreme variability of the manufacturing situation, it is necessary to review and revise control procedures as well as reporting procedures.

Vendor relations entails the process of assuring that all incoming materials and purchased items are of the

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

desired quality. To assure incoming quality, the quality engineer must develop and implement acceptance sampling procedures for all incoming items. In an effort to reduce incoming inspection, it has become common practice to assist vendors with their quality problems. This would involve the development of quality systems that will be used by the vendor as part of the manufacturing process.

Customer relations involves the process of assuring that the customer is satisfied with the product and/or service that has been obtained from the company. To assure that satisfaction, the quality function must develop and implement customer feedback systems. These systems must collect information, analyze it, and suggest corrective action to be taken. The analysis of the problem requires that the identified deficiency be traced backwards through the production system, the source of the problem be identified, and corrective action is taken to eliminate that problem.

The quality engineer must apply general management principles as well as specific quality technology. These management principles might be organized as follows.

Communication skills are extremely important. The engineer must be able to write understandable proposals and reports as part of the management information system. Everyday interactions with co-workers, superiors, and

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

subordinates, require the engineer to speak and discuss clearly.

Leadership skills are required so that instructions are carried out in the manner expected. The engineer/manager must be able to motivate subordinates and peers, and must be able to effectively delegate responsibilities. Another important aspect of leadership is the ability to perform effective training sessions.

Management skills also include the ability to plan for the future and to organize resources. Planning requires the identification of goals and objectives, as well as the development of systems to accomplish those goals and objectives. The organization of resources requires the establishment of responsibilities and the determination of accountability.

The understanding of and the ability to apply statistics are everyday activities of the quality engineer. Statistical methods are applied to incoming materials, in-process items, as well as final products. Process capability is determined through statistical techniques and process control requires continued application of various statistical concepts. These applications include descriptive as well as inferential techniques. The design of experiments allows quality engineers to determine the interaction of various variables in the manufacturing process.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Because of the scope of the quality effort, it is necessary to incorporate computer technology to save time and to keep track of the large volumes of information. Quality engineers are required to design and/or select computer technology and implement its use.

Quality engineers must have a base of technical and scientific knowledge in order to determine what variables are involved in a given situation. This knowledge must be oriented to the types of products and processes that are used in the particular company that they are working for. Because of the growth of knowledge in the technical and scientific fields, engineers must have an organized method of "keeping up to date."

Together the text book organization and the ASQC outline provide a framework for the development of the tasks and the task categories which are of major interest to this study.

Descriptions of Quality Related Careers

The process of seeking a description of duties and tasks performed by quality engineers included searching various career oriented references. The following descriptions were observed.

The Dictionary of Occupational Titles (1977) presents this description of a quality control engineer.

> Plans and directs activities concerned with development, application, and maintenance of quality

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

> standards for processing materials into partially finished or finished material or product. Develops and initiates methods and procedures for inspection, testing, and evaluation. Devises sampling procedures, designs forms for recording, evaluating, and reporting quality and reliability data, and writes instructions on use of forms. Establishes program to evaluate precision and accuracy of production and processing equipment and testing, measurement, and analytical facilities. Develops and implements methods and procedures for disposition and devises methods to assess cost and responsibility of discrepant material. Directs workers engaged in measuring and testing product and tabulating quality and reliability data. Compiles and writes training material and conducts training sessions on quality control activities. May specialize in any of following areas of quality control: engineering and design, incoming material, process control, product evaluation, inventory control, product reliability, research and development, and administrative application. Usually required to have an engineering degree, such as chemical, mechanical, or electrical engineering which is related to technology of the product evaluated. (p. 29)

The ASQC (1984) Quality Engineering-in-Training Certification Program presents this description:

> Quality Engineering is that specialty branch of professional engineering which requires such education and experience as to master the unique body of knowledge of substantial intellectual content which makes up the quality sciences and to understand and apply the principles of product and service quality evaluation and control. This body of knowledge and applied technologies include, but are not limited to: development and operation of quality control systems; application and analysis of testing and inspection procedures; the ability to apply metrology and statistical methods to diagnose and correct improper quality control practices which assure product and service conformity to prescribed standards; an understanding of human factors and motivation; facility with quality cost concepts and techniques; the knowledge and ability to develop and administer management information systems and to audit quality systems for deficiency identification and correction. (1984, p. 5)

The Dictionary of Business and Management states:

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

"Quality Control: The attempt to ensure the presence of qualitative factors in a product or standards of performance in a service" (1983, p. 408).

The Encyclopedia of Careers and Vocational Guidance (1984) states that:

> Quality Control Engineers promote precision in manufacturing through constant surveillance of quality and incoming parts received from suppliers or subcontractors. They control this area of work through supervisory as well as personal involvement. (p. 54)

Among the potential references for descriptive information on quality related careers, there were many which did not include specific descriptions. Among these were:

1. Occupational Outlook Handbook (1982)
2. College Placement Council, Incorporated 1984-85 (1983)
3. Career Employment Opportunities Directory (1980)

Definitions and Characteristics of Tasks

The term task has many definitions. A search of the job analysis literature has revealed that McCormick (1979) lists six criteria for identifying tasks:

1. A task is a group of manual activities directed toward a goal.
2. A task usually has a definite beginning and end.
3. A task involves people's interaction with equipment, other people and/or media.
4. A task, when performed, results in a meaningful product.
5. A task includes a mixture of decisions, perceptions, and/or physical activities required of a person.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

6. A task may be of any size or degree of complexity. But, it must be directed toward a specific purpose or separate portion of a total duty. (pp. 92-93)

Another definition of a task is presented by Fine, Holt, and Hutchinson (1974):

> A task is an action or action sequence grouped through time designed to contribute a specified end result to the accomplishment of an objective and for which functional levels and orientation can be reliably assigned. The task action or action sequence may be primarily physical, such as operating an electric typewriter; or primarily mental, such as analyzing data; and/or primarily interpersonal, such as consulting with another person. (p. 4)

West (1976) states that, "a task is an activity, either mental or physical or both (usually both), the results of which are either directly observable or indirectly inferrable" (p. 4). He further states that there are six identification criteria for tasks:

1. A task has a definite beginning and ending.
2. A task is an inherent part of a job.
3. A task is done in a relatively short period of time.
4. A task is amenable to testing in a real-life situation.
5. A task is composed of sub-tasks which are capable of sequencing into a terminal performance.
6. A task is the smallest bit of meaningful activity that is done for its own sake when viewed in relation to the total array of job activities performed by the job incumbent. (pp. 6 & 7)

Terry and Evans (1973) reviewed a number of job analysis articles and summarized the following definitions of the term task:

1. An action or sequence of actions performed closely together in time and directed toward an objective, common goal, or outcome.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

2. A unit of work that is a consistent and significant part of a duty or is a logical and necessary step in the performance of a duty.

3. An orderly, homogeneous grouping of goal-oriented human activities applied methodically to things or equipment and usually performed by one person in less than a day. Task activities have an observable start and stop and are composed of elements or simple discrete responses that are carried out in a cumulative and progressive sequence.

4. A series or set of work activities needed to produce an identifiable output that can be independently consumed or used or can be used as input in a further stage of production by the performer or someone else. (p. 8)

Gael (1983) has developed the following: A definition of the term task, a definition of the term function, and a definition of the term job.

1. Task: A discrete organized unit of work, with a definite beginning and end, performed by an individual to accomplish the goals of a job. A task is described by a statement that starts with an action verb and includes the object of that verb. Tasks performed by job incumbents can be divided into finer and finer segments. As a general rule, tasks should be stated at a level and in a form suitable to meet the job analysis objectives at hand. Greater degrees of task specificity and detail are usually reserved for specialized technical purposes -- for example, preparing training materials or maintenance manuals. Some examples of tasks are to solder leaks in a radiator, to schedule basic input for a manual data system, and to operate a paper tape punch and reader.

2. Function: A broad subdivision of a job composed of a group of tasks that are somewhat related because of the nature of the work or the behavior involved, such as acquiring information. There appear to be two types of functions: (1) supervisory (organizing, planning, directing, developing, and so on) and (2) direct work (maintaining, repairing, operating, and so on). Functions are generally expressed with action words ending in "ing." Examples of functions include performing preventive maintenance, collecting data, and developing subordinates.

3. Job: An amalgam of functions performed by individual employees. When the same group of

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

> functions is performed by a set of employees, they are said to have the same job. (pp. 9 & 10)

These definitions assist in grouping tasks into functions and functions into jobs.

Writing Task Statements

The process of writing task statements involves the collection of information about a job, breaking the job into functions, and breaking these functions into tasks. It must be remembered that a task is a unit of work that is performed by an individual, has a definite beginning and end, and results in a product or a service (West, 1976, p. 2).

The process of writing the specific task statements follows a set of procedures as presented by Gael (1983):

> The standard grammatical form for writing task statements is the simple sentence with a subject, a verb, and an immediate object. The subject of each task statement is "I" understood and is omitted from the task statement. The verb is an action verb, and the object of the task statement is, of course, the object of the verb. A practice that seems to have evolved is to omit articles from task statements, thereby making the statements somewhat choppy, as well as shorter and less well-structured than complete sentences. (p. 55)

He goes on to state that:

> When writing task statements, then, you should (1) begin with an appropriate action verb in the present tense--what is done; (2) include the object of the verb--what is being acted upon; and (3) include qualifying information as needed. (p. 56)

The task statements will eventually be evaluated by respondents to questionnaires. Therefore, it is imperative

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

that the statements be clear and understandable to these respondents. The following guidelines should be followed to insure understandability:

1. Use specific verbs and nouns.
2. Include one action and one object.
3. Each task should stand alone.
4. Use familiar words.
5. Use words consistently.
6. Each statement must be compatible with rating scales. (Gael, 1983, pp. 57-59)

Task statements should not include:

1. Worker or job qualifications.
2. Participation in nonproductive activities.
3. Organization policies and practices.
4. Working conditions.
5. Imprecise or ambiguous terms. (Gael, 1983, pp. 59 & 60)

Research Methodology

Research methods must be consistent with the nature of the data. According to Leedy (1974), there are various sources of data which lead to research methodologies. This study involved observations which are quantified and therefore could be evaluated with appropriate statistical procedures. Of the types of research methods, this study would be commonly called a descriptive survey with statistical analysis to measure significance.

In the case of this study, survey respondents are certified by the American Society for Quality Control (ASQC). Quality engineering certification requires seven years of direct experience and the passage of the quality engineering certification examination. To maintain

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

certification, the engineer must demonstrate that he/she is keeping up-to-date in the field by attending at least 36 hours of related educational experiences every three years. Therefore, the respondents of this study are recognized by the ASCQ as experts in the field of quality engineering. Their perceptions were gathered and analyzed using a Likert scale with five distinct values, one through five. The data, therefore, are at least nominal. The survey process involved two groups. Group I consisted of certified quality engineers working for leading companies. Leading companies were identified by a Gallup study completed in 1985. Group II consisted of certified quality engineers working for nonleading companies. The survey process will begin with the establishment of what tasks are presently performed by those responding. The process allowed for the addition to tasks not found in the review of literature.

Group I and Group II were statistically tested to measure any differences in perceptions of the importance and frequency of performance of tasks. Of the various statistical tests available, the chi-square two sample test is the most powerful for the type of data and research method (Dayton & Stunkard, 1971, p. 10).

To determine the importance and frequency of performance of the various tasks in the future, a second survey asked respondents to give their perceptions by

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

completing the instrument. The instrument allowed respondents to add any tasks which they felt are not included in the original list. Group I and Group II were statistically compared to measure any differences in perceptions of the future, five years hence. The chi-square two sample test was used to measure for the statistical difference. Group I present responses were compared to Group I future responses. Group II present responses were compared to Group II future responses. The chi-square two sample test measured for statistical difference.

All differences discovered were accumulated and reported in the third survey instrument. Respondents were asked to identify potential reasons for the identified changes.

The three step survey process is a modified form of the Delphi technique (Worsham, 1980, p. 27). It allowed for input by the respondents at each of the three steps while reporting the results of the previous step.

Related Studies

A similar study, A Study to Identify the Importance of Tasks Performed by Manufacturing Engineers for Manufacturers in the State of Wisconsin, was conducted at the University of Minnesota (Yost, 1984). The study was completed as part of the requirements for a Doctor of Philosophy Degree in

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Vocational Education. That study had the following objectives:

1. What is the present level of importance of the tasks done in manufacturing firms?
2. What will the task level of importance be fives years from now?
3. What major changes will take place during the intervening five years?
4. What is the present level of importance of categories of manufacturing engineering tasks in manufacturing firms?
5. What will the level of importance of task categories be five years from now?
6. What major changes in level of importance of categories of tasks will take place during the intervening five years?
7. Does the present importance of tasks differ among small, medium, and large size firms?
8. Will the importance of tasks differ in five years among small, medium, and large size manufacturing firms?
9. Does the present importance of tasks differ among manufacturing firms drawn from various standard industrial classifications?
10. Will the importance of tasks differ in five years among manufacturing firms drawn from various standard industrial classifications? (pp. 7 & 8)

To accomplish these objectives, the study collected information from 75 Wisconsin firms in three size designations and five fields of durable goods manufacturing. The five fields included:

1. Gray iron foundries
2. Fabricated plate work
3. Farm machinery and equipment
4. Construction machinery
5. Motors and generators (pp. 83 & 84)

Managers of manufacturing engineering were asked their opinions concerning the importance of tasks performed by manufacturing engineers. The inquiry was made concerning the degree of importance of tasks "now" and the degree of

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

importance of the same tasks "in five years." Ninety-nine tasks were included that were divided into ten categories:

1. Product design
2. Manufacturing planning
3. Manufacturing control
4. Quality control
5. Human factors
6. Manufacturing practice
7. Manufacturing cost control
8. Inventory control
9. Social responsibility
10. Manufacturing research and development (p. 95)

The individual tasks were extracted from expert opinion, review of current literature, position descriptions, house organs and national curricula. The primary source of current literature was the Society of Manufacturing Engineers.

Manufacturing firms were ranked by chief operating officers of firms in the same industrial classification and the top five in each class were asked to evaluate each task. The choices were:

1. Very important
2. Important
3. Somewhat important
4. Not important

The importance level was rated "now" and "in five years."

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

After the data were collected, the arithmetic mean, the percentage, and frequency distributions of importance "now" and importance "in five years" for each individual task, were established. The means of all tasks were ranked "now" and "in five years." The mean of means was used to rank each category of tasks "now" and "in five years." Analysis of variance was used to test for significant differences for size groups of respondents and on categories of tasks.

The tasks were arranged in a hierarchy of present importance from lowest mean to highest mean. Of the 99 tasks, 13 (13%) were considered "very important," 56 (57%) of the tasks were rated "important," 24 (24%) of the tasks were considered "somewhat important," and 6 (6%) were rated "not important." The hierarchy of future, "in five years," importance found 33 (33%) of the 99 tasks rated as "very important," 56 (57%) rated as "important," 10 (10%) rated as "somewhat important," and none of the tasks rated as "not important." All but one task were perceived as increasing in importance during the next five years. The number one ranked task was Communicate Effectively. The number one ranked category of tasks was Human Factors.

Yost (1984) came to the following conclusions:

1. In the future, computer-specific tasks are expected to substantially increase in importance.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

2. Competency is required in most of the tasks studied for current entry in the occupation of manufacturing engineering.

3. Competency is required in all of the tasks for future entry into the occupation of manufacturing engineering. Of particular importance are tasks related to computer applications.

4. A broader set of competencies are required for employment in larger firms.

5. The specific importance levels of the various tasks differ with the nature of the product manufactured.

Quality Technology Curricula

In the interest of gaining a better understanding of the tasks performed by quality engineers, an extensive review was begun to identify course offerings and programs of study at the post secondary level in the area of quality technology in the United States. It was quickly discovered that the American Society for Quality Control (1984) had undertaken such a study. That study found that this subject area might come under the various titles of Quality Technology, Quality Science, or Quality Management.

Courses related to quality technology can be found at 167 technical schools, junior colleges, colleges, and universities. Typical course titles include:

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

1. Quality Control
2. Quality Assurance
3. Statistical Quality Control
4. Statistical Process Control
5. Quality Control for Service Industries
6. Quality Management
7. Quality Circles
8. Design of Experiments
9. Inspection and Testing
10. Dimensional Metrology
11. Quality Assurance Practicum
12. Reliability Engineering
13. Test Engineering
14. Materials Testing
15. Metrology
16. Simulation
17. Industrial Statistics

These courses are most frequently analytically oriented and require a basic understanding of statistical applications. Most frequently, at least a basic course in statistics is a prerequisite to those offered in the quality technology area.

There are 50 two-year institutions, technical schools, and junior colleges that offer certificate programs in the area of quality technology. These certificates are awarded for compilation of prescribed courses. Often this

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

compilation is a one year concentration within a two year degree program.

Associate degree programs, specifically oriented to quality technology, can be found at 16 institutions of higher learning. These are two year programs leading to an Associate of Science degree.

There are 10 Bachelor of Science and 16 Master of Science degree programs in the United States. In most cases, the degree granted is in a more traditional discipline, with a concentration or major in quality science, technology, or management. In rare cases, a special "deans" diploma with the quality title may be attached to the regular diploma to more clearly indicate the quality major.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

CHAPTER III

DESIGN OF THE STUDY

The Population and Sampling

The population for this study included quality engineers certified by the American Society for Quality Control (ASQC). The population was divided into two groups. Group I consisted of those that were employed by one of the companies identified as being in the top forty-three for quality by the study titled Consumer Perceptions Concerning the Quality of American Products and Services (Gallup, 1985). Group II consisted of those employed by companies other than those listed in the Gallup study.

Based upon ASQC information, there are approximately 12,000 certified quality engineers (L. A. Draeger, personal communication, February 21, 1987). Of these approximately 762 work for one of the top forty-three companies. Therefore, 11,238 work for nonleading companies.

$$Op = \sqrt{\frac{Pq}{n-1}} \quad X \quad \sqrt{\frac{N-n}{N-1}}$$

Where:

Op = Standard error of the proportion
Pq = Measure of dispersion
N = Population size
n = Sample size

(Emory, 1980, p. 163)

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

The estimate of the dispersion of the population would be a maximum of .50 x.50 or .25. The confidence level selected is 95% (alpha = .05). The desired interval within which the sample proportion will fall is plus and minus 10% of the true population proportion. There are 762 certified quality engineers that work for leading companies.

Therefore:

$$\frac{.10}{1.96} = \sqrt{\frac{.5 \times .5}{n-1}} \quad X \quad \sqrt{\frac{762 - n}{762 - 1}}$$

$$.051 = \sqrt{\frac{.25}{n-1}} \quad X \quad \sqrt{\frac{762 - n}{761}}$$

$$n \cong 86$$

A sample of 86 was required to establish, with 95% confidence, that the proportions of the sample responses are within 10% of the true value of the population proportions for leading companies.

To calculate the sample size for the nonleading companies, only the population size would change. There are 11,238 certified quality engineers that work for nonleading companies.

Therefore:

$$\frac{.10}{1.96} = \sqrt{\frac{.5 \times .5}{n-1}} \quad X \quad \sqrt{\frac{11,238 - n}{11,238 - 1}}$$

$$.051 = \sqrt{\frac{.25}{n-1}} \quad X \quad \sqrt{\frac{11,238 - n}{11,237}}$$

$$n \cong 96$$

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

A sample of 96 was required to establish, with 95% confidence, that the proportions of the sample responses are within 10% of the true value of the population proportions for the nonleading companies.

Development of the Questionnaire

The process of developing the questionnaire began with a review of selected texts related to quality control and/or assurance, a review of job descriptions of quality control and/or assurance positions in industry, and a review of the American Society for Quality Control (ASQC) Quality Engineer Certification Study Guide (1984).

The texts included 20 that had been published within the last five years (1983-1987) and included the term quality in the title. A list of these texts has been included in Appendix B.

As stated by Gael, "job descriptions are excellent sources of task information" (1983, p. 67). Therefore, job descriptions were solicited from those companies identified as being leaders in quality (Gallup, 1985, pp. 5-7). The list included 43 companies. The soliciting process included the identification of a corporate level manager with a title related to personnel management such as vice-president of Human Resource Development. A letter of request was sent to each individual, see Appendix C.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

A list of the individuals to which the request was sent appears in Appendix D.

Of the 43 requests sent, 16 (37%) responses were acquired. The job descriptions returned included titles such as:

1. Quality Control Analyst
2. Quality Engineer
3. Quality Technologist
4. Quality Assurance Supervisor
5. Quality Assurance Manager
6. Quality Assurance Representative
7. Quality Specialist
8. Quality Control Coordinator

Appendix E includes several typical job descriptions for these titles.

The ASQC Quality Engineer Certification Study Guide (1984) provides an outline of the body of knowledge included in the certification examination. This outline was used as a source of quality engineering tasks and as an example of how those tasks could be organized into categories.

The review of these resources, texts, job descriptions, and the ASQC study guide provided for the identification of task categories and generalized tasks within each of those categories. Following is a list of those selected organized into task categories:

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

1. Design Review
    a. Review quality specifications.
    b. Relate specifications to process capability.
    c. Identify potentially significant variables.
    d. Develop pilot-run quality procedures.
2. Process Capability
    a. Identify potential controlling variables.
    b. Develop/select statistical tests.
    c. Analyze statistical data.
    d. Develop/utilize computer data bases/programs.
3. Process Control
    a. Develop/implement inspection/audit procedures.
    b. Develop/implement control chart procedures.
    c. Establish control limits.
    d. Review/revise control procedures.
    e. Develop control reporting procedures.
4. Vendor Relations
    a. Develop/implement acceptance sampling procedures.
    b. Evaluate vendor quality systems.
    c. Assist vendors with quality system development/revision.
5. Customer Relations
    a. Develop/implement customer feedback systems.
    b. Analyze customer feedback.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

c. Trace variation back through manufacturing system.

6. Applications

a. Communication

1) Write understandable reports

2) Speak and discuss clearly

b. Leadership

1) Motivate subordinates

2) Delegate responsibilities

3) Perform training sessions

c. Management

1) Plan quality systems

2) Organize resources

d. Statistical

1) Apply descriptive statistics

2) Apply inferential statistics

3) Design experiments

e. Computer

1) Design computer programs

2) Utilize available software

f. Technical/Scientific

1) Design/improve

2) Evaluate materials

3) Apply design procedures

These tasks were then used to create a questionnaire using a five point Likert scale for each of the two

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

measures, importance and frequency of performance. The 34 tasks were included as well as blank lines for the respondent to add any tasks which were not already presented. The questionnaire was then pilot tested with 42 members of the Northwest Subsection of the American Society for Quality Control and revised for clarity.

Sampling Procedure

The sampling procedure began with the acquisition of the names and addresses of certified quality engineers from the American Society for Quality Control. The names were randomly selected by company. Those who worked for companies identified as being in the top 43 by the Gallup Organization Study were placed in one population, the others made up the second population. A sample of 250 names was randomly drawn from each group. These 500 individuals were sent a letter explaining the study and requesting that they participate (see Appendix F). The letter included a postage paid return postcard upon which they included:

1. Whether they would or would not participate.
2. Years of experience in the area of quality control.
3. Years of experience in the present position.
4. Amount of formal training in quality control.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Because of the selection process, the following demographic information is also available:

1. Company name.
2. Company size.
3. Type of product.

This information provided additional profiles of the typical quality engineer.

Each individual was identified by code number for identification and follow-up purposes. As cards were returned, they were sorted by response and group. To allow for shrinkage during the survey process, an additional 50% was added to the sample size. After four weeks, 129 positive responses were randomly selected for Group I, 144 positive responses were randomly selected for Group II, and the process of identifying participants stopped. It should be noted that this process received 89% positive responses.

The selected individuals were sent the first cover letter and questionnaire, see Appendix G. The objective of this questionnaire was to establish the present importance and frequency of performance of each of the selected tasks. As the surveys were returned, they were separated into their respective group. After four weeks, the respective sample size was drawn from the returns and the data were processed to determine the mean and rank order of the importance and the mean and the rank order of the frequency of performance of each task.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

The statistical analysis then attempted to answer the first research question: What are the tasks presently performed by quality engineers, how important are they, and how frequently are they performed? To answer this question the responses of each group were summed, the mean of each measure calculated, and the rank order established. The rank order then identified the relative importance and frequency of performance of each of the tasks. Because of the fact that no additional tasks were added by more than one respondent in either group, it was assumed that the original selected tasks were inclusive of those performed by quality engineers.

The second research question: Is there a statistically significant difference between tasks performed in leading companies and others at present?, was then answered. The first null hypothesis stated that: There is no significant difference in the importance, the frequency of performance, or the sum of those two measures between leading and nonleading companies. To test the hypothesis a chi-square two sample test was used because the data were considered to be at least nominal and two independent samples were involved (Emory, 1980, pp. 415-6). The significance level was set at 95 percent (alpha = .05) with four degrees of freedom. The chi-square value was then calculated and compared to the critical value from the chi-square table. If the calculated value

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

of chi-square was greater than the critical value, there was a significant difference between the two groups.

Completion of the first round led to the third research question: Of the selected tasks, how important will each be and how frequently will they be performed, in five years? The second question and cover letter were then developed to include the results of the first round and provide the means for each respondent to forecast the importance and the frequency of performance of each task in five years. Appendix H includes the second questionnaire and cover letter. As they were returned, the data were added to the data base. After four weeks, the respective sample sizes were drawn for each group and the analysis proceeded. The mean of each measure was calculated and the rank order identified thereby answering the third research question.

The answer to the fourth research question: Is there a statistically significant difference in the perception of the tasks performed within each group between the present and the future?, was then attempted. The null hypothesis stated that: There is no significant difference in the importance, the frequency of performance, or the sum of those two measures within each group between the present and the future. The chi-square test with the same parameters was then applied and the significant differences identified.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

The fifth research question: Is there a statistically significant difference in the perception of the tasks performed between leading companies and others, five years hence?, was then approached. The null hypothesis stated that: There is no significant difference in the importance, the frequency of performance, or the sum of those two measures between leading companies and others in the future. The chi-square test using the same parameters was then applied and the significant differences in perception identified.

There was a very high degree of agreement between the two groups in the present and in the future. For that reason, it was decided to combine the two groups in the present into one group in the present and to combine the two groups in the future into one group in the future. The raw data were then combined in the data base. The mean was calculated and the rank order established for the present and for the future.

This allowed for examination of the sixth research question: Is there a statistically significant difference in the perceptions of the tasks performed by both groups combined between the present and the future? The null hypothesis stated that: There is no significant difference in the perceptions of the tasks performed between both groups combined in the present and both groups combined in the future. The chi-square test using the same parameters

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

was then applied to the combined data and the significant differences in perception identified.

The analysis procedures between the present and the future indicated a need for the third step in the data gathering process. Each task was analyzed to identify those that were projected to change in importance and/or frequency of performance. It was found that of the 34 tasks, 27 were expected to increase in importance and would be performed more frequently. Therefore, the third questionnaire was developed.

The development of the third questionnaire began with a search for potential catalysts that could induce change in the tasks performed by quality engineers. Current (1985 to 1987) business and industrial journals such as Quality Progress, Management Review, Wisconsin Business Journal, and Industry Week were searched for articles related to potential changes in quality engineering activities. A total of 17 articles were found and analyzed. The analysis revealed ten potential catalysts for change:

1. An increase in consumer quality requirements.

2. Increased quality offered by competitors on the international market.

3. Increased quality offered by competitors on the national market.

4. An increased emphasis placed on quality by top management.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

5. An increase in quality requirements called for by subcontractees.

6. An increase in quality requirements caused by federal or state legislation.

7. Increased quality required of the presently used manufacturing processes.

8. Increased quality engineering activity due to the installation of new equipment and/or processes.

9. Increased quality engineering activity due to the introduction of new products and/or new product options.

10. Increased quality engineering activity due to the installation of new production and inventory control systems.

These catalysts were organized into a questionnaire, and a cover letter was written to accompany it. The respondents were asked to rate each catalyst on a scale of zero to five and to select two as being the most important. The questionnaire was then pilot tested with 40 members of the Northwest Subsection of the American Society for Quality Control and revisions were made for clarity. A copy of the questionnaire and cover letter appears in Appendix I.

The third round questionnaire was then mailed to the participants and as they were returned, the data were added to the data base. After four weeks, 86 were randomly selected from the Group I returns and 96 were randomly

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

selected from the Group II returns so that analysis could commence. The catalysts were rank ordered using each of the two scales and a rank order correlation was calculated between the two rankings. This analysis was done for each group and for the two groups combined in an attempt to answer the final research question: What catalysts are anticipated to influence any future change in quality engineering activity?

This completed the study process. It should be noted that the overall response rates for Group I and Group II were 62 percent and 68 percent respectively. That provides a 65 percent overall response rate.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

CHAPTER IV

REPORT OF THE FINDINGS

This chapter contains a report and statistical analysis of the data collected from the two respondent groups. Three major sections are included. The first section reports the responses of both groups in the present. The second section reports responses five years hence. The third section reports responses to possible catalysts for change from the present to the future.

Each section involves the responses of the two groups as well as their responses combined. Group I consists of certified quality engineers of the 43 leading companies (Gallup, 1985, pp. 5-7). Group II consists of certified quality engineers of companies not identified as leading. Each group has gone through the three step process. Step one considered the present, step two five years hence, and step three perceptions of potential catalysts for change.

The Present

This section of the findings is directed at the first two research questions:

1. What are the tasks presently performed by quality engineers, how important are they, and how frequently are they performed?

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

2. Is there a statistically significant difference between tasks performed in leading companies and other companies at present?

The section includes the raw data for individual tasks, the mean and rank order for individual tasks, the mean and rank order for task categories, and a chi-square analysis comparing groups. These findings are presented by group.

Group I--Leading Companies

Raw Data for Individual Tasks

Table 1 presents the raw data for the importance of tasks as reported by Group I in the present. Of the 34 tasks on the questionnaire, 27 (79%) had 100% response. Table 2 presents the raw data for the frequency of performance of tasks as reported by Group I in the present. Of the 34 tasks on the questionnaire, 27 (79%) had 100% response. Table 3 presents the raw data for grouped scales for the sum of the importance and the frequency of tasks as reported by Group I in the present. Three cells were used for the sum of the responses. The lowest cell includes sums from two to four, where two is not important and never performed. The center cell includes sums from five to seven and the highest cell includes sums from eight to ten, where ten is imperative and very frequently performed.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 1

Raw Data for Importance of Tasks as Reported by Group I In the Present

	1	2	3	4	5	Total
Design Review						
1. Review quality specifications.	4	3	23	26	30	86
2. Relate specifications to process.	4	4	15	25	38	86
3. Identify potentially significant variables.	3	5	31	24	23	86
4. Develop pilot-run quality procedures.	5	21	31	23	6	86
Process Capability						
1. Identify potential controlling variables.	1	4	26	38	15	84
2. Develop/select statistical tests.	2	8	26	35	15	86
3. Analyze statistical data.	1	6	16	43	20	86
4. Develop/utilize computer data bases/programs.	3	10	33	19	21	86
Process Control						
1. Develop/implement inspection/audit procedures.	3	6	19	35	22	85
2. Develop/implement control chart procedures.	2	10	18	36	20	86
3. Establish control limits.	2	7	32	35	10	86
4. Review/revise control procedures.	3	10	28	38	7	86
5. Develop/revise control reporting procedures.	2	13	37	28	6	86
Vendor Relations						
1. Develop/implement acceptance sampling procedures.	9	11	33	19	14	86
2. Develop vendor quality systems.	5	8	26	28	19	86
3. Assist vendors with quality system development/revision.	4	12	27	25	18	86
Customer Relations						
1. Develop/implement customer feedback systems.	7	7	16	29	27	86
2. Analyze customer feedback.	3	2	26	31	24	86
3. Trace variation through manufacturing system.	6	8	25	30	17	86
Application						
1. Communication						
a. Write understandable reports/proposals.	1	1	12	35	37	86
b. Speak/discuss clearly.	0	1	14	29	42	86
2. Leadership						
a. Motivate subordinates and peers.	0	4	17	34	31	86
b. Delegate responsibilities.	0	11	29	35	11	86
c. Perform training sessions.	2	4	28	34	18	86
3. Management						
a. Plan activities.	1	2	21	43	17	84
b. Organize resources.	1	6	21	44	12	84
4. Statistical						
a. Apply descriptive statistics.	1	6	29	32	17	85
b. Apply inferential statistics.	2	15	34	30	14	85
c. Design experiments.	3	7	23	32	19	84
5. Computer						
a. Design/select computer programs.	7	4	46	20	9	86
b. Utilize available software.	4	1	33	34	14	86
6. Technical/Scientific						
a. Design/improve processes.	4	5	19	36	22	86
b. Evaluate product materials.	6	9	26	30	15	86
c. Apply design procedures.	8	8	37	21	12	86

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 2

Raw Data for Frequency of Performance of Tasks as Reported By Group I in the Present

	1	2	3	4	5	Total
Design Review						
1. Review quality specifications.	3	16	36	20	11	86
2. Relate specifications to process.	5	18	36	19	8	86
3. Identify potentially significant variables.	3	23	31	22	7	86
4. Develop pilot-run quality procedures.	12	45	20	8	1	86
Process Capability						
1. Identify potential controlling variables.	5	23	32	20	4	84
2. Develop/select statistical tests.	4	19	36	22	5	86
3. Analyze statistical data.	0	12	27	29	18	86
4. Develop/utilize computer data bases/programs.	6	17	28	23	12	86
Process Control						
1. Develop/implement inspection/audit procedures.	3	13	21	33	15	85
2. Develop/implement control chart procedures.	11	17	24	26	8	86
3. Establish control limits.	9	19	29	21	8	86
4. Review/revise control procedures.	7	28	30	17	4	86
5. Develop/revise control reporting procedures.	7	30	32	13	4	86
Vendor Relations						
1. Develop/implement acceptance sampling procedures.	16	22	23	16	9	86
2. Develop vendor quality systems.	22	21	17	19	7	86
3. Assist vendors with quality system development/revision.	22	25	18	14	7	86
Customer Relations						
1. Develop/implement customer feedback systems.	20	12	28	20	6	86
2. Analyze customer feedback.	8	20	29	19	10	86
3. Trace variation through manufacturing system.	15	21	29	13	8	86
Application						
1. Communication						
a. Write understandable reports/proposals.	0	4	23	31	28	86
b. Speak/discuss clearly.	0	6	17	33	30	86
2. Leadership						
a. Motivate subordinates and peers.	3	10	23	33	17	86
b. Delegate responsibilities.	5	19	28	25	9	86
c. Perform training sessions.	1	25	30	19	11	86
3. Management						
a. Plan activities.	2	9	26	36	11	84
b. Organize resources.	2	12	28	35	7	84
4. Statistical						
a. Apply descriptive statistics.	5	17	28	24	11	85
b. Apply inferential statistics.	10	25	27	16	7	85
c. Design experiments.	10	35	23	10	6	84
5. Computer						
a. Design/select computer programs.	14	32	12	22	6	86
b. Utilize available software.	4	11	23	29	19	86
6. Technical/Scientific						
a. Design/improve processes.	9	26	25	20	6	86
b. Evaluate product materials.	15	23	21	18	9	86
c. Apply design procedures.	19	21	30	14	2	86

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 3

Raw Data for Grouped Scales for the Sum of Importance and Frequency of Tasks as Reported by Group I in the Present

	2-4	5-7	8-10	Total
Design Review				
1. Review quality specifications.	6	41	39	86
2. Relate specifications to process.	6	46	34	86
3. Identify potentially significant variables.	9	44	33	86
4. Develop pilot-run quality procedures.	29	51	6	86
Process Capability				
1. Identify potential controlling variables.	5	54	25	84
2. Develop/select statistical tests.	10	47	29	86
3. Analyze statistical data.	5	33	48	86
4. Develop/utilize computer data bases/programs.	10	43	33	86
Process Control				
1. Develop/implement inspection/audit procedures.	8	33	44	85
2. Develop/implement control chart procedures.	14	37	35	86
3. Establish control limits.	14	42	30	86
4. Review/revise control procedures.	16	52	18	86
5. Develop/revise control reporting procedures.	16	56	14	86
Vendor Relations				
1. Develop/implement acceptance sampling procedures.	24	41	21	86
2. Develop vendor quality systems.	20	42	24	86
3. Assist vendors with quality system development/revision.	20	47	19	86
Customer Relations				
1. Develop/implement customer feedback systems.	17	34	35	86
2. Analyze customer feedback.	9	45	32	86
3. Trace variation through manufacturing system.	18	46	22	86
Application				
1. Communication				
a. Write understandable reports/proposals.	2	24	60	86
b. Speak/discuss clearly.	2	21	63	86
2. Leadership				
a. Motivate subordinates and peers.	2	36	48	86
b. Delegate responsibilities.	12	41	33	86
c. Perform training sessions.	4	50	32	86
3. Management				
a. Plan activities.	3	37	44	84
b. Organize resources.	6	39	39	84
4. Statistical				
a. Apply descriptive statistics.	6	45	34	85
b. Apply inferential statistics.	16	43	26	85
c. Design experiments.	14	48	22	84
5. Computer				
a. Design/select computer programs.	17	52	17	86
b. Utilize available software.	5	40	41	86
6. Technical/Scientific				
a. Design/improve processes.	11	48	27	86
b. Evaluate product materials.	16	44	26	86
c. Apply design procedures	16	59	11	86

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Mean and Rank Order for Individual Tasks

Table 4 identifies the mean and rank order of the importance of each task as reported by Group I in the present. Speak/Discuss Clearly was ranked first. Develop Pilot-Run Quality Procedures was ranked last. Table 5 identifies mean and rank order of the frequency of performance of tasks as reported by Group I in the present. Speak/Discuss Clearly was ranked first. Develop Pilot-Run Quality Procedures was ranked last. A comparison of the importance (Table 4) to the frequency of performance (Table 5) shows for the most part that tasks that are important are performed most frequently. An exception is Relate Specifications to Process which was ranked four of 34 on importance and 14.5 of 34 on frequency. Another exception is Utilize Available Software which was ranked 19.5 of 34 on importance and 5 of 34 on frequency.

Table 6 identifies the mean and rank order of the sum of the importance and frequency of tasks as reported by Group I in the present. Speak/Discuss Clearly is ranked number one and Develop Pilot-Run Quality Procedures is ranked number 34. A three way comparison of Table 4, Table 5, and Table 6 provides an interesting perception of Utilize Available Software as it was ranked 19.5 on importance and 5 on frequency, but by combining the scales it was ranked 7 of the 34 overall.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 4

Mean and Rank Order of Importance of Tasks as Reported By Group I in the Present

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	86	3.872	5.5
2. Relate specifications to process.	86	4.035	4
3. Identify potentially significant variables.	86	3.651	18
4. Develop pilot-run quality procedures.	86	3.047	34
Process Capability			
1. Identify potential controlling variables.	84	3.738	11
2. Develop/select statistical tests.	86	3.616	19.5
3. Analyze statistical data.	86	3.872	5.5
4. Develop/utilize computer data bases/programs.	86	3.523	23
Process Control			
1. Develop/implement inspection/audit procedures.	85	3.788	9
2. Develop/implement control chart procedures.	86	3.721	13
3. Establish control limits.	86	3.512	24.5
4. Review/revise control procedures.	86	3.419	29
5. Develop/revise control reporting procedures.	86	3.267	30
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	86	3.209	33
2. Develop vendor quality systems.	86	3.558	21
3. Assist vendors with quality system development/revision.	86	3.477	26
Customer Relations			
1. Develop/implement customer feedback systems.	86	3.721	13
2. Analyze customer feedback.	86	3.826	8
3. Trace variation through manufacturing system.	86	3.512	24.5
Application			
1. Communication			
a. Write understandable reports/proposals.	86	4.233	2
b. Speak/discuss clearly.	86	4.302	1
2. Leadership			
a. Motivate subordinates and peers.	86	4.070	3
b. Delegate responsibilities.	86	3.535	22
c. Perform training sessions.	86	3.721	13
3. Management			
a. Plan activities.	84	3.869	7
b. Organize resources.	84	3.714	15
4. Statistical			
a. Apply descriptive statistics.	85	3.682	16
b. Apply inferential statistics.	85	3.459	27
c. Design experiments.	84	3.679	17
5. Computer			
a. Design/select computer programs.	86	3.233	32
b. Utilize available software.	86	3.616	19.5
6. Technical/Scientific			
a. Design/improve processes.	86	3.779	10
b. Evaluate product materials.	86	3.453	28
c. Apply design procedures.	86	3.244	31

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 5

Mean and Rank Order of Frequency of Performance of Tasks As Reported by Group I in the Present

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	86	3.233	9
2. Relate specifications to process.	86	3.081	14.5
3. Identify potentially significant variables.	86	3.081	14.5
4. Develop pilot-run quality procedures.	86	2.314	34
Process Capability			
1. Identify potential controlling variables.	84	2.940	20
2. Develop/select statistical tests.	86	3.058	16
3. Analyze statistical data.	86	3.616	3
4. Develop/utilize computer data bases/programs.	86	3.209	11
Process Control			
1. Develop/implement inspection/audit procedures.	85	3.518	7
2. Develop/implement control chart procedures.	86	3.035	17.5
3. Establish control limits.	86	3.000	19
4. Review/revise control procedures.	86	2.802	23.5
5. Develop/revise control reporting procedures.	86	2.733	28
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	86	2.767	25.5
2. Develop vendor quality systems.	86	2.628	30
3. Assist vendors with quality system development/revision.	86	2.523	32.5
Customer Relations			
1. Develop/implement customer feedback systems.	86	2.767	25.5
2. Analyze customer feedback.	86	3.035	17.5
3. Trace variation through manufacturing system.	86	2.744	27
Application			
1. Communication			
a. Write understandable reports/proposals.	86	3.965	2
b. Speak/discuss clearly.	86	4.012	1
2. Leadership			
a. Motivate subordinates and peers.	86	3.593	4
b. Delegate responsibilities.	86	3.163	12.5
c. Perform training sessions.	86	3.163	12.5
3. Management			
a. Plan activities.	84	3.536	6
b. Organize resources.	84	3.393	8
4. Statistical			
a. Apply descriptive statistics.	85	3.224	10
b. Apply inferential statistics.	85	2.824	22
c. Design experiments.	84	2.607	31
5. Computer			
a. Design/select computer programs.	86	2.698	29
b. Utilize available software.	86	3.558	5
6. Technical/Scientific			
a. Design/improve processes.	86	2.860	21
b. Evaluate product materials.	86	2.802	23.5
c. Apply design procedures.	86	2.523	32.5

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 6

Mean and Rank Order of the Sum of the Importance and Frequency of Tasks as Reported by Group I in the Present

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	86	7.105	10
2. Relate specifications to process.	86	7.116	8
3. Identify potentially significant variables.	86	6.733	15.5
4. Develop pilot-run quality procedures.	86	5.360	34
Process Capability			
1. Identify potential controlling variables.	84	6.679	18
2. Develop/select statistical tests.	86	6.674	19
3. Analyze statistical data.	86	7.488	4
4. Develop/utilize computer data bases/programs.	86	6.733	15.5
Process Control			
1. Develop/implement inspection/audit procedures.	85	7.306	6
2. Develop/implement control chart procedures.	86	6.756	14
3. Establish control limits.	86	6.512	21
4. Review/revise control procedures.	86	6.221	27
5. Develop/revise control reporting procedures.	86	6.000	29.5
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	86	5.977	31
2. Develop vendor quality systems.	86	6.186	28
3. Assist vendors with quality system development/revision.	86	6.000	29.5
Customer Relations			
1. Develop/implement customer feedback systems.	86	6.488	22
2. Analyze customer feedback.	86	6.860	13
3. Trace variation through manufacturing system.	86	6.256	25.5
Application			
1. Communication			
a. Write understandable reports/proposals.	86	8.198	2
b. Speak/discuss clearly.	86	8.314	1
2. Leadership			
a. Motivate subordinates and peers.	86	7.663	3
b. Delegate responsibilities.	86	6.698	17
c. Perform training sessions.	86	6.884	12
3. Management			
a. Plan activities.	84	7.405	5
b. Organize resources.	84	7.107	9
4. Statistical			
a. Apply descriptive statistics.	84	6.906	11
b. Apply inferential statistics.	85	6.282	24
c. Design experiments.	84	6.286	23
5. Computer			
a. Design/select computer programs.	86	5.930	32
b. Utilize available software.	86	7.174	7
6. Technical/Scientific			
a. Design/improve processes.	86	6.640	20
b. Evaluate product materials.	86	6.256	25.5
c. Apply design procedures.	86	5.767	33

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Mean and Rank Order for Task Categories

Table 7 identifies the mean and rank order of task categories as reported by Group I in the present. The Application category was ranked first, while Vendor Relations was ranked last. Table 8 identifies the mean and rank order of the frequency of performance of task categories as reported by Group I in the present. The category Process Capability was ranked first and the category Vendor Relations was ranked last. A comparison of Table 7 to Table 8 shows that Customer Relations is ranked three of six on importance and five of six on frequency of performance, while Process Control is ranked five of six on importance and three of six on frequency. Customer Relations is more important than Process Control, but Process Control is performed more frequently than Customer Relations.

Table 9 identifies the mean and rank order of the sum of the importance and the frequency of task categories as reported by Group I in the present. The category Application was ranked first and Vendor Relations was ranked last. A three way comparison of Tables 7, 8, and 9 provides an interesting perspective for Design Review which was ranked four of six on both importance (Table 7) and frequency (Table 8), but the power of the combined ratings moved it to three of six overall (Table 9).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 7

Mean and Rank Order of Importance of Task Categories as Reported by Group I in the Present

	Mean	Rank
Design Review	3.651	4
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	3.687	2
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	3.541	5
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	3.415	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	3.686	3
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	3.706	1
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

Group II--Nonleading Companies

Raw Data for Individual Tasks

Table 10 presents the raw data for the importance of tasks as reported by Group II in the present. Of the 34 tasks, 27 (79%) had 100% response. Table 11 presents the raw data for the frequency of performance of tasks as

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 8

Mean and Rank Order of Frequency of Performance of Task Categories as Reported by Group I in the Present

	Mean	Rank
Design Review	2.927	4
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	3.206	1
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	3.018	3
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	2.639	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	2.849	5
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	3.195	2
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

reported by Group II in the present. Of the 34 tasks, 27 (79%) had 100% response. Table 12 presents the raw data for grouped scales for the sum of the importance and the frequency of tasks as reported by Group II in the present, where two is not important and never performed and ten is imperative and very frequently performed.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 9

Mean and Rank Order of the Sum of the Importance and Frequency of Task Categories as Reported by Group I in the Present

	Mean	Rank
Design Review	6.579	3
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	6.894	2
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	6.559	4
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	6.054	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	6.535	5
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	6.901	1
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

Mean and Rank Order of Individual Tasks

Table 13 identifies the mean and rank order of the importance of each task as reported by Group II in the present. Speak/Discuss Clearly was ranked first. Develop Vendor Quality Systems was ranked last. Table 14 identifies the mean and rank order of the frequency of

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 10

Raw Data for Importance of Tasks as Reported by Group II In the Present

	1	2	3	4	5	Total
Design Review						
1. Review quality specifications.	7	6	20	32	31	96
2. Relate specifications to process.	7	4	15	36	34	96
3. Identify potentially significant variables.	6	5	17	49	19	96
4. Develop pilot-run quality procedures.	10	15	29	28	14	96
Process Capability						
1. Identify potential controlling variables.	3	7	18	49	19	96
2. Develop/select statistical tests.	3	7	32	40	14	96
3. Analyze statistical data.	4	6	23	32	31	96
4. Develop/utilize computer data bases/programs.	8	20	25	30	13	96
Process Control						
1. Develop/implement inspection/audit procedures.	2	5	24	36	29	96
2. Develop/implement control chart procedures.	5	10	18	38	25	96
3. Establish control limits.	8	13	17	32	26	96
4. Review/revise control procedures.	6	6	26	46	12	96
5. Develop/revise control reporting procedures.	6	17	24	42	6	95
Vendor Relations						
1. Develop/implement acceptance sampling procedures.	13	17	19	28	19	96
2. Develop vendor quality systems.	20	9	16	38	13	96
3. Assist vendors with quality system development/revision.	19	10	15	36	16	96
Customer Relations						
1. Develop/implement customer feedback systems.	13	6	17	32	27	95
2. Analyze customer feedback.	12	7	15	31	31	96
3. Trace variation through manufacturing system.	3	10	14	35	22	94
Application						
1. Communication						
a. Write understandable reports/proposals.	1	0	10	38	47	96
b. Speak/discuss clearly.	1	1	7	37	50	96
2. Leadership						
a. Motivate subordinates and peers.	0	3	13	46	34	96
b. Delegate responsibilities.	3	7	18	45	23	96
c. Perform training sessions.	2	9	19	32	34	96
3. Management						
a. Plan activities.	2	5	12	43	34	96
b. Organize resources.	2	3	13	47	30	95
4. Statistical						
a. Apply descriptive statistics.	4	7	29	36	19	95
b. Apply inferential statistics.	6	11	35	26	18	96
c. Design experiments.	6	13	35	37	15	96
5. Computer						
a. Design/select computer programs.	4	21	33	24	14	96
b. Utilize available software.	4	12	30	36	13	95
6. Technical/Scientific						
a. Design/improve processes.	7	11	16	33	29	96
b. Evaluate product materials.	6	14	20	34	22	96
c. Apply design procedures.	7	18	20	42	8	95

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 11

Raw Data for Frequency of Performance of Tasks as Reported By Group II in the Present

	1	2	3	4	5	Total
Design Review						
1. Review quality specifications.	3	19	38	25	11	96
2. Relate specifications to process.	6	20	34	20	16	96
3. Identify potentially significant variables.	6	17	37	24	12	96
4. Develop pilot-run quality procedures.	18	35	20	12	11	96
Process Capability						
1. Identify potential controlling variables.	5	24	28	34	5	96
2. Develop/select statistical tests.	5	25	31	24	11	96
3. Analyze statistical data.	4	18	24	22	28	96
4. Develop/utilize computer data bases/programs.	9	23	26	17	21	96
Process Control						
1. Develop/implement inspection/audit procedures.	3	18	32	23	20	96
2. Develop/implement control chart procedures.	10	24	22	27	13	96
3. Establish control limits.	11	24	27	24	10	96
4. Review/revise control procedures.	6	27	32	27	4	96
5. Develop/revise control reporting procedures.	5	27	37	21	5	95
Vendor Relations						
1. Develop/implement acceptance sampling procedures.	16	18	23	24	15	96
2. Develop vendor quality systems.	24	28	23	13	8	96
3. Assist vendors with quality system development/revision.	22	31	21	17	5	96
Customer Relations						
1. Develop/implement customer feedback systems.	14	32	21	14	14	95
2. Analyze customer feedback.	12	26	22	17	19	96
3. Trace variation through manufacturing system.	6	28	31	19	10	94
Application						
1. Communication						
a. Write understandable reports/proposals.	1	6	14	37	38	96
b. Speak/discuss clearly.	0	3	16	26	51	96
2. Leadership						
a. Motivate subordinates and peers.	0	6	28	32	30	96
b. Delegate responsibilities.	1	20	20	35	20	96
c. Perform training sessions.	4	22	35	27	8	96
3. Management						
a. Plan activities.	0	9	31	36	20	96
b. Organize resources.	1	8	33	37	16	95
4. Statistical						
a. Apply descriptive statistics.	5	19	27	27	17	95
b. Apply inferential statistics.	8	31	24	20	13	96
c. Design experiments.	18	30	32	12	4	96
5. Computer						
a. Design/select computer programs.	8	37	30	14	7	96
b. Utilize available software.	6	25	23	23	18	95
6. Technical/Scientific						
a. Design/improve processes.	11	18	23	36	8	96
b. Evaluate product materials.	8	21	28	30	9	96
c. Apply design procedures.	8	37	35	14	1	95

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 12

Raw Data for Grouped Scales for the Sum of Importance and Frequency of Tasks as Reported by Group II in the Present

	2-4	5-7	8-10	Total
Design Review				
1. Review quality specifications.	14	41	41	96
2. Relate specifications to process.	9	48	39	96
3. Identify potentially significant variables.	12	44	40	96
4. Develop pilot-run quality procedures.	28	49	19	96
Process Capability				
1. Identify potential controlling variables.	9	44	43	96
2. Develop/select statistical tests.	11	51	34	96
3. Analyze statistical data.	10	39	47	96
4. Develop/utilize computer data bases/programs.	20	40	36	96
Process Control				
1. Develop/implement inspection/audit procedures.	8	41	47	96
2. Develop/implement control chart procedures.	16	38	42	96
3. Establish control limits.	18	42	36	96
4. Review/revise control procedures.	11	50	35	96
5. Develop/revise control reporting procedures.	20	53	22	95
Vendor Relations				
1. Develop/implement acceptance sampling procedures.	28	31	37	96
2. Develop vendor quality systems.	29	44	23	96
3. Assist vendors with quality system development/revision.	27	44	25	96
Customer Relations				
1. Develop/implement customer feedback systems.	17	48	30	95
2. Analyze customer feedback.	18	42	36	96
3. Trace variation through manufacturing system.	12	54	28	94
Application				
1. Communication				
a. Write understandable reports/proposals.	1	21	74	96
b. Speak/discuss clearly.	1	19	76	96
2. Leadership				
a. Motivate subordinates and peers.	2	30	64	96
b. Delegate responsibilities.	9	36	51	96
c. Perform training sessions.	10	41	45	96
3. Management				
a. Plan activities.	3	36	57	96
b. Organize resources.	4	37	54	95
4. Statistical				
a. Apply descriptive statistics.	8	49	38	95
b. Apply inferential statistics.	19	46	31	96
c. Design experiments.	20	54	22	96
5. Computer				
a. Design/select computer programs.	23	48	25	96
b. Utilize available software.	15	43	37	95
6. Technical/Scientific				
a. Design/improve processes.	13	39	44	96
b. Evaluate product materials.	18	38	40	96
c. Apply design procedures	22	55	18	95

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 13

Mean and Rank Order of Importance of Tasks as Reported By Group II in the Present

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	96	3.772	11
2. Relate specifications to process.	96	3.896	7
3. Identify potentially significant variables.	96	3.729	13
4. Develop pilot-run quality procedures.	96	3.219	31
Process Capability			
1. Identify potential controlling variables.	96	3.771	12
2. Develop/select statistical tests.	96	3.573	19.5
3. Analyze statistical data.	96	3.833	9
4. Develop/utilize computer data bases/programs.	96	3.208	32.5
Process Control			
1. Develop/implement inspection/audit procedures.	96	3.885	8
2. Develop/implement control chart procedures.	96	3.708	14
3. Establish control limits.	96	3.573	19.5
4. Review/revise control procedures.	96	3.542	22.5
5. Develop/revise control reporting procedures.	95	3.263	28
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	96	3.240	29.5
2. Develop vendor quality systems.	96	3.156	34
3. Assist vendors with quality system development/revision.	96	3.208	32.5
Customer Relations			
1. Develop/implement customer feedback systems.	95	3.568	21
2. Analyze customer feedback.	96	3.646	17
3. Trace variation through manufacturing system.	94	3.670	16
Application			
1. Communication			
a. Write understandable reports/proposals.	96	4.354	2
b. Speak/discuss clearly.	96	4.396	1
2. Leadership			
a. Motivate subordinates and peers.	96	4.156	3
b. Delegate responsibilities.	96	3.813	10
c. Perform training sessions.	96	3.906	6
3. Management			
a. Plan activities.	96	4.063	4
b. Organize resources.	95	4.053	5
4. Statistical			
a. Apply descriptive statistics.	95	3.621	18
b. Apply inferential statistics.	96	3.406	26
c. Design experiments.	96	3.438	25
5. Computer			
a. Design/select computer programs.	96	3.240	29.5
b. Utilize available software.	95	3.442	24
6. Technical/Scientific			
a. Design/improve processes.	96	3.688	15
b. Evaluate product materials.	96	3.542	22.5
c. Apply design procedures.	95	3.274	27

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 14

Mean and Rank order of Frequency of Performance of Tasks As Reported by Group II in the Present

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	96	3.229	11
2. Relate specifications to process.	96	3.208	12
3. Identify potentially significant variables.	96	3.198	13
4. Develop pilot-run quality procedures.	96	2.615	30
Process Capability			
1. Identify potential controlling variables.	96	3.104	19
2. Develop/select statistical tests.	96	3.115	17.5
3. Analyze statistical data.	96	3.542	7
4. Develop/utilize computer data bases/programs.	96	3.188	14
Process Control			
1. Develop/implement inspection/audit procedures.	96	3.406	8
2. Develop/implement control chart procedures.	96	3.094	20
3. Establish control limits.	96	2.979	25
4. Review/revise control procedures.	96	2.958	26
5. Develop/revise control reporting procedures.	95	2.937	27
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	96	3.042	22
2. Develop vendor quality systems.	96	2.510	33
3. Assist vendors with quality system development/revision.	96	2.500	34
Customer Relations			
1. Develop/implement customer feedback systems.	95	2.811	28
2. Analyze customer feedback.	96	3.052	21
3. Trace variation through manufacturing system.	94	2.989	24
Application			
1. Communication			
a. Write understandable reports/proposals.	96	4.094	2
b. Speak/discuss clearly.	96	4.302	1
2. Leadership			
a. Motivate subordinates and peers.	96	3.896	3
b. Delegate responsibilities.	96	3.552	6
c. Perform training sessions.	96	3.135	15
3. Management			
a. Plan activities.	96	3.698	4
b. Organize resources.	95	3.621	5
4. Statistical			
a. Apply descriptive statistics.	95	3.337	9
b. Apply inferential statistics.	96	2.990	23
c. Design experiments.	96	2.521	32
5. Computer			
a. Design/select computer programs.	96	2.740	29
b. Utilize available software.	95	3.232	10
6. Technical/Scientific			
a. Design/improve processes.	96	3.125	16
b. Evaluate product materials.	96	3.115	17.5
c. Apply design procedures.	95	2.611	31

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

performance of tasks as reported by Group II in the present. Speak/Discuss Clearly was ranked first. Assist Vendors With Quality System Development/Revision was ranked last. A comparison of importance (Table 13) and frequency of performance (Table 14) shows for the most part that Group II (nonleading companies) performs the most important tasks most frequently. There seem to be two exceptions to the case. The first relates to Develop/Utilize Computer Data Bases/Programs which ranks 32.5 of 34 on importance and 14 of 34 on frequency. The other exception involves Utilize Available Software which was ranked 24 of 34 on importance and 10 of 34 on frequency. It appears that these two tasks, both related to computers, are thought to be relatively unimportant, but are performed quite frequently.

Table 15 identifies the mean and rank order of the sum of the importance and frequency of tasks as reported by Group II in the present. It reaffirms the ranking of Speak/Discuss Clearly as number one, but indicates a difference between the importance and frequency for the tasks Develop Vendor Quality Systems and Assist Vendors With Quality System Development/Revision though both relate to vendor quality systems. A three way comparison of Tables 13, 14, and 15 indicates that there is fundamental agreement between the individual scales and the sum of the two scales. One interesting note is that Analyze

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 15

Mean and Rank Order of the Sum of Importance and Frequency of Tasks As Reported by Group II in the Present

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	96	7.000	11
2. Relate specifications to process.	96	7.104	9
3. Identify potentially significant variables.	96	6.927	13
4. Develop pilot-run quality procedures.	96	5.833	32
Process Capability			
1. Identify potential controlling variables.	96	6.875	14
2. Develop/select statistical tests.	96	6.688	18
3. Analyze statistical data.	96	7.375	6
4. Develop/utilize computer data bases/programs.	96	6.396	24.5
Process Control			
1. Develop/implement inspection/audit procedures.	96	7.292	8
2. Develop/implement control chart procedures.	96	6.802	16
3. Establish control limits.	96	6.552	22
4. Review/revise control procedures.	96	6.500	23
5. Develop/revise control reporting procedures.	95	6.200	28
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	96	6.281	27
2. Develop vendor quality systems.	96	5.667	34
3. Assist vendors with quality system development/revision.	96	5.703	33
Customer Relations			
1. Develop/implement customer feedback systems.	95	6.379	26
2. Analyze customer feedback.	96	6.698	17
3. Trace variation through manufacturing system.	94	6.660	20
Application			
1. Communication			
a. Write understandable reports/proposals.	96	8.448	2
b. Speak/discuss clearly.	96	8.698	1
2. Leadership			
a. Motivate subordinates and peers.	96	8.052	3
b. Delegate responsibilities.	96	7.365	7
c. Perform training sessions.	96	7.042	10
3. Management			
a. Plan activities.	96	7.760	4
b. Organize resources.	95	7.674	5
4. Statistical			
a. Apply descriptive statistics.	95	6.958	12
b. Apply inferential statistics.	95	6.396	24.5
c. Design experiments.	96	5.958	30
5. Computer			
a. Design/select computer programs.	96	5.979	29
b. Utilize available software.	95	6.674	19
6. Technical/Scientific			
a. Design/improve processes.	96	6.813	15
b. Evaluate product materials.	96	6.656	21
c. Apply design procedures.	95	5.884	31

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Statistical Data ranked 9 of 34 on importance (Table 13) and 7 of 34 on frequency (Table 14), but appears as 6 of 34 overall (Table 15).

Mean and Rank Order of Task Categories

Table 16 identifies the mean and rank order of task categories as reported by Group II in the present. The category Application was ranked first, while Vendor Relations was ranked last. Table 17 identifies the mean and rank order of the frequency of performance of task categories as reported by Group II in the present. The category Application was ranked first and the category Vendor Relations was ranked last. A comparison of importance (Table 16) to frequency (Table 17) indicates that Design Review is thought to be quite important, rank two of six, but is not performed frequently, rank four of six. As well, Customer Relations is quite important, rank three of six, but ranked low on frequency, five of six. Two categories were thought to be relatively unimportant but were performed quite frequently. Process Capability ranked four of six on importance and two of six on frequency. Process Control ranked five of six on importance and three of six on frequency. Table 18 identifies the mean and rank order of the sum of the importance and the frequency of task categories as reported by Group II in the present. The category Application was ranked first and Vendor Relations was ranked last. A three

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 16

Mean and Rank Order of Importance of Task Categories as Reported by Group II in the Present

	Mean	Rank
Design Review	3.654	2
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	3.597	4
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	3.595	5
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	3.202	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	3.628	3
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	3.760	1
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

way comparison of Tables 16, 17, and 18 shows that Process Capability was ranked four of six on importance (Table 16), two of six on frequency (Table 17), and two of six overall (Table 18).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 17

Mean and Rank Order of Frequency of Performance of Task Categories as Reported by Group II in the Present

	Mean	Rank
Design Review	3.063	4
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	3.238	2
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	3.075	3
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	2.684	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	2.951	5
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	3.332	1
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

Comparison of Group I to Group II

Table 19 presents a chi-square analysis of the importance of each task comparing Group I (Table 1) to Group II (Table 10) in the present. The comparison indicates that nine (27%) of the tasks are perceived to be different between the two groups. Of particular note among

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 18

Mean and Rank Order of the Sum of Importance and Frequency Of Task Categories as Reported by Group II in the Present

	Mean	Rank
Design Review	6.716	3
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	6.834	2
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	6.670	4
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	5.886	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	6.579	5
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	7.091	1
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

these nine are three that Group I (engineers from leading companies) found more important:

1. Develop Vendor Quality Systems
2. Assist Vendors with Quality System Development/Revision
3. Analyze Customer Feedback

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 19

Chi-Square Analysis for Importance of Task Comparing Group I to Group II in the Present

	Chi Square	Critical Value (K)	x >K
Design Review			
1. Review quality specifications.	2.122	9.49	
2. Relate specifications to process.	2.482	9.49	
3. Identify potentially significant variables.	13.517	9.49	*
4. Develop pilot-run quality procedures.	5.892	9.49	
Process Capability			
1. Identify potential controlling variables.	4.353	9.49	
2. Develop/select statistical tests.	.708	9.49	
3. Analyze statistical data.	6.513	9.49	
4. Develop/utilize computer data bases/programs.	10.544	9.49	*
Process Control			
1. Develop/implement inspection/audit procedures.	1.183	9.49	
2. Develop/implement control chart procedures.	1.350	9.49	
3. Establish control limits.	16.738	9.49	*
4. Review/revise control procedures.	3.613	9.49	
5. Develop/revise control reporting procedures.	7.675	9.49	
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	7.737	9.49	
2. Develop vendor quality systems.	13.571	9.49	*
3. Assist vendors with quality system development/revision.	14.990	9.49	*
Customer Relations			
1. Develop/implement customer feedback systems.	1.611	9.49	
2. Analyze customer feedback.	11.505	9.49	*
3. Trace variation through manufacturing system.	1.917	9.49	
Application			
1. Communication			
a. Write understandable reports/proposals.	1.283	7.82	
b. Speak/discuss clearly.	3.794	7.82	
2. Leadership			
a. Motivate subordinates and peers.	2.071	7.82	
b. Delegate responsibilities.	7.581	7.82	
c. Perform training sessions.	8.105	9.49	
3. Management			
a. Plan activities.	8.980	9.49	
b. Organize resources.	10.392	9.49	*
4. Statistical			
a. Apply descriptive statistics.	1.673	9.49	
b. Apply inferential statistics.	3.410	9.49	
c. Design experiments.	2.929	9.49	
5. Computer			
a. Design/select computer programs.	15.465	9.49	*
b. Utilize available software.	9.120	9.49	
6. Technical/Scientific			
a. Design/improve processes.	3.879	9.49	
b. Evaluate product materials.	2.903	9.49	
c. Apply design procedures.	16.376	9.49	*

Note: Confidence interval is 95% (alpha=.05).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

The interesting aspect of these is that they are all external of the company. Another interesting difference appears with the task Organize Resources. Group II (engineers from nonleading companies) found that task more important than did Group I.

Table 20 presents a chi-square analysis of the frequency of performance of each task comparing Group I (Table 2) to Group II (Table 11) in the present. This comparison indicates that three (9%) of the tasks are perceived to be different between the two groups. Group II perceived all three of these tasks as performed more frequently, they were:

1. Develop Pilot-Run Quality Procedures
2. Develop/Implement Customer Feedback Systems
3. Design/Select Computer Programs

Table 21 presents a chi-square analysis of the sum of the importance and the frequency of performance of each task comparing Group I (Table 3) to Group II (Table 12) in the present. In combining the importance and frequency elements it was found that only two tasks (6%) were perceived to be different between Group I and Group II. Group I rated Identify Potential Controlling Variables higher than Group II, while Group II rated Develop Pilot-Run Quality Procedures higher than Group II.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 20

Chi-Square Analysis for Frequency of Task Comparing Group I to Group II in the Present

	Chi Square	Critical Value (K)	x >K
Design Review			
1. Review quality specifications.	.318	9.49	
2. Relate specifications to process.	2.403	9.49	
3. Identify potentially significant variables.	3.293	9.49	
4. Develop pilot-run quality procedures.	11.067	9.49	*
Process Capability			
1. Identify potential controlling variables.	3.243	9.49	
2. Develop/select statistical tests.	3.099	9.49	
3. Analyze statistical data.	5.720	7.82	
4. Develop/utilize computer data bases/programs.	4.392	9.49	
Process Control			
1. Develop/implement inspection/audit procedures.	4.939	9.49	
2. Develop/implement control chart procedures.	1.996	9.49	
3. Establish control limits.	.728	9.49	
4. Review/revise control procedures.	1.889	9.49	
5. Develop/revise control reporting procedures.	2.405	9.49	
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	2.959	9.49	
2. Develop vendor quality systems.	2.637	9.49	
3. Assist vendors with quality system development/revision.	.951	9.49	
Customer Relations			
1. Develop/implement customer feedback systems.	14.998	9.49	*
2. Analyze customer feedback.	4.913	9.49	
3. Trace variation through manufacturing system.	5.927	9.49	
Application			
1. Communication			
a. Write understandable reports/proposals.	4.516	7.82	
b. Speak/discuss clearly.	6.776	7.82	
2. Leadership			
a. Motivate subordinates and peers.	6.149	7.82	
b. Delegate responsibilities.	9.343	9.49	
c. Perform training sessions.	3.703	9.49	
3. Management			
a. Plan activities.	2.462	7.82	
b. Organize resources.	4.461	9.49	
4. Statistical			
a. Apply descriptive statistics.	1.039	9.49	
b. Apply inferential statistics.	2.627	9.49	
c. Design experiments.	3.942	9.49	
5. Computer			
a. Design/select computer programs.	11.052	9.49	*
b. Utilize available software.	6.131	9.49	
6. Technical/Scientific			
a. Design/improve processes.	6.062	9.49	
b. Evaluate product materials.	5.689	9.49	
c. Apply design procedures.	9.188	9.49	

Note: Confidence interval is 95% (alpha=.05).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 21

Chi-Square Analysis for the Sum of Importance and Frequency of Task Comparing Group I to Group II In the Present

	Chi Square	x >K (5.99)
Design Review		
1. Review quality specifications.	2.709	
2. Relate specifications to process.	.437	
3. Identify potentially significant variables.	.552	
4. Develop pilot-run quality procedures.	6.287	*
Process Capability		
1. Identify potential controlling variables.	6.155	*
2. Develop/select statistical tests.	.058	
3. Analyze statistical data.	1.633	
4. Develop/utilize computer data bases/programs.	3.032	
Process Control		
1. Develop/implement inspection/audit procedures.	.296	
2. Develop/implement control chart procedures.	.234	
3. Establish control limits.	.498	
4. Review/revise control procedures.	5.886	
5. Develop/revise control reporting procedures.	1.862	
Vendor Relations		
1. Develop/implement acceptance sampling procedures.	5.578	
2. Develop vendor quality systems.	1.175	
3. Assist vendors with quality system development/revision.	1.414	
Customer Relations		
1. Develop/implement customer feedback systems.	2.333	
2. Analyze customer feedback.	2.798	
3. Trace variation through manufacturing system.	2.209	
Application		
1. Communication		
a. Write understandable reports/proposals.	1.451	
b. Speak/discuss clearly.	1.103	
2. Leadership		
a. Motivate subordinates and peers.	2.289	
b. Delegate responsibilities.	4.073	
c. Perform training sessions.	5.122	
3. Management		
a. Plan activities.	.891	
b. Organize resources.	2.204	
4. Statistical		
a. Apply descriptive statistics.	.123	
b. Apply inferential statistics.	.129	
c. Design experiments.	.614	
5. Computer		
a. Design/select computer programs.	2.041	
b. Utilize available software.	4.878	
6. Technical/Scientific		
a. Design/improve processes.	4.633	
b. Evaluate product materials.	2.986	
c. Apply design procedures.	2.336	

Note: Confidence interval is 95% (alpha=.05).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Groups Combined

These data are presented because of the fact that there appeared to be little difference between Group I and Group II, especially when the two scales of importance and frequency were combined by summing their values.

The raw data combined present a sample size of 182, which provides more confidence in the relative values of importance and frequency of performance. This will become more evident when the present is compared to the future.

Raw Data for Individual Tasks

Table 22 presents the raw data for the importance of each task as reported by both groups combined in the present. Table 23 presents the raw data for the frequency of performance of each task as reported by both groups combined in the present. Table 24 presents the raw data for the grouped scales of the sum of the importance and the frequency of each task as reported by both groups combined in the present.

Mean and Rank Order of Individual Tasks

Table 25 identifies the mean and rank order of the importance of each task as reported by both groups combined in the present. Speak/Discuss Clearly was ranked first. Develop Pilot-Run Quality Procedure was ranked last among the 34 tasks. Table 26 identifies the mean and rank order of the frequency of performance of each task as reported by

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 22

Raw Data for Importance of Tasks as Reported by Both Groups Combined in the Present

	1	2	3	4	5	Total
Design Review						
1. Review quality specifications.	11	9	43	58	61	182
2. Relate specifications to process.	11	8	30	61	72	182
3. Identify potentially significant variables.	9	10	48	73	42	182
4. Develop pilot-run quality procedures.	15	36	60	51	20	182
Process Capability						
1. Identify potential controlling variables.	4	11	44	87	34	180
2. Develop/select statistical tests.	5	15	58	75	29	182
3. Analyze statistical data.	5	12	39	75	51	182
4. Develop/utilize computer data bases/programs.	11	30	58	49	34	182
Process Control						
1. Develop/implement inspection/audit procedures.	5	11	43	71	51	181
2. Develop/implement control chart procedures.	7	20	36	74	45	182
3. Establish control limits.	10	20	49	67	36	182
4. Review/revise control procedures.	9	16	54	84	19	182
5. Develop/revise control reporting procedures.	8	30	61	70	12	181
Vendor Relations						
1. Develop/implement acceptance sampling procedures.	22	28	52	47	33	182
2. Develop vendor quality systems.	25	17	42	66	32	182
3. Assist vendors with quality system development/revision.	23	22	42	61	34	182
Customer Relations						
1. Develop/implement customer feedback systems.	20	13	33	61	54	181
2. Analyze customer feedback.	15	9	41	62	55	182
3. Trace variation through manufacturing system.	9	18	39	65	39	180
Application						
1. Communication						
a. Write understandable reports/proposals.	2	1	22	73	84	182
b. Speak/discuss clearly.	1	2	21	66	92	182
2. Leadership						
a. Motivate subordinates and peers.	0	7	30	80	65	182
b. Delegate responsibilities.	3	18	47	80	34	182
c. Perform training sessions.	4	13	47	66	52	182
3. Management						
a. Plan activities.	3	7	33	86	51	180
b. Organize resources.	3	9	34	91	42	179
4. Statistical						
a. Apply descriptive statistics.	5	13	58	68	36	180
b. Apply inferential statistics.	8	26	69	56	32	181
c. Design experiments.	9	20	58	69	34	180
5. Computer						
a. Design/select computer programs.	11	25	79	44	23	182
b. Utilize available software.	8	13	63	70	27	181
6. Technical/Scientific						
a. Design/improve processes.	11	16	35	69	51	182
b. Evaluate product materials.	12	23	46	64	37	182
c. Apply design procedures.	15	26	57	63	20	181

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 23

Raw Data for Frequency of Performance of Tasks as Reported By Both Groups Combined in the Present

	1	2	3	4	5	Total
Design Review						
1. Review quality specifications.	6	35	74	45	22	182
2. Relate specifications to process.	11	38	70	39	24	182
3. Identify potentially significant variables.	9	40	68	46	19	182
4. Develop pilot-run quality procedures.	30	80	40	20	12	182
Process Capability						
1. Identify potential controlling variables.	10	47	60	54	9	180
2. Develop/select statistical tests.	9	44	67	46	16	182
3. Analyze statistical data.	4	30	51	51	46	182
4. Develop/utilize computer data bases/programs.	15	40	54	40	33	182
Process Control						
1. Develop/implement inspection/audit procedures.	6	31	53	56	35	181
2. Develop/implement control chart procedures.	21	41	46	53	21	182
3. Establish control limits.	20	43	56	45	18	182
4. Review/revise control procedures.	13	55	62	44	8	182
5. Develop/revise control reporting procedures.	12	57	69	34	9	181
Vendor Relations						
1. Develop/implement acceptance sampling procedures.	32	40	46	40	24	182
2. Develop vendor quality systems.	46	49	40	32	15	182
3. Assist vendors with quality system development/revision.	44	56	39	31	12	182
Customer Relations						
1. Develop/implement customer feedback systems.	34	44	49	34	20	181
2. Analyze customer feedback.	20	46	51	36	29	182
3. Trace variation through manufacturing system.	21	49	60	32	18	180
Application						
1. Communication						
a. Write understandable reports/proposals.	1	10	37	68	66	182
b. Speak/discuss clearly.	0	9	33	59	81	182
2. Leadership						
a. Motivate subordinates and peers.	3	16	51	65	47	182
b. Delegate responsibilities.	6	39	48	60	29	182
c. Perform training sessions.	5	47	65	46	19	182
3. Management						
a. Plan activities.	2	18	57	72	31	180
b. Organize resources.	3	20	61	72	23	179
4. Statistical						
a. Apply descriptive statistics.	10	36	55	51	28	180
b. Apply inferential statistics.	18	56	51	36	20	181
c. Design experiments.	28	65	55	22	10	180
5. Computer						
a. Design/select computer programs.	22	69	32	36	13	182
b. Utilize available software.	10	36	46	52	37	181
6. Technical/Scientific						
a. Design/improve processes.	20	44	48	56	14	182
b. Evaluate product materials.	23	44	49	48	18	182
c. Apply design procedures.	27	58	65	28	3	181

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 24

Raw Data for Grouped Scales for the Sum of Importance and Frequency of Tasks as Reported by Both Groups Combined In the Present

	2-4	5-7	8-10	Total
Design Review				
1. Review quality specifications.	20	82	80	182
2. Relate specifications to process.	15	94	73	182
3. Identify potentially significant variables.	21	88	73	182
4. Develop pilot-run quality procedures.	57	100	25	182
Process Capability				
1. Identify potential controlling variables.	14	98	68	180
2. Develop/select statistical tests.	21	98	63	182
3. Analyze statistical data.	15	72	95	182
4. Develop/utilize computer data bases/programs.	30	83	69	182
Process Control				
1. Develop/implement inspection/audit procedures.	16	74	91	181
2. Develop/implement control chart procedures.	30	75	77	182
3. Establish control limits.	32	84	66	182
4. Review/revise control procedures.	27	102	53	182
5. Develop/revise control reporting procedures.	36	109	36	181
Vendor Relations				
1. Develop/implement acceptance sampling procedures.	52	72	58	182
2. Develop vendor quality systems.	49	86	47	182
3. Assist vendors with quality system development/revision.	47	91	44	182
Customer Relations				
1. Develop/implement customer feedback systems.	34	82	65	181
2. Analyze customer feedback.	27	47	68	182
3. Trace variation through manufacturing system.	30	100	50	180
Application				
1. Communication				
a. Write understandable reports/proposals.	3	45	134	182
b. Speak/discuss clearly.	3	40	139	182
2. Leadership				
a. Motivate subordinates and peers.	4	66	112	182
b. Delegate responsibilities.	21	77	84	182
c. Perform training sessions.	14	91	77	182
3. Management				
a. Plan activities.	6	73	101	180
b. Organize resources.	10	76	93	179
4. Statistical				
a. Apply descriptive statistics.	14	94	72	180
b. Apply inferential statistics.	35	49	57	181
c. Design experiments.	34	102	44	180
5. Computer				
a. Design/select computer programs.	40	100	42	182
b. Utilize available software.	20	83	78	181
6. Technical/Scientific				
a. Design/improve processes.	24	87	71	182
b. Evaluate product materials.	34	82	66	182
c. Apply design procedures	38	114	29	181

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 25

Mean and Rank Order of Importance of Tasks as Reported By Both Groups Combined in the Present

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	182	3.819	9.5
2. Relate specifications to process.	182	4.110	4
3. Identify potentially significant variables.	182	3.692	15
4. Develop pilot-run quality procedures.	182	3.137	34
Process Capability			
1. Identify potential controlling variables.	180	3.756	11
2. Develop/select statistical tests.	182	3.593	20
3. Analyze statistical data.	182	3.852	7
4. Develop/utilize computer data bases/programs.	182	3.357	27
Process Control			
1. Develop/implement inspection/audit procedures.	181	3.840	8
2. Develop/implement control chart procedures.	182	3.714	14
3. Establish control limits.	182	3.544	22
4. Review/revise control procedures.	182	3.484	25
5. Develop/revise control reporting procedures.	181	3.265	30
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	182	3.225	33
2. Develop vendor quality systems.	182	3.346	28
3. Assist vendors with quality system development/revision.	182	3.335	29
Customer Relations			
1. Develop/implement customer feedback systems.	181	3.641	18
2. Analyze customer feedback.	182	3.731	12.5
3. Trace variation through manufacturing system.	180	3.594	19
Application			
1. Communication			
a. Write understandable reports/proposals.	182	4.297	2
b. Speak/discuss clearly.	182	4.352	1
2. Leadership			
a. Motivate subordinates and peers.	182	4.115	3
b. Delegate responsibilities.	182	3.681	16
c. Perform training sessions.	182	3.819	9.5
3. Management			
a. Plan activities.	180	3.972	5
b. Organize resources.	179	3.892	6
4. Statistical			
a. Apply descriptive statistics.	180	3.650	17
b. Apply inferential statistics.	181	3.431	26
c. Design experiments.	180	3.550	21
5. Computer			
a. Design/select computer programs.	182	3.236	32
b. Utilize available software.	181	3.525	23
6. Technical/Scientific			
a. Design/improve processes.	182	3.731	12.5
b. Evaluate product materials.	182	3.500	24
c. Apply design procedures.	181	3.260	31

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 26

Mean and Rank Order of Frequency of Tasks as Reported By Both Groups Combined in the Present

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	182	3.231	11
2. Relate specifications to process.	182	3.148	13.5
3. Identify potentially significant variables.	182	3.143	15
4. Develop pilot-run quality procedures.	182	2.473	34
Process Capability			
1. Identify potential controlling variables.	180	3.028	19
2. Develop/select statistical tests.	182	3.088	16
3. Analyze statistical data.	182	3.577	5
4. Develop/utilize computer data bases/programs.	182	3.198	12
Process Control			
1. Develop/implement inspection/audit procedures.	181	3.459	7
2. Develop/implement control chart procedures.	182	3.066	17
3. Establish control limits.	182	2.989	21
4. Review/revise control procedures.	182	2.885	25
5. Develop/revise control reporting procedures.	181	2.840	27
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	182	2.912	23.5
2. Develop vendor quality systems.	182	2.566	31
3. Assist vendors with quality system development/revision.	182	2.511	33
Customer Relations			
1. Develop/implement customer feedback systems.	181	2.790	28
2. Analyze customer feedback.	182	3.044	18
3. Trace variation through manufacturing system.	180	2.872	26
Application			
1. Communication			
a. Write understandable reports/proposals.	182	4.033	2
b. Speak/discuss clearly.	182	4.165	1
2. Leadership			
a. Motivate subordinates and peers.	182	3.753	3
b. Delegate responsibilities.	182	3.368	9
c. Perform training sessions.	182	3.148	13.5
3. Management			
a. Plan activities.	180	3.622	4
b. Organize resources.	179	3.514	6
4. Statistical			
a. Apply descriptive statistics.	180	3.283	10
b. Apply inferential statistics.	181	2.912	23.5
c. Design experiments.	180	2.561	32
5. Computer			
a. Design/select computer programs.	182	2.720	29
b. Utilize available software.	181	3.387	8
6. Technical/Scientific			
a. Design/improve processes.	182	3.000	20
b. Evaluate product materials.	182	2.967	22
c. Apply design procedures.	181	2.569	30

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

both groups combined in the present. Speak/Discuss Clearly was ranked first, while Develop Pilot-Run Quality Procedures, was ranked last. A comparison of importance (Table 25) to frequency of performance (Table 26) indicates that for the most part important tasks are performed most frequently. There appear to be five tasks which are considered to be quite important, but are not performed frequently. They are:

1. Relate Specifications to Process
2. Develop/Implement Acceptance Sampling Procedures
3. Develop/Implement Customer Feedback Systems
4. Design Experiments
5. Utilize Available Software

Table 27 identifies the mean and rank order of the sum of the importance and frequency of tasks as reported by both groups combined in the present. It identifies Speak/Discuss Clearly as number one, and Develop Pilot-Run Quality Procedures as number 34. A three way comparison of Tables 25, 26, and 27 provides no unexpected information, though it might be noted that all 34 tasks were rated higher in importance than in frequency of performance. It can also be noted that all tasks are rated above three on the importance scale.

Mean and Rank Order of Task Categories

Table 28 identifies the mean and rank order of each task category as reported by both groups combined in the

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 27

Mean and Rank Order of the Sum of the Importance and Frequency of Tasks as Reported by Both Groups Combined in the Present

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	182	7.049	9.5
2. Relate specifications to process.	182	7.110	8
3. Identify potentially significant variables.	182	6.835	14
4. Develop pilot-run quality procedures.	182	5.610	34
Process Capability			
1. Identify potential controlling variables.	180	6.783	15
2. Develop/select statistical tests.	182	6.681	19
3. Analyze statistical data.	182	7.429	5
4. Develop/utilize computer data bases/programs.	182	6.555	20
Process Control			
1. Develop/implement inspection/audit procedures.	181	7.298	7
2. Develop/implement control chart procedures.	182	6.780	16
3. Establish control limits.	182	6.533	21
4. Review/revise control procedures.	182	6.368	25
5. Develop/revise control reporting procedures.	181	6.105	29
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	182	6.137	27
2. Develop vendor quality systems.	182	5.912	31
3. Assist vendors with quality system development/revision.	182	5.846	32
Customer Relations			
1. Develop/implement customer feedback systems.	181	6.431	24
2. Analyze customer feedback.	182	6.775	17
3. Trace variation through manufacturing system.	180	6.467	22.5
Application			
1. Communication			
a. Write understandable reports/proposals.	182	8.330	2
b. Speak/discuss clearly.	182	8.516	1
2. Leadership			
a. Motivate subordinates and peers.	182	7.868	3
b. Delegate responsibilities.	182	7.049	9.5
c. Perform training sessions.	182	6.967	11
3. Management			
a. Plan activities.	180	7.594	4
b. Organize resources.	179	7.408	6
4. Statistical			
a. Apply descriptive statistics.	180	6.933	12
b. Apply inferential statistics.	181	6.343	26
c. Design experiments.	180	6.111	28
5. Computer			
a. Design/select computer programs.	182	5.956	30
b. Utilize available software.	181	6.912	13
6. Technical/Scientific			
a. Design/improve processes.	182	6.731	18
b. Evaluate product materials.	182	6.467	22.5
c. Apply design procedures.	181	5.829	33

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 28

Mean and Rank Order of Importance of Task Categories as Reported by Both Groups Combined in the Present

	Mean	Rank
Design Review	3.690	2
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	3.640	4
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	3.569	5
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	3.302	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	3.655	3
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	3.734	1
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

present. The category Application was ranked first. The category Vendor Relations was ranked last. Table 29 identifies the mean and rank order of the frequency of performance of each task category as reported by both groups combined in the present. The category Application was ranked first while the category Vendor Relations was

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 29

Mean and Rank Order of Frequency of Task Categories as Reported by Both Groups Combined in the Present

	Mean	Rank
Design Review	2.999	4
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	3.223	2
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	3.048	3
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	2.663	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	2.902	5
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	3.267	1
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

ranked last. A comparison of importance (Table 28) to frequency of performance (Table 29) indicates that Design Review and Customer Relations are considered quite important, but are not frequently performed relative to other categories. It also indicates that Process Capability and Process Control are performed frequently, but are not as important as some of the other categories.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 30 identifies the mean and rank order of the sum of the importance and the frequency of each task category as reported by both groups combined in the present. The task category Application was again ranked first and Vendor Relations was again ranked last. A comparison of Tables 28, 29, and 30 indicates that frequency measure dominated the over importance rankings. Process Capability was ranked fourth in importance, but because of a high ranking in frequency of performance, was ranked second overall. Customer Relations was ranked third in importance and fifth on frequency, but was ranked fifth overall.

The Future

This section of the findings is directed at two research questions:

1. Of the selected tasks, how important will they be and how frequently will they be performed, five years hence?

2. Is there a statistically significant difference in the perception of the tasks performed between leading companies and others, five years hence?

The section includes the raw data for individual tasks, the mean and rank order for individual tasks, the mean and rank order for task categories, and a chi-square analysis comparing the two groups in the future. These findings are presented by group.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 30

Mean and Rank Order of the Sum of Importance and Frequency of Task Categories as Reported by Both Groups in the Present

	Mean	Rank
Design Review	6.651	3
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	6.862	2
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	6.617	4
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	5.965	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	6.558	5
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	7.001	1
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

Group I--Leading Companies

Raw Data for Individual Tasks

Table 31 presents the raw data for the importance of tasks as predicted by Group I for the future. Of the 34 tasks on the questionnaire, 32 (94%) had 100% response.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 31

Raw Data for Importance of Tasks as Predicted by Group I for the Future

	1	2	3	4	5	Total
Design Review						
1. Review quality specifications.	2	6	11	22	45	86
2. Relate specifications to process.	2	3	12	24	45	86
3. Identify potentially significant variables.	1	4	19	35	27	86
4. Develop pilot-run quality procedures.	1	11	33	27	14	86
Process Capability						
1. Identify potential controlling variables.	1	3	16	28	38	86
2. Develop/select statistical tests.	1	7	26	31	20	85
3. Analyze statistical data.	1	5	17	35	28	86
4. Develop/utilize computer data bases/programs.	1	4	24	35	22	86
Process Control						
1. Develop/implement inspection/audit procedures.	1	11	31	27	16	86
2. Develop/implement control chart procedures.	1	7	24	36	18	86
3. Establish control limits.	1	5	23	36	21	86
4. Review/revise control procedures.	1	5	24	35	21	86
5. Develop/revise control reporting procedures.	1	6	42	23	10	82
Vendor Relations						
1. Develop/implement acceptance sampling procedures.	2	14	41	19	10	86
2. Develop vendor quality systems.	1	8	22	27	28	86
3. Assist vendors with quality system development/revision.	2	5	23	30	26	86
Customer Relations						
1. Develop/implement customer feedback systems.	1	5	13	35	32	86
2. Analyze customer feedback.	1	6	18	38	23	86
3. Trace variation through manufacturing system.	1	4	19	41	21	86
Application						
1. Communication						
a. Write understandable reports/proposals.	0	3	7	22	54	86
b. Speak/discuss clearly.	0	4	4	23	55	86
2. Leadership						
a. Motivate subordinates and peers.	0	2	10	36	38	86
b. Delegate responsibilities.	1	4	14	40	27	86
c. Perform training sessions.	1	3	11	36	35	86
3. Management						
a. Plan activities.	0	2	12	45	27	86
b. Organize resources.	0	2	10	47	27	86
4. Statistical						
a. Apply descriptive statistics.	1	3	17	46	19	86
b. Apply inferential statistics.	1	4	23	39	19	86
c. Design experiments.	0	5	21	33	27	86
5. Computer						
a. Design/select computer programs.	0	11	31	35	9	86
b. Utilize available software.	0	3	18	39	26	86
6. Technical/Scientific						
a. Design/improve processes.	0	3	12	36	35	86
b. Evaluate product materials.	1	3	20	45	17	86
c. Apply design procedures.	0	7	27	40	12	86

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 32 presents the raw data for the frequency of performance of tasks as predicted by Group I for the future. Of the 34 tasks on the questionnaire, 32 (94%) had 100% response. Table 33 presents the raw data for grouped scales for the sum of the importance and the frequency of tasks as predicted by Group I for the future. Three cells were used for the sum of the responses. The lowest cell includes sums from two to four, where two is not important and never performed. The center cell includes sums from five to seven and the highest cell includes sums from eight to ten, where ten is imperative and very frequently performed.

Mean and Rank Order for Individual Tasks

Table 34 identifies the mean and rank order of the importance of each task as predicted by Group I for the future. Speak/Discuss Clearly was ranked first. Develop/Implement Acceptance Sampling Procedures was ranked last. Table 35 identifies mean and rank order of the frequency of performance of tasks as predicted by Group I for the future. Speak/Discuss Clearly was ranked first. Develop Pilot-Run Quality Procedures was ranked last. A comparison of importance (Table 34) to frequency of performance (Table 35) shows that for the most part tasks that are important will be performed most frequently. Four (12%) tasks have been ranked high for importance and low for frequency. They are:

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 32

Raw Data for Frequency of Performance of Tasks as Predicted by Group I for the Future

	1	2	3	4	5	Total
Design Review						
1. Review quality specifications.	4	7	40	25	10	86
2. Relate specifications to process.	2	10	27	34	13	86
3. Identify potentially significant variables.	2	11	18	39	16	86
4. Develop pilot-run quality procedures.	7	21	36	16	6	86
Process Capability						
1. Identify potential controlling variables.	1	15	21	35	14	86
2. Develop/select statistical tests.	2	12	37	27	7	85
3. Analyze statistical data.	1	5	28	32	20	86
4. Develop/utilize computer data bases/programs.	3	7	21	39	16	86
Process Control						
1. Develop/implement inspection/audit procedures.	3	15	28	28	12	86
2. Develop/implement control chart procedures.	3	10	27	31	15	86
3. Establish control limits.	2	7	27	34	16	86
4. Review/revise control procedures.	1	11	26	32	16	86
5. Develop/revise control reporting procedures.	2	18	45	12	5	82
Vendor Relations						
1. Develop/implement acceptance sampling procedures.	4	14	45	17	6	86
2. Develop vendor quality systems.	3	18	25	23	17	86
3. Assist vendors with quality system development/revision.	4	24	23	17	18	86
Customer Relations						
1. Develop/implement customer feedback systems.	2	13	27	29	15	86
2. Analyze customer feedback.	2	9	21	36	18	86
3. Trace variation through manufacturing system.	2	12	29	35	8	86
Application						
1. Communication						
a. Write understandable reports/proposals.	0	3	13	38	32	86
b. Speak/discuss clearly.	0	6	11	31	38	86
2. Leadership						
a. Motivate subordinates and peers.	0	3	18	37	28	86
b. Delegate responsibilities.	2	5	29	38	12	86
c. Perform training sessions.	0	7	23	38	18	86
3. Management						
a. Plan activities.	1	5	15	47	18	86
b. Organize resources.	1	6	17	48	14	86
4. Statistical						
a. Apply descriptive statistics.	2	11	32	30	11	86
b. Apply inferential statistics.	1	15	25	33	12	86
c. Design experiments.	4	17	26	26	13	86
5. Computer						
a. Design/select computer programs.	3	24	27	25	7	86
b. Utilize available software.	1	8	22	40	15	86
6. Technical/Scientific						
a. Design/improve processes.	5	8	30	32	11	86
b. Evaluate product materials.	2	14	26	36	8	86
c. Apply design procedures.	5	11	35	27	8	86

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 33

Raw Data for Grouped Scales for the Sum of Importance and Frequency of Tasks as Predicted by Group I for the Future

	2-4	5-7	8-10	Total
Design Review				
1. Review quality specifications.	6	28	52	86
2. Relate specifications to process.	4	25	57	86
3. Identify potentially significant variables.	2	35	49	86
4. Develop pilot-run quality procedures.	12	55	19	86
Process Capability				
1. Identify potential controlling variables.	3	31	52	86
2. Develop/select statistical tests.	6	46	33	85
3. Analyze statistical data.	4	31	51	86
4. Develop/utilize computer data bases/programs.	4	36	46	86
Process Control				
1. Develop/implement inspection/audit procedures.	10	41	35	85
2. Develop/implement control chart procedures.	7	38	41	86
3. Establish control limits.	4	37	45	86
4. Review/revise control procedures.	4	38	44	86
5. Develop/revise control reporting procedures.	5	60	17	82
Vendor Relations				
1. Develop/implement acceptance sampling procedures.	9	61	16	86
2. Develop vendor quality systems.	5	45	36	86
3. Assist vendors with quality system development/revision.	8	43	35	86
Customer Relations				
1. Develop/implement customer feedback systems.	4	37	45	86
2. Analyze customer feedback.	3	35	48	86
3. Trace variation through manufacturing system.	4	40	42	86
Application				
1. Communication				
a. Write understandable reports/proposals.	1	13	72	86
b. Speak/discuss clearly.	3	11	72	86
2. Leadership				
a. Motivate subordinates and peers.	1	18	67	86
b. Delegate responsibilities.	2	36	48	86
c. Perform training sessions.	3	25	58	86
3. Management				
a. Plan activities.	2	21	63	86
b. Organize resources.	2	23	61	86
4. Statistical				
a. Apply descriptive statistics.	4	44	38	86
b. Apply inferential statistics.	4	39	43	86
c. Design experiments.	6	42	38	86
5. Computer				
a. Design/select computer programs.	6	58	22	86
b. Utilize available software.	2	31	53	86
6. Technical/Scientific				
a. Design/improve processes.	3	38	45	86
b. Evaluate product materials.	4	38	44	86
c. Apply design procedures	7	45	34	86

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 34

Mean and Rank Order of Importance of Tasks as Predicted By Group I for the Future

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	86	4.186	6
2. Relate specifications to process.	86	4.244	4
3. Identify potentially significant variables.	86	3.965	15
4. Develop pilot-run quality procedures.	86	3.488	31.5
Process Capability			
1. Identify potential controlling variables.	86	4.151	8.5
2. Develop/select statistical tests.	85	3.729	28
3. Analyze statistical data.	86	3.977	14
4. Develop/utilize computer data bases/programs.	86	3.849	22
Process Control			
1. Develop/implement inspection/audit procedures.	85	3.535	30
2. Develop/implement control chart procedures.	86	3.733	27
3. Establish control limits.	86	3.826	24.5
4. Review/revise control procedures.	86	3.814	26
5. Develop/revise control reporting procedures.	82	3.427	33
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	86	3.244	34
2. Develop vendor quality systems.	86	3.849	22
3. Assist vendors with quality system development/revision.	86	3.849	22
Customer Relations			
1. Develop/implement customer feedback systems.	86	4.070	11
2. Analyze customer feedback.	86	3.884	19
3. Trace variation through manufacturing system.	86	3.895	18
Application			
1. Communication			
a. Write understandable reports/proposals.	86	4.477	2
b. Speak/discuss clearly.	86	4.500	1
2. Leadership			
a. Motivate subordinates and peers.	86	4.279	3
b. Delegate responsibilities.	86	4.023	12.5
c. Perform training sessions.	86	4.174	7
3. Management			
a. Plan activities.	86	4.128	10
b. Organize resources.	86	4.151	8.5
4. Statistical			
a. Apply descriptive statistics.	86	3.919	17
b. Apply inferential statistics.	86	3.826	24.5
c. Design experiments.	86	3.953	16
5. Computer			
a. Design/select computer programs.	86	3.488	31.5
b. Utilize available software.	86	4.023	12.5
6. Technical/Scientific			
a. Design/improve processes.	86	4.198	5
b. Evaluate product materials.	86	3.860	20
c. Apply design procedures.	86	3.663	29

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 35

Mean and Rank Order of Frequency of Performance of Tasks as Predicted by Group I for the Future

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	86	3.349	26
2. Relate specifications to process.	86	3.535	15.5
3. Identify potentially significant variables.	86	3.651	10
4. Develop pilot-run quality procedures.	86	2.919	34
Process Capability			
1. Identify potential controlling variables.	86	3.535	15.5
2. Develop/select statistical tests.	85	3.294	28
3. Analyze statistical data.	86	3.756	7
4. Develop/utilize computer data bases/programs.	86	3.674	9
Process Control			
1. Develop/implement inspection/audit procedures.	86	3.360	25
2. Develop/implement control chart procedures.	86	3.523	17
3. Establish control limits.	86	3.640	12
4. Review/revise control procedures.	86	3.593	14
5. Develop/revise control reporting procedures.	82	3.000	33
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	86	3.081	32
2. Develop vendor quality systems.	86	3.384	24
3. Assist vendors with quality system development/revision.	86	3.244	30
Customer Relations			
1. Develop/implement customer feedback systems.	86	3.488	18
2. Analyze customer feedback.	86	3.686	8
3. Trace variation through manufacturing system.	86	3.407	22
Application			
1. Communication			
a. Write understandable reports/proposals.	86	4.151	2
b. Speak/discuss clearly.	86	4.174	1
2. Leadership			
a. Motivate subordinates and peers.	86	4.047	3
b. Delegate responsibilities.	86	3.616	13
c. Perform training sessions.	86	3.779	6
3. Management			
a. Plan activities.	86	3.884	4
b. Organize resources.	86	3.791	5
4. Statistical			
a. Apply descriptive statistics.	86	3.430	20
b. Apply inferential statistics.	86	3.465	19
c. Design experiments.	86	3.314	27
5. Computer			
a. Design/select computer programs.	86	3.105	31
b. Utilize available software.	86	3.648	11
6. Technical/Scientific			
a. Design/improve processes.	86	3.419	21
b. Evaluate product materials.	86	3.395	23
c. Apply design procedures.	86	3.256	29

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

1. Review Quality Specifications
2. Relate Specifications to Process
3. Design Experiments
4. Design/Improve Processes

Five (15%) tasks were ranked low on importance and high on frequency. They are:

1. Develop/Utilize Computer Data Bases/Programs
2. Develop/Implement Control Chart Procedures
3. Establish Control Limits
4. Review/Revise Control Techniques
5. Analyze Customer Feedback

Table 36 identifies the mean and rank order of the sum of the importance and frequency of tasks as predicted by Group I for the future. It reaffirms the ranking of the task Speak/Discuss Clearly as number one. Develop/Implement Acceptance Sampling Procedures was ranked number 34. A three way comparison of Tables 34, 35, and 36 provides two situations of interest. Three tasks ended up with an overall ranking (Table 36) higher than the individual importance or frequency ranking. They are:

1. Delegate Responsibilities
2. Perform Training Sessions
3. Utilize Available Software

Two tasks, Develop Vendor Quality Systems and Design Experiments, were ranked lower overall than they had been ranked for importance or frequency of performance.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 36

Mean and Rank Order of the Sum of the Importance and Frequency of Tasks as Predicted by Group I for the Future

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	86	7.535	16
2. Relate specifications to process.	86	7.779	7
3. Identify potentially significant variables.	86	7.616	12.5
4. Develop pilot-run quality procedures.	86	6.407	33
Process Capability			
1. Identify potential controlling variables.	86	7.686	10
2. Develop/select statistical tests.	85	7.024	28
3. Analyze statistical data.	86	7.733	8
4. Develop/utilize computer data bases/programs.	86	7.523	17
Process Control			
1. Develop/implement inspection/audit procedures.	86	6.895	30
2. Develop/implement control chart procedures.	86	7.256	24.5
3. Establish control limits.	86	7.465	18
4. Review/revise control procedures.	86	7.407	19
5. Develop/revise control reporting procedures.	82	6.427	32
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	86	6.326	34
2. Develop vendor quality systems.	86	7.233	26
3. Assist vendors with quality system development/revision.	86	7.093	27
Customer Relations			
1. Develop/implement customer feedback systems.	86	7.558	15
2. Analyze customer feedback.	86	7.570	14
3. Trace variation through manufacturing system.	86	7.302	21
Application			
1. Communication			
a. Write understandable reports/proposals.	86	8.628	2
b. Speak/discuss clearly.	86	8.686	1
2. Leadership			
a. Motivate subordinates and peers.	86	8.326	3
b. Delegate responsibilities.	86	7.640	11
c. Perform training sessions.	86	7.953	5
3. Management			
a. Plan activities.	86	8.012	4
b. Organize resources.	86	7.942	6
4. Statistical			
a. Apply descriptive statistics.	86	7.349	20
b. Apply inferential statistics.	86	7.291	22
c. Design experiments.	86	7.267	23
5. Computer			
a. Design/select computer programs.	86	6.593	31
b. Utilize available software.	86	7.721	9
6. Technical/Scientific			
a. Design/improve processes.	86	7.616	12.5
b. Evaluate product materials.	86	7.256	24.5
c. Apply design procedures.	86	6.919	29

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Mean and Rank Order for Task Categories

Table 37 identifies the mean and rank order of task categories as predicted by Group I for the future. The Application category was ranked first, while Vendor Relations was ranked last. Table 38 identifies the mean and rank order of the frequency of performance of task categories as predicted by Group I for the future. The category Application was ranked first and Vendor Relations was ranked last. A comparison of Table 37 to Table 38 indicates that Design Review is ranked two of six on importance and five of six on frequency. It is considered to be rather low on importance, but is performed frequently.

Table 39 identifies the mean and rank order of the sum of the importance and the frequency of task categories as predicted by Group I for the future. The category Application was ranked first and Vendor Relations was ranked last. A three way comparison of Tables 37, 38, and 39 shows that the category Process Capability, though ranked four of six on importance (Table 37), achieved an overall ranking (Table 39) of two of six.

Group II--Nonleading Companies

Raw Data for Individual Tasks

Table 40 presents the raw data for the importance of tasks as predicted by Group II for the future. Of the 34

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 37

Mean and Rank Order of Importance of Task Categories as Predicted by Group I for the Future

	Mean	Rank
Design Review	3.971	2
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	3.849	4
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	3.667	5
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	3.647	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	3.950	3
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	4.044	1
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

tasks, 26 (77%) had 100% response. Table 41 presents the raw data for the frequency of performance of tasks as predicted by Group II for the future. Of the 34 tasks, 26 (77%) had 100 percent response. Table 42 presents the raw data for grouped scales for the sum of the importance and the frequency of tasks as predicted by Group II for the

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 38

Mean and Rank Order of Frequency of Performance of Task Categories as Predicted by Group I for the Future

	Mean	Rank
Design Review	3.364	5
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	3.565	2
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	3.423	4
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	3.236	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	3.527	3
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	3.632	1
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

future where two is not important and never performed and ten is imperative and very frequently performed.

Mean and Rank Order of Individual Tasks

Table 43 identifies the mean and rank order of the importance of each task as predicted by Group II for the

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 39

Mean and Rank Order of the Sum of the Importance and Frequency of Task Categories as Predicted by Group I For the Future

	Mean	Rank
Design Review	7.334	4
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	7.492	2
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	7.090	5
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	6.884	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	7.477	3
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	7.680	1
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

future. Write Understandable Reports/Proposals was ranked first. Develop/Implement Acceptance Sampling Procedures was ranked last. Table 44 identifies the mean and rank order of the frequency of performance of tasks as predicted by Group II for the future. Speak/Discuss Clearly was ranked first. Develop/Implement Acceptance Sampling

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 40

Raw Data for Importance of Tasks as Predicted by Group II for the Future

	1	2	3	4	5	Total
Design Review						
1. Review quality specifications.	1	3	9	49	34	96
2. Relate specifications to process.	1	3	7	39	46	96
3. Identify potentially significant variables.	1	1	21	51	22	96
4. Develop pilot-run quality procedures.	1	16	34	29	16	96
Process Capability						
1. Identify potential controlling variables.	1	3	14	41	37	96
2. Develop/select statistical tests.	1	5	22	44	24	96
3. Analyze statistical data.	2	2	15	36	41	96
4. Develop/utilize computer data bases/programs.	1	10	23	35	27	96
Process Control						
1. Develop/implement inspection/audit procedures.	1	8	33	32	22	96
2. Develop/implement control chart procedures.	1	3	28	48	16	96
3. Establish control limits.	3	5	24	46	18	96
4. Review/revise control procedures.	1	4	22	57	12	96
5. Develop/revise control reporting procedures.	1	8	33	45	9	96
Vendor Relations						
1. Develop/implement acceptance sampling procedures.	6	15	29	30	15	95
2. Develop vendor quality systems.	7	6	12	39	31	95
3. Assist vendors with quality system development/revision.	3	4	10	53	25	95
Customer Relations						
1. Develop/implement customer feedback systems.	2	5	17	31	41	96
2. Analyze customer feedback.	1	5	10	26	54	96
3. Trace variation through manufacturing system.	1	4	9	64	18	96
Application						
1. Communication						
a. Write understandable reports/proposals.	0	0	4	24	68	96
b. Speak/discuss clearly.	0	0	3	28	65	96
2. Leadership						
a. Motivate subordinates and peers.	1	4	18	49	23	95
b. Delegate responsibilities.	1	1	19	57	18	96
c. Perform training sessions.	1	1	24	40	30	96
3. Management						
a. Plan activities.	0	2	11	47	36	96
b. Organize resources.	0	2	12	43	39	96
4. Statistical						
a. Apply descriptive statistics.	2	1	15	53	22	93
b. Apply inferential statistics.	2	4	33	47	7	93
c. Design experiments.	2	3	23	43	22	93
5. Computer						
a. Design/select computer programs.	3	11	36	38	8	96
b. Utilize available software.	0	7	20	44	24	95
6. Technical/Scientific						
a. Design/improve processes.	0	5	10	36	45	96
b. Evaluate product materials.	1	7	18	47	23	96
c. Apply design procedures.	5	2	35	40	14	96

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 41

Raw Data for Frequency of Performance of Tasks as Predicted by Group II for the Future

	1	2	3	4	5	Total
Design Review						
1. Review quality specifications.	1	9	36	32	18	96
2. Relate specifications to process.	2	4	39	31	20	96
3. Identify potentially significant variables.	3	7	46	31	9	96
4. Develop pilot-run quality procedures.	3	39	27	17	10	96
Process Capability						
1. Identify potential controlling variables.	2	10	31	37	16	96
2. Develop/select statistical tests.	1	11	40	34	10	96
3. Analyze statistical data.	1	6	17	36	36	96
4. Develop/utilize computer data bases/programs.	2	13	19	32	30	96
Process Control						
1. Develop/implement inspection/audit procedures.	1	18	39	31	7	96
2. Develop/implement control chart procedures.	3	17	39	32	5	96
3. Establish control limits.	4	17	45	23	7	96
4. Review/revise control procedures.	1	19	34	37	5	96
5. Develop/revise control reporting procedures.	1	25	43	22	5	96
Vendor Relations						
1. Develop/implement acceptance sampling procedures.	9	30	27	19	10	95
2. Develop vendor quality systems.	13	15	32	20	15	95
3. Assist vendors with quality system development/revision.	6	18	21	38	12	95
Customer Relations						
1. Develop/implement customer feedback systems.	8	20	23	33	12	96
2. Analyze customer feedback.	5	14	22	37	18	96
3. Trace variation through manufacturing system.	3	11	31	47	4	96
Application						
1. Communication						
a. Write understandable reports/proposals.	0	4	13	34	45	96
b. Speak/discuss clearly.	0	2	6	34	54	96
2. Leadership						
a. Motivate subordinates and peers.	2	11	22	50	10	95
b. Delegate responsibilities.	3	7	34	43	9	96
c. Perform training sessions.	1	12	30	33	20	96
3. Management						
a. Plan activities.	0	7	32	37	20	96
b. Organize resources.	0	7	32	34	23	96
4. Statistical						
a. Apply descriptive statistics.	1	6	23	41	22	93
b. Apply inferential statistics.	1	17	44	25	6	93
c. Design experiments.	2	22	25	33	11	93
5. Computer						
a. Design/select computer programs.	5	36	23	25	7	96
b. Utilize available software.	0	12	34	27	22	95
6. Technical/Scientific						
a. Design/improve processes.	0	13	22	48	13	96
b. Evaluate product materials.	3	17	23	41	12	96
c. Apply design procedures.	7	25	38	19	7	96

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 42

Raw Data for Grouped Scales for the Sum of Importance and Frequency of Tasks as Predicted by Group II for the Future

	2-4	5-7	8-10	Total
Design Review				
1. Review quality specifications.	4	37	55	96
2. Relate specifications to process.	3	31	62	96
3. Identify potentially significant variables.	2	51	43	96
4. Develop pilot-run quality procedures.	15	51	30	96
Process Capability				
1. Identify potential controlling variables.	4	34	58	96
2. Develop/select statistical tests.	2	48	46	96
3. Analyze statistical data.	3	23	70	96
4. Develop/utilize computer data bases/programs.	8	33	55	96
Process Control				
1. Develop/implement inspection/audit procedures.	7	52	37	96
2. Develop/implement control chart procedures.	4	56	36	96
3. Establish control limits.	8	54	34	96
4. Review/revise control procedures.	4	51	41	96
5. Develop/revise control reporting procedures.	9	58	29	95
Vendor Relations				
1. Develop/implement acceptance sampling procedures.	21	45	29	95
2. Develop vendor quality systems.	13	39	43	95
3. Assist vendors with quality system development/revision.	8	35	52	95
Customer Relations				
1. Develop/implement customer feedback systems.	7	38	51	96
2. Analyze customer feedback.	8	23	65	96
3. Trace variation through manufacturing system.	5	39	52	96
Application				
1. Communication				
a. Write understandable reports/proposals.	0	8	88	96
b. Speak/discuss clearly.	0	5	91	96
2. Leadership				
a. Motivate subordinates and peers.	5	30	60	95
b. Delegate responsibilities.	3	40	53	96
c. Perform training sessions.	2	40	54	96
3. Management				
a. Plan activities.	2	34	60	96
b. Organize resources.	2	30	64	96
4. Statistical				
a. Apply descriptive statistics.	3	28	62	93
b. Apply inferential statistics.	5	61	27	93
c. Design experiments.	5	48	40	93
5. Computer				
a. Design/select computer programs.	14	56	26	96
b. Utilize available software.	5	43	47	95
6. Technical/Scientific				
a. Design/improve processes.	5	25	66	96
b. Evaluate product materials.	8	36	52	96
c. Apply design procedures	7	59	30	96

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 43

Mean and Rank Order of Importance of Tasks as Predicted by Group II for the Future

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	96	4.167	8.5
2. Relate specifications to process.	96	4.333	3
3. Identify potentially significant variables.	96	3.948	15
4. Develop pilot-run quality procedures.	96	3.448	32
Process Capability			
1. Identify potential controlling variables.	96	4.146	10
2. Develop/select statistical tests.	96	3.885	19
3. Analyze statistical data.	96	4.167	8.5
4. Develop/utilize computer data bases/programs.	96	3.802	23
Process Control			
1. Develop/implement inspection/audit procedures.	96	3.688	27
2. Develop/implement control chart procedures.	96	3.781	24.5
3. Establish control limits.	96	3.740	26
4. Review/revise control procedures.	96	3.781	24.5
5. Develop/revise control reporting procedures.	96	3.552	30
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	95	3.347	34
2. Develop vendor quality systems.	95	3.853	22
3. Assist vendors with quality system development/revision.	95	3.479	31
Customer Relations			
1. Develop/implement customer feedback systems.	96	4.083	11
2. Analyze customer feedback.	96	4.323	4
3. Trace variation through manufacturing system.	96	3.979	14
Application			
1. Communication			
a. Write understandable reports/proposals.	96	4.667	1
b. Speak/discuss clearly.	96	4.646	2
2. Leadership			
a. Motivate subordinates and peers.	95	3.937	17
b. Delegate responsibilities.	96	3.938	16
c. Perform training sessions.	96	4.010	12
3. Management			
a. Plan activities.	96	4.219	7
b. Organize resources.	96	4.240	6
4. Statistical			
a. Apply descriptive statistics.	93	3.989	13
b. Apply inferential statistics.	93	3.570	29
c. Design experiments.	93	3.860	21
5. Computer			
a. Design/select computer programs.	96	3.385	33
b. Utilize available software.	95	3.895	18
6. Technical/Scientific			
a. Design/improve processes.	96	4.260	5
b. Evaluate product materials.	96	3.875	20
c. Apply design procedures.	96	3.583	28

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 44

Mean and Rank Order of Frequency of Performance of Tasks As Predicted by Group II for the Future

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	96	3.594	12
2. Relate specifications to process.	96	3.656	8
3. Identify potentially significant variables.	96	3.375	20
4. Develop pilot-run quality procedures.	96	2.917	33
Process Capability			
1. Identify potential controlling variables.	96	3.573	14
2. Develop/select statistical tests.	96	3.427	18
3. Analyze statistical data.	96	4.042	3
4. Develop/utilize computer data bases/programs.	96	3.781	5
Process Control			
1. Develop/implement inspection/audit procedures.	96	3.260	24
2. Develop/implement control chart procedures.	96	3.198	26
3. Establish control limits.	96	3.125	28
4. Review/revise control procedures.	96	3.271	23
5. Develop/revise control reporting procedures.	96	3.052	30
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	95	2.905	34
2. Develop vendor quality systems.	95	3.095	29
3. Assist vendors with quality system development/revision.	95	3.337	21
Customer Relations			
1. Develop/implement customer feedback systems.	96	3.219	25
2. Analyze customer feedback.	96	3.510	15
3. Trace variation through manufacturing system.	96	3.396	19
Application			
1. Communication			
a. Write understandable reports/proposals.	96	4.250	2
b. Speak/discuss clearly.	96	4.458	1
2. Leadership			
a. Motivate subordinates and peers.	95	3.579	13
b. Delegate responsibilities.	96	3.500	16
c. Perform training sessions.	96	3.615	11
3. Management			
a. Plan activities.	96	3.729	7
b. Organize resources.	96	3.760	6
4. Statistical			
a. Apply descriptive statistics.	93	3.828	4
b. Apply inferential statistics.	93	3.194	27
c. Design experiments.	93	3.312	22
5. Computer			
a. Design/select computer programs.	96	2.927	32
b. Utilize available software.	95	3.621	10
6. Technical/Scientific			
a. Design/improve processes.	96	3.635	9
b. Evaluate product materials.	96	3.438	17
c. Apply design procedures.	96	2.938	31

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Procedures was ranked last. A comparison of importance (Table 43) to frequency (Table 44) shows that for the most part important tasks are performed most frequently. There are four (12%) exceptions to that case. Two tasks, Develop/Utilize Computer Data Bases/Programs and Assist Vendors with Quality System Development/Revision, were ranked considerably higher for frequency than they were for importance. On the other hand, two tasks, Develop/Implement Customer Feedback Systems and Analyze Customer Feedback, were considerably lower for frequency than they were for importance.

Table 45 identifies the mean and rank order of the sum of the importance and frequency of tasks as predicted by Group II for the future. It reaffirms the ranking of the task Speak/Discuss Clearly as number one and Develop/Implement Acceptance Sampling Procedures as number 34. A three way comparison of Tables 43, 44, and 45 shows agreement between the two individual scales and the sum of those scales, but there are five (15%) exceptions. Three tasks were ranked lower overall (Table 45) than they were on either of the individual scales of importance (Table 43) or frequency (Table 44). They are:

1. Develop/Select Statistical Tests
2. Design Experiments
3. Evaluate Product Materials

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 45

Mean and Rank Order of the Sum of Importance and Frequency Of Tasks as Predicted by Group II for the Future

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	96	7.761	10
2. Relate specifications to process.	96	7.990	5
3. Identify potentially significant variables.	96	7.323	18
4. Develop pilot-run quality procedures.	96	6.365	32
Process Capability			
1. Identify potential controlling variables.	96	7.719	11
2. Develop/select statistical tests.	96	7.313	20.5
3. Analyze statistical data.	96	8.208	3
4. Develop/utilize computer data bases/programs.	96	7.583	13
Process Control			
1. Develop/implement inspection/audit procedures.	96	6.948	26
2. Develop/implement control chart procedures.	96	6.979	25
3. Establish control limits.	96	6.865	28
4. Review/revise control procedures.	96	7.052	24
5. Develop/revise control reporting procedures.	96	6.604	30
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	95	6.253	34
2. Develop vendor quality systems.	95	6.947	27
3. Assist vendors with quality system development/revision.	95	7.316	19
Customer Relations			
1. Develop/implement customer feedback systems.	96	7.302	22
2. Analyze customer feedback.	96	7.833	8
3. Trace variation through manufacturing system.	96	7.375	17
Application			
1. Communication			
a. Write understandable reports/proposals.	96	8.917	2
b. Speak/discuss clearly.	96	9.104	1
2. Leadership			
a. Motivate subordinates and peers.	95	7.516	14.5
b. Delegate responsibilities.	96	7.438	16
c. Perform training sessions.	96	7.625	12
3. Management			
a. Plan activities.	96	7.948	6
b. Organize resources.	96	8.000	4
4. Statistical			
a. Apply descriptive statistics.	93	7.817	9
b. Apply inferential statistics.	93	6.763	29
c. Design experiments.	93	7.172	23
5. Computer			
a. Design/select computer programs.	96	6.313	33
b. Utilize available software.	95	7.516	14.5
6. Technical/Scientific			
a. Design/improve processes.	96	7.896	7
b. Evaluate product materials.	96	7.313	20.5
c. Apply design procedures.	96	6.521	31

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Two tasks, Assist Vendors with Quality System Development/Revision and Organize Resources, were ranked higher overall (Table 45) than they were on the two individual scales of importance (Table 43) or frequency (Table 44).

Mean and Rank Order of Task Categories

Table 46 identifies the mean and rank order of task categories as predicted by Group II for the future. Customer Relations was ranked first while Process Control was ranked last. Table 47 identifies the mean and rank order of the frequency of performance of task categories as predicted by Group II for the future. The category Process Capability was ranked first and the category Vendor Relations was ranked last. A comparison of importance (Table 46) to frequency of performance (Table 47) provides two interesting notes. First of all, Customer Relations was ranked as the most important category, but it was ranked four of six on frequency of performance. Engineers of nonleading companies do not perform the most important category of tasks very frequently. The second note involves Process Capability which was ranked three of six on importance (Table 46) and one of six on frequency of performance. The most frequently performed category was not as important as some others.

Table 48 identifies the mean and rank order of the sum of the importance and the frequency of task categories as

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 46

Mean and Rank Order of Importance of Task Categories as Predicted by Group II for the Future

	Mean	Rank
Design Review	3.974	4
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	4.000	3
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	3.708	6
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	3.726	5
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	4.128	1
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	4.005	2
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

predicted by Group II for the future. The category Process Capability was ranked first and Vendor Relations was ranked last. A three way comparison of Tables 46, 47, and 48 indicates that engineers from nonleading companies ranked Process Capability first overall and Customer Relations

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 47

Mean and Rank Order of Frequency of Performance of Task Categories as Predicted by Group II for the Future

	Mean	Rank
Design Review	3.386	3
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	3.706	1
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	3.181	5
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	3.112	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	3.375	4
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	3.586	2
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

third overall though these two categories were the opposite on the importance scale.

Comparison of Group I to Group II

Table 49 presents a chi-square analysis of the importance of each task comparing Group I (Table 31) to Group II (Table 40) in the future. The comparison

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 48

Mean and Rank Order of the Sum of Importance and Frequency Of Task Categories as Predicted by Group II for the Future

	Mean	Rank
Design Review	7.360	4
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	7.706	1
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	6.890	5
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	6.839	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	7.503	3
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	7.591	2
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

indicates that five (15%) of the tasks are perceived to be different between the two groups. Group I (engineers from leading companies) identified three tasks as more important in the future. They are:

1. Review Quality Specifications

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 49

Chi-Square Analysis for Importance of Task Comparing Group I to Group II in the Future

	Chi Square	Critical Value (K)	x >K
Design Review			
1. Review quality specifications.	12.822	9.49	*
2. Relate specifications to process.	4.696	9.49	
3. Identify potentially significant variables.	4.852	9.49	
4. Develop pilot-run quality procedures.	0.598	9.49	
Process Capability			
1. Identify potential controlling variables.	2.053	9.49	
2. Develop/select statistical tests.	2.625	9.49	
3. Analyze statistical data.	3.669	9.49	
4. Develop/utilize computer data bases/programs.	2.561	9.49	
Process Control			
1. Develop/implement inspection/audit procedures.	1.362	9.49	
2. Develop/implement control chart procedures.	3.200	9.49	
3. Establish control limits.	1.928	9.49	
4. Review/revise control procedures.	7.386	9.49	
5. Develop/revise control reporting procedures.	7.481	9.49	
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	7.131	9.49	
2. Develop vendor quality systems.	9.638	9.49	*
3. Assist vendors with quality system development/revision.	11.406	9.49	*
Customer Relations			
1. Develop/implement customer feedback systems.	1.674	9.49	
2. Analyze customer feedback.	16.608	9.49	*
3. Trace variation through manufacturing system.	8.316	9.49	
Application			
1. Communication			
a. Write understandable reports/proposals.	3.727	7.82	
b. Speak/discuss clearly.	3.056	7.82	
2. Leadership			
a. Motivate subordinates and peers.	8.822	7.82	*
b. Delegate responsibilities.	6.808	9.49	
c. Perform training sessions.	5.892	9.49	
3. Management			
a. Plan activities.	.826	7.82	
b. Organize resources.	1.998	7.82	
4. Statistical			
a. Apply descriptive statistics.	1.902	9.49	
b. Apply inferential statistics.	8.140	9.49	
c. Design experiments.	1.646	7.82	
5. Computer			
a. Design/select computer programs.	.367	7.82	
b. Utilize available software.	1.643	7.82	
6. Technical/Scientific			
a. Design/improve processes.	1.387	7.82	
b. Evaluate product materials.	2.206	9.49	
c. Apply design procedures.	.639	7.82	

Note: Confidence interval is 95% (alpha=.05).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

2. Assist Vendors with Quality System Development/Revision

3. Motivate Subordinates and Peers

Group II identified two tasks as being more important in the future: Develop Vendor Quality Systems and Analyze Customer Feedback.

Table 50 presents a chi-square analysis of the frequency of performance of each task comparing Group I (Table 32) to Group II (Table 41) in the future. This comparison indicates that six (18%) of the tasks are perceived to be different between the two groups. This analysis identified five tasks that will be more frequently performed by Group I (engineers in leading companies) in the future. They are:

1. Identify Potentially Significant Variables
2. Establish Control Limits
3. Develop/Implement Acceptance Sampling Procedures
4. Motivate Subordinates and Peers
5. Organize Resources

Only one task, Assist Vendors with Quality System Development/Revision, was identified as being more frequently performed by Group II (engineers from nonleading companies) in the future.

Table 51 presents a chi-square analysis of the sum of the importance and the frequency of performance of each task comparing Group I to Group II in the future. In

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 50

Chi-Square Analysis for Frequency of Task Comparing Group I to Group II in the Future

	Chi Square	Critical Value (K)	x >K
Design Review			
1. Review quality specifications.	4.871	9.49	
2. Relate specifications to process.	5.845	9.49	
3. Identify potentially significant variables.	15.711	9.49	*
4. Develop pilot-run quality procedures.	8.793	9.49	
Process Capability			
1. Identify potential controlling variables.	2.905	9.49	
2. Develop/select statistical tests.	1.162	9.49	
3. Analyze statistical data.	7.058	9.49	
4. Develop/utilize computer data bases/programs.	6.521	9.49	
Process Control			
1. Develop/implement inspection/audit procedures.	4.010	9.49	
2. Develop/implement control chart procedures.	8.489	9.49	
3. Establish control limits.	14.472	9.49	*
4. Review/revise control procedures.	8.801	9.49	
5. Develop/revise control reporting procedures.	3.379	9.49	
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	12.937	9.49	*
2. Develop vendor quality systems.	7.287	9.49	
3. Assist vendors with quality system development/revision.	10.144	9.49	*
Customer Relations			
1. Develop/implement customer feedback systems.	5.463	9.49	
2. Analyze customer feedback.	1.866	9.49	
3. Trace variation through manufacturing system.	2.859	9.49	
Application			
1. Communication			
a. Write understandable reports/proposals.	2.017	7.82	
b. Speak/discuss clearly.	5.860	7.82	
2. Leadership			
a. Motivate subordinates and peers.	16.713	7.82	*
b. Delegate responsibilities.	1.121	9.49	
c. Perform training sessions.	2.640	7.82	
3. Management			
a. Plan activities.	6.993	7.82	
b. Organize resources.	8.648	7.82	*
4. Statistical			
a. Apply descriptive statistics.	8.387	9.49	
b. Apply inferential statistics.	8.199	9.49	
c. Design experiments.	2.054	9.49	
5. Computer			
a. Design/select computer programs.	2.679	9.49	
b. Utilize available software.	6.415	7.82	
6. Technical/Scientific			
a. Design/improve processes.	4.060	7.82	
b. Evaluate product materials.	1.253	9.49	
c. Apply design procedures.	6.830	9.49	

Note: Confidence interval is 95% (alpha=.05).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 51

Chi-Square Analysis for the Sum of Importance and Frequency Of Task Comparing Group I to Group II in the Future

	Chi Square	x >K (5.99)
Design Review		
1. Review quality specifications.	1.184	
2. Relate specifications to process.	.448	
3. Identify potentially significant variables.	2.827	
4. Develop pilot-run quality procedures.	2.411	
Process Capability		
1. Identify potential controlling variables.	.059	
2. Develop/select statistical tests.	3.526	
3. Analyze statistical data.	3.773	
4. Develop/utilize computer data bases/programs.	1.721	
Process Control		
1. Develop/implement inspection/audit procedures.	1.341	
2. Develop/implement control chart procedures.	4.052	
3. Establish control limits.	5.508	
4. Review/revise control procedures.	1.460	
5. Develop/revise control reporting procedures.	3.226	
Vendor Relations		
1. Develop/implement acceptance sampling procedures.	10.549	*
2. Develop vendor quality systems.	4.167	
3. Assist vendors with quality system development/revision.	3.704	
Customer Relations		
1. Develop/implement customer feedback systems.	.659	
2. Analyze customer feedback.	6.784	*
3. Trace variation through manufacturing system.	.640	
Application		
1. Communication		
a. Write understandable reports/proposals.	2.695	
b. Speak/discuss clearly.	5.946	
2. Leadership		
a. Motivate subordinates and peers.	5.619	
b. Delegate responsibilities.	.109	
c. Perform training sessions.	3.265	
3. Management		
a. Plan activities.	2.604	
b. Organize resources.	.448	
4. Statistical		
a. Apply descriptive statistics.	9.199	*
b. Apply inferential statistics.	8.347	*
c. Design experiments.	.269	
5. Computer		
a. Design/select computer programs.	3.028	
b. Utilize available software.	3.152	
6. Technical/Scientific		
a. Design/improve processes.	6.626	*
b. Evaluate product materials.	1.509	
c. Apply design procedures.	1.590	

Note: Confidence interval is 95% (alpha=.05).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

combining the importance and frequency elements it was found that five (15%) tasks were perceived to be different between Group I (engineers from leading companies) and Group II. This analysis identified two tasks rated higher by Group I (engineers in leading companies) in the future; Develop/Implement Acceptance Sampling Procedures and Apply Inferential Statistics. Three tasks were rated higher by Group II in the future. They are:

1. Analyze Customer Feedback
2. Apply Descriptive Statistics
3. Design/Improve Processes

Groups Combined

These data are presented because of the fact that there appeared to be little difference (15%) between Group I and Group II, especially when the two scales of importance and frequency were combined by summing their values. The combined samples provide a sample of 182 participants which will greatly increase the confidence in the value of the responses.

Raw Data for Individual Tasks

Table 52 presents the raw data for the importance of each task as predicted by both groups combined for the future. Table 53 presents the raw data for the frequency of performance of each task as predicted by both groups combined for the future. Table 54 presents the raw data

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 52

Raw Data for Importance of Tasks as Predicted by Both Groups Combined for the Future

	1	2	3	4	5	Total
Design Review						
1. Review quality specifications.	3	9	20	71	79	182
2. Relate specifications to process.	3	6	19	63	91	182
3. Identify potentially significant variables.	2	5	40	86	49	182
4. Develop pilot-run quality procedures.	2	27	67	56	30	182
Process Capability						
1. Identify potential controlling variables.	2	6	30	69	75	182
2. Develop/select statistical tests.	2	12	48	75	44	181
3. Analyze statistical data.	3	7	32	71	69	182
4. Develop/utilize computer data bases/programs.	2	14	47	70	49	182
Process Control						
1. Develop/implement inspection/audit procedures.	2	19	64	59	38	182
2. Develop/implement control chart procedures.	2	10	52	84	34	182
3. Establish control limits.	4	10	47	82	39	182
4. Review/revise control procedures.	2	9	46	92	33	182
5. Develop/revise control reporting procedures.	2	14	75	68	19	178
Vendor Relations						
1. Develop/implement acceptance sampling procedures.	8	29	70	49	25	181
2. Develop vendor quality systems.	8	14	34	66	59	181
3. Assist vendors with quality system development/revision.	5	9	33	83	51	181
Customer Relations						
1. Develop/implement customer feedback systems.	3	10	30	66	73	182
2. Analyze customer feedback.	2	11	28	64	77	182
3. Trace variation through manufacturing system.	2	8	28	105	39	182
Application						
1. Communication						
a. Write understandable reports/proposals.	0	3	11	46	122	182
b. Speak/discuss clearly.	0	4	7	51	120	182
2. Leadership						
a. Motivate subordinates and peers.	1	6	28	85	61	181
b. Delegate responsibilities.	2	5	33	97	45	182
c. Perform training sessions.	2	4	35	76	65	182
3. Management						
a. Plan activities.	0	4	23	92	63	182
b. Organize resources.	0	4	22	90	66	182
4. Statistical						
a. Apply descriptive statistics.	3	4	32	99	41	179
b. Apply inferential statistics.	3	8	56	86	26	179
c. Design experiments.	2	8	44	76	49	179
5. Computer						
a. Design/select computer programs.	3	22	67	73	17	182
b. Utilize available software.	0	10	38	83	50	181
6. Technical/Scientific						
a. Design/improve processes.	0	8	22	72	80	182
b. Evaluate product materials.	2	10	38	92	40	182
c. Apply design procedures.	5	9	62	80	26	182

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 53

Raw Data for Frequency of Performance of Tasks as Predicted By Both Groups Combined for the Future

	1	2	3	4	5	Total
Design Review						
1. Review quality specifications.	5	16	76	57	28	182
2. Relate specifications to process.	4	14	66	65	33	182
3. Identify potentially significant variables.	5	18	64	70	25	182
4. Develop pilot-run quality procedures.	10	60	63	33	16	182
Process Capability						
1. Identify potential controlling variables.	3	25	52	72	30	182
2. Develop/select statistical tests.	3	23	77	61	17	181
3. Analyze statistical data.	2	11	45	68	56	182
4. Develop/utilize computer data bases/programs.	5	20	40	71	46	182
Process Control						
1. Develop/implement inspection/audit procedures.	4	33	67	59	19	182
2. Develop/implement control chart procedures.	6	27	66	63	20	182
3. Establish control limits.	6	24	72	57	23	182
4. Review/revise control procedures.	2	30	60	69	21	182
5. Develop/revise control reporting procedures.	3	43	88	34	10	178
Vendor Relations						
1. Develop/implement acceptance sampling procedures.	13	44	72	36	16	181
2. Develop vendor quality systems.	16	33	57	43	32	181
3. Assist vendors with quality system development/revision.	10	42	44	55	30	181
Customer Relations						
1. Develop/implement customer feedback systems.	10	33	50	62	27	182
2. Analyze customer feedback.	7	23	43	73	36	182
3. Trace variation through manufacturing system.	5	23	60	82	12	182
Application						
1. Communication						
a. Write understandable reports/proposals.	0	7	26	72	77	182
b. Speak/discuss clearly.	0	8	17	65	92	182
2. Leadership						
a. Motivate subordinates and peers.	2	14	40	87	38	181
b. Delegate responsibilities.	5	12	63	81	21	182
c. Perform training sessions.	1	19	53	71	38	182
3. Management						
a. Plan activities.	1	12	47	84	38	182
b. Organize resources.	1	13	49	82	37	182
4. Statistical						
a. Apply descriptive statistics.	3	17	55	71	33	179
b. Apply inferential statistics.	2	32	69	58	18	179
c. Design experiments.	6	39	51	59	24	179
5. Computer						
a. Design/select computer programs.	8	60	50	50	14	182
b. Utilize available software.	1	20	56	67	37	181
6. Technical/Scientific						
a. Design/improve processes.	5	21	52	80	24	182
b. Evaluate product materials.	5	31	49	77	20	182
c. Apply design procedures.	12	36	73	46	15	182

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 54

Raw Data for Grouped Scales for the Sum of Importance and Frequency of Tasks as Predicted by Both Groups Combined For the Future

	2-4	5-7	8-10	Total
Design Review				
1. Review quality specifications.	10	65	107	182
2. Relate specifications to process.	7	56	119	182
3. Identify potentially significant variables.	4	86	92	182
4. Develop pilot-run quality procedures.	27	106	49	182
Process Capability				
1. Identify potential controlling variables.	7	65	130	182
2. Develop/select statistical tests.	8	94	79	181
3. Analyze statistical data.	7	54	121	182
4. Develop/utilize computer data bases/programs.	12	69	101	182
Process Control				
1. Develop/implement inspection/audit procedures.	17	93	72	182
2. Develop/implement control chart procedures.	11	94	77	182
3. Establish control limits.	12	91	79	182
4. Review/revise control procedures.	8	89	85	182
5. Develop/revise control reporting procedures.	14	118	46	178
Vendor Relations				
1. Develop/implement acceptance sampling procedures.	30	106	45	181
2. Develop vendor quality systems.	18	84	79	181
3. Assist vendors with quality system development/revision.	16	78	87	181
Customer Relations				
1. Develop/implement customer feedback systems.	11	75	96	182
2. Analyze customer feedback.	11	58	113	182
3. Trace variation through manufacturing system.	9	79	94	182
Application				
1. Communication				
a. Write understandable reports/proposals.	1	21	160	182
b. Speak/discuss clearly.	3	16	163	182
2. Leadership				
a. Motivate subordinates and peers.	6	48	127	181
b. Delegate responsibilities.	5	76	101	182
c. Perform training sessions.	5	65	112	182
3. Management				
a. Plan activities.	4	55	123	182
b. Organize resources.	4	53	125	182
4. Statistical				
a. Apply descriptive statistics.	7	72	100	179
b. Apply inferential statistics.	9	100	70	179
c. Design experiments.	11	90	78	179
5. Computer				
a. Design/select computer programs.	20	114	48	182
b. Utilize available software.	7	74	100	181
6. Technical/Scientific				
a. Design/improve processes.	8	63	111	182
b. Evaluate product materials.	12	74	96	182
c. Apply design procedures	14	104	64	182

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

for the grouped scales of the sum of the importance and the frequency of each task as predicted by both groups combined for the future.

Mean and Rank Order of Individual Tasks

Table 55 identifies the mean and rank order of the importance of each task as predicted by both groups combined for the future. Write Understandable Reports/Proposals and Speak/Discuss Clearly were ranked first. Develop/Implement Acceptance Sampling Procedures was ranked last among the 34 tasks. Table 56 identifies the mean and rank order of the frequency of performance of each task as predicted by both groups combined for the future. Speak/Discuss Clearly was ranked first, while Develop Pilot-Run Quality Procedures was ranked last. A comparison of importance (Table 55) to frequency of performance (Table 56) indicates that the important tasks are performed most frequently. Four tasks do not appear to follow that rule. Three tasks are ranked considerably higher for importance than they are for frequency. They are:

1. Review Quality Specifications
2. Develop Customer Feedback Systems
3. Design/Improve Processes

On the other hand, Develop/Utilize Computer Data Bases is ranked considerably higher for frequency than it is for importance.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 55

Mean and Rank Order of Importance of Tasks as Predicted by Both Groups Combined for the Future

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	182	4.176	6.5
2. Relate specifications to process.	182	4.291	3
3. Identify potentially significant variables.	182	3.956	15.5
4. Develop pilot-run quality procedures.	182	3.467	32
Process Capability			
1. Identify potential controlling variables.	182	4.148	8
2. Develop/select statistical tests.	181	3.812	24
3. Analyze statistical data.	182	4.077	12.5
4. Develop/utilize computer data bases/programs.	182	3.824	23
Process Control			
1. Develop/implement inspection/audit procedures.	182	3.615	30
2. Develop/implement control chart procedures.	182	3.758	27
3. Establish control limits.	182	3.780	26
4. Review/revise control procedures.	182	3.797	25
5. Develop/revise control reporting procedures.	178	3.494	31
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	181	3.298	34
2. Develop vendor quality systems.	181	3.851	22
3. Assist vendors with quality system development/revision.	181	3.917	19
Customer Relations			
1. Develop/implement customer feedback systems.	182	4.077	12.5
2. Analyze customer feedback.	182	4.115	9
3. Trace variation through manufacturing system.	182	3.940	18
Application			
1. Communication			
a. Write understandable reports/proposals.	182	4.577	1.5
b. Speak/discuss clearly.	182	4.577	1.5
2. Leadership			
a. Motivate subordinates and peers.	181	4.099	10
b. Delegate responsibilities.	182	3.978	14
c. Perform training sessions.	182	4.088	11
3. Management			
a. Plan activities.	182	4.176	6.5
b. Organize resources.	182	4.198	5
4. Statistical			
a. Apply descriptive statistics.	179	3.955	17
b. Apply inferential statistics.	179	3.693	28
c. Design experiments.	179	3.905	20
5. Computer			
a. Design/select computer programs.	182	3.434	33
b. Utilize available software.	181	3.956	15.5
6. Technical/Scientific			
a. Design/improve processes.	182	4.231	4
b. Evaluate product materials.	182	3.868	21
c. Apply design procedures.	182	3.621	29

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 56

Mean and Rank Order of Frequency of Tasks as Predicted by Both Groups Combined for the Future

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	182	3.478	17
2. Relate specifications to process.	182	3.599	11
3. Identify potentially significant variables.	182	3.505	16
4. Develop pilot-run quality procedures.	182	2.918	34
Process Capability			
1. Identify potential controlling variables.	182	3.555	13.5
2. Develop/select statistical tests.	181	3.365	22
3. Analyze statistical data.	182	3.907	3
4. Develop/utilize computer data bases/programs.	182	3.731	7
Process Control			
1. Develop/implement inspection/audit procedures.	182	3.308	27
2. Develop/implement control chart procedures.	182	3.352	23
3. Establish control limits.	182	3.368	21
4. Review/revise control procedures.	182	3.423	18
5. Develop/revise control reporting procedures.	178	3.028	31
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	181	2.989	33
2. Develop vendor quality systems.	181	3.232	29
3. Assist vendors with quality system development/revision.	181	3.293	28
Customer Relations			
1. Develop/implement customer feedback systems.	182	3.346	24
2. Analyze customer feedback.	182	3.593	12
3. Trace variation through manufacturing system.	182	3.401	20
Application			
1. Communication			
a. Write understandable reports/proposals.	182	4.203	2
b. Speak/discuss clearly.	182	4.324	1
2. Leadership			
a. Motivate subordinates and peers.	181	3.801	5
b. Delegate responsibilities.	182	3.555	13.5
c. Perform training sessions.	182	3.692	8
3. Management			
a. Plan activities.	182	3.802	4
b. Organize resources.	182	3.775	6
4. Statistical			
a. Apply descriptive statistics.	179	3.637	10
b. Apply inferential statistics.	179	3.324	25
c. Design experiments.	179	3.313	26
5. Computer			
a. Design/select computer programs.	182	3.011	32
b. Utilize available software.	181	3.657	9
6. Technical/Scientific			
a. Design/improve processes.	182	3.533	15
b. Evaluate product materials.	182	3.418	19
c. Apply design procedures.	182	3.088	30

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 57 identifies the mean and rank order of the sum of the importance and frequency of tasks as predicted by both groups combined for the future. It reaffirms Speak/Discuss Clearly as number one. Develop/Implement Acceptance Sampling Procedures is ranked number 34. A three way comparison of Tables 55, 56, and 57 provides an interesting perspective on two tasks. Identify Potentially Significant Variables and Delegate Responsibilities are both ranked lower overall (Table 57) than they are on either of the two individual scales of importance and frequency of performance.

Mean and Rank Order of Task Categories

Table 58 identifies the mean and rank order of each task category as predicted by both groups combined for the future. The category Customer Relations was ranked first. Two categories, Process Control and Vendor Relations, were ranked last. Table 59 identifies the mean and rank order of the frequency of performance of each task category as predicted by both groups combined for the future. Process Capability was ranked first while Vendor Relations was ranked last. A comparison of importance (Table 58) to frequency of performance (Table 59) provides an interesting perspective of two task categories. Process Capability is ranked four of six on importance and one of six on frequency. It appears that the most frequently

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 57

Mean and Rank Order of the Sum of the Importance and Frequency of Tasks as Predicted by Both Groups Combined for the Future

	Sample	Mean	Rank
Design Review			
1. Review quality specifications.	182	7.654	12
2. Relate specifications to process.	182	7.890	7
3. Identify potentially significant variables.	182	7.462	17
4. Develop pilot-run quality procedures.	182	6.385	33
Process Capability			
1. Identify potential controlling variables.	182	7.703	11
2. Develop/select statistical tests.	181	7.177	24
3. Analyze statistical data.	182	7.984	3
4. Develop/utilize computer data bases/programs.	182	7.555	15
Process Control			
1. Develop/implement inspection/audit procedures.	182	6.923	29
2. Develop/implement control chart procedures.	182	7.110	26
3. Establish control limits.	182	7.148	25
4. Review/revise control procedures.	182	7.220	21
5. Develop/revise control reporting procedures.	178	6.522	31
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	181	6.287	34
2. Develop vendor quality systems.	181	7.083	27
3. Assist vendors with quality system development/revision.	181	7.210	23
Customer Relations			
1. Develop/implement customer feedback systems.	182	7.423	18
2. Analyze customer feedback.	182	7.709	10
3. Trace variation through manufacturing system.	182	7.341	19
Application			
1. Communication			
a. Write understandable reports/proposals.	182	8.780	2
b. Speak/discuss clearly.	182	8.901	1
2. Leadership			
a. Motivate subordinates and peers.	181	7.901	6
b. Delegate responsibilities.	182	7.533	16
c. Perform training sessions.	182	7.780	8
3. Management			
a. Plan activities.	182	7.978	4
b. Organize resources.	182	7.973	5
4. Statistical			
a. Apply descriptive statistics.	179	7.592	14
b. Apply inferential statistics.	179	7.017	28
c. Design experiments.	179	7.218	22
5. Computer			
a. Design/select computer programs.	182	6.445	32
b. Utilize available software.	181	7.613	13
6. Technical/Scientific			
a. Design/improve processes.	182	7.764	9
b. Evaluate product materials.	182	7.286	20
c. Apply design procedures.	182	6.709	30

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 58

Mean and Rank Order of Importance of Task Categories as Predicted by Both Groups Combined for the Future

	Mean	Rank
Design Review	3.973	3
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	3.965	4
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	3.689	5.5
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	3.689	5.5
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	4.044	1
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	4.024	2
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: 1=not important; 2=somewhat important; 3=important; 4=very important; 5=imperative.

performed category is considerably less than the most important. Vendor Relations, the most important category, is performed considerably less than the most frequent.

Table 60 identifies the mean and rank order of the sum of the importance and the frequency of each task category as predicted by both groups combined for the future. The

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 59

Mean and Rank Order of Frequency of Task Categories as Predicted by Both Groups Combined for the Future

	Mean	Rank
Design Review	3.375	4
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	3.640	1
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	3.296	5
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	3.171	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	3.447	3
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	3.609	2
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: 1=never; 2=seldom; 3=somewhat frequently; 4=frequently; 5=very frequently.

task category Application was again ranked first and Vendor Relations was again ranked last. A three way comparison of Tables 58, 59, and 60 provides no apparent differences between importance, frequency, and overall rankings.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 60

Mean and Rank Order of the Sum of Importance and Frequency Of Task Categories as Predicted by Both Groups Combined For the Future

	Mean	Rank
Design Review	7.348	4
1. Review quality specifications.		
2. Relate specifications to process.		
3. Identify potentially significant variables.		
4. Develop pilot-run quality procedures.		
Process Capability	7.605	2
1. Identify potential controlling variables.		
2. Develop/select statistical tests.		
3. Analyze statistical data.		
4. Develop/utilize computer data bases/programs.		
Process Control	6.985	5
1. Develop/implement inspection/audit procedures.		
2. Develop/implement control chart procedures.		
3. Establish control limits.		
4. Review/revise control procedures.		
5. Develop/revise control reporting procedures.		
Vendor Relations	6.860	6
1. Develop/implement acceptance sampling procedures.		
2. Develop vendor quality systems.		
3. Assist vendors with quality system development/revision.		
Customer Relations	7.491	3
1. Develop/implement customer feedback systems.		
2. Analyze customer feedback.		
3. Trace variation through manufacturing system.		
Application	7.633	1
1. Communication		
2. Leadership		
3. Management		
4. Statistical		
5. Computer		
6. Technical/Scientific		

Note: Sum of the importance and frequency scales grouped where 2 is not important and never performed and 10 is imperative and very frequently performed.

Chi-square Comparison Present to Future

This section of the findings is directed to two research questions:

1. Is there a statistically significant difference between the perception of the tasks performed within each group between the present and the future?

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

2. Is there a statistically significant difference in the perceptions of the tasks performed by both groups combined, treating the two groups as if they were one, between the present and the future?

Table 61 presents a chi-square analysis of the importance of each task comparing Group I in the present (Table 1) to Group I (Table 31) in the future. The comparison indicates that 11 (32%) of the tasks are perceived to be different between the present and the future. Engineers of leading companies considered all 11 of these tasks to be more important in the future. They are:

1. Identify Potential Controlling Variables
2. Develop/Utilize Computer Data Bases/Programs
3. Develop/Revise Control Procedures
4. Speak/Discuss Clearly
5. Delegate Responsibilities
6. Perform Training Sessions
7. Organize Resources
8. Apply Inferential Statistics
9. Utilize Available Software
10. Evaluate Product Materials
11. Apply Design Procedures

Table 62 presents a chi-square analysis of the frequency of performance of each task comparing Group I present (Table 2) to Group I in the future (Table 32).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 61

Chi-Square Analysis for Importance of Task Comparing Group I Present to Group I Future

	Chi Square	Critical Value (K)	x >K
Design Review			
1. Review quality specifications.	9.235	9.49	
2. Relate specifications to process.	1.754	9.49	
3. Identify potentially significant variables.	6.362	9.49	
4. Develop pilot-run quality procedures.	9.374	9.49	
Process Capability			
1. Identify potential controlling variables.	13.999	9.49	*
2. Develop/select statistical tests.	1.351	9.49	
3. Analyze statistical data.	2.275	9.49	
4. Develop/utilize computer data bases/programs.	9.756	9.49	*
Process Control			
1. Develop/implement inspection/audit procedures.	7.325	9.49	
2. Develop/implement control chart procedures.	1.825	9.49	
3. Establish control limits.	6.057	9.49	
4. Review/revise control procedures.	10.098	9.49	*
5. Develop/revise control reporting procedures.	4.626	9.49	
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	6.346	9.49	
2. Develop vendor quality systems.	4.742	9.49	
3. Assist vendors with quality system development/revision.	5.778	9.49	
Customer Relations			
1. Develop/implement customer feedback systems.	6.130	9.49	
2. Analyze customer feedback.	5.186	9.49	
3. Trace variation through manufacturing system.	7.848	9.49	
Application			
1. Communication			
a. Write understandable reports/proposals.	7.657	7.82	
b. Speak/discuss clearly.	9.790	7.82	*
2. Leadership			
a. Motivate subordinates and peers.	3.249	7.82	
b. Delegate responsibilities.	15.564	7.82	*
c. Perform training sessions.	13.396	9.49	*
3. Management			
a. Plan activities.	4.950	7.82	
b. Organize resources.	12.527	7.82	*
4. Statistical			
a. Apply descriptive statistics.	6.749	9.49	
b. Apply inferential statistics.	10.334	9.49	*
c. Design experiments.	3.141	7.82	
5. Computer			
a. Design/select computer programs.	7.013	7.82	
b. Utilize available software.	8.854	7.82	*
6. Technical/Scientific			
a. Design/improve processes.	7.546	7.82	
b. Evaluate product materials.	10.479	9.49	*
c. Apply design procedures.	11.002	7.82	*

Note: Confidence interval is 95% (alpha=.05).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 62

Chi-Square Analysis for Frequency of Task Comparing Group I Present to Group I Future

	Chi Square	Critical Value (K)	x >K
Design Review			
1. Review quality specifications.	4.478	9.49	
2. Relate specifications to process.	10.293	9.49	*
3. Identify potentially significant variables.	16.144	9.49	*
4. Develop pilot-run quality procedures.	20.853	9.49	*
Process Capability			
1. Identify potential controlling variables.	16.259	9.49	*
2. Develop/select statistical tests.	3.099	9.49	*
3. Analyze statistical data.	2.271	7.82	
4. Develop/utilize computer data bases/programs.	10.876	9.49	*
Process Control			
1. Develop/implement inspection/audit procedures.	1.880	9.49	
2. Develop/implement control chart procedures.	9.132	9.49	
3. Establish control limits.	15.804	9.49	*
4. Review/revise control procedures.	23.988	9.49	*
5. Develop/revise control reporting procedures.	8.033	9.49	
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	16.726	9.49	*
2. Develop vendor quality systems.	20.742	9.49	*
3. Assist vendors with quality system development/revision.	18.222	9.49	*
Customer Relations			
1. Develop/implement customer feedback systems.	20.296	9.49	*
2. Analyze customer feedback.	16.593	9.49	*
3. Trace variation through manufacturing system.	22.479	9.49	*
Application			
1. Communication			
a. Write understandable reports/proposals.	3.897	7.82	
b. Speak/discuss clearly.	2.289	7.82	
2. Leadership			
a. Motivate subordinates and peers.	9.777	7.82	*
b. Delegate responsibilities.	12.581	9.49	*
c. Perform training sessions.	19.887	7.82	*
3. Management			
a. Plan activities.	7.552	9.49	
b. Organize resources.	9.369	9.49	
4. Statistical			
a. Apply descriptive statistics.	3.499	9.49	
b. Apply inferential statistics.	17.149	9.49	*
c. Design experiments.	18.655	9.49	*
5. Computer			
a. Design/select computer programs.	14.298	9.49	*
b. Utilize available software.	4.520	9.49	
6. Technical/Scientific			
a. Design/improve processes.	15.367	9.49	*
b. Evaluate product materials.	18.721	9.49	*
c. Apply design procedures.	19.398	9.49	*

Note: Confidence interval is 95% (alpha=.05).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

This comparison indicates that 23 (68%) of the tasks are perceived to be different between the present and the future. Engineers of leading companies forecasted that all 23 of these tasks would be performed more frequently in the future. They are:

1. Relate Specifications to Process
2. Identify Potential Significant Variables
3. Develop Pilot-Run Quality Procedures
4. Identify Potential Controlling Variables
5. Develop/Select Statistical Tests
6. Develop/Utilize Computer Data Bases/Programs
7. Establish Control Limits
8. Review/Revise Control Procedures
9. Develop/Select Acceptance Sampling Procedures
10. Develop Vendor Quality Systems
11. Assist Vendors with Quality System Development/Revision
12. Develop/Implement Customer Feedback Systems
13. Analyze Customer Feedback
14. Trace Variation Through Manufacturing System
15. Motivate Subordinates and Peers
16. Delegate Responsibilities
17. Perform Training Sessions
18. Apply Inferential Statistics
19. Design Experiments
20. Design/Select Computer Programs

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

21. Design/Improve Processes

22. Evaluate Product Materials

23. Apply Design Procedures

Table 63 presents a chi-square analysis of the sum of the importance and the frequency of performance of each task comparing Group I in the present (Table 3) to Group I in the future (Table 33). The results of this comparison are similar to those made for importance (Table 61) and for frequency of performance (Table 62), with one interesting exception. Plan Activities had not previously been forecast to change, but is now expected to be more important and more frequently performed in the future.

Table 64 presents a chi-square analysis of the importance of each task comparing Group II in the present (Table 10) to Group II in the future (Table 40). The comparison indicates that 17 (50%) of the tasks are perceived to be different between the present and the future. Engineers of nonleading companies forecasted that all 17 of these tasks would be more important in the future. They are:

1. Review Quality Specifications
2. Identify Potential Controlling Variables
3. Develop/Implement Control Chart Procedures
4. Establish Control Limits
5. Develop Vendor Quality Systems

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 63

Chi-Square Analysis for the Sum of Importance and Frequency of Task Comparing Group I Present to Group I Future

	Chi Square	x >K (5.99)
Design Review		
1. Review quality specifications.	4.306	
2. Relate specifications to process.	12.424	*
3. Identify potentially significant variables.	8.602	*
4. Develop pilot-run quality procedures.	13.960	*
Process Capability		
1. Identify potential controlling variables.	16.170	*
2. Develop/select statistical tests.	1.263	
3. Analyze statistical data.	.265	
4. Develop/utilize computer data bases/programs.	5.331	
Process Control		
1. Develop/implement inspection/audit procedures.	2.107	
2. Develop/implement control chart procedures.	2.820	
3. Establish control limits.	8.872	*
4. Review/revise control procedures.	20.281	*
5. Develop/revise control reporting procedures.	5.376	
Vendor Relations		
1. Develop/implement acceptance sampling procedures.	11.415	*
2. Develop vendor quality systems.	11.503	*
3. Assist vendors with quality system development/revision.	10.061	*
Customer Relations		
1. Develop/implement customer feedback systems.	9.424	*
2. Analyze customer feedback.	7.450	*
3. Trace variation through manufacturing system.	15.578	*
Application		
1. Communication		
a. Write understandable reports/proposals.	4.695	
b. Speak/discuss clearly.	3.925	
2. Leadership		
a. Motivate subordinates and peers.	9.472	*
b. Delegate responsibilities.	10.245	*
c. Perform training sessions.	15.987	*
3. Management		
a. Plan activities.	7.965	*
b. Organize resources.	10.947	*
4. Statistical		
a. Apply descriptive statistics.	.538	
b. Apply inferential statistics.	11.578	*
c. Design experiments.	7.844	*
5. Computer		
a. Design/select computer programs.	6.229	*
b. Utilize available software.	3.958	
6. Technical/Scientific		
a. Design/improve processes.	10.234	*
b. Evaluate product materials.	12.268	*
c. Apply design procedures.	17.162	*

Note: Confidence interval is 95% (alpha=.05).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 64

Chi-Square Analysis for Importance of Task Comparing Group II Present to Group II Future

	Chi Square	Critical Value (K)	x >K
Design Review			
1. Review quality specifications.	13.379	9.49	*
2. Relate specifications to process.	9.472	9.49	
3. Identify potentially significant variables.	6.919	9.49	
4. Develop pilot-run quality procedures.	7.944	9.49	
Process Capability			
1. Identify potential controlling variables.	9.597	9.49	*
2. Develop/select statistical tests.	6.007	9.49	
3. Analyze statistical data.	5.975	9.49	
4. Develop/utilize computer data bases/programs.	14.146	9.49	
Process Control			
1. Develop/implement inspection/audit procedures.	3.643	9.49	
2. Develop/implement control chart procedures.	11.748	9.49	*
3. Establish control limits.	10.991	9.49	*
4. Review/revise control procedures.	5.480	9.49	
5. Develop/revise control reporting procedures.	8.931	9.49	
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	5.322	9.49	
2. Develop vendor quality systems.	14.802	9.49	*
3. Assist vendors with quality system development/revision.	20.426	9.49	*
Customer Relations			
1. Develop/implement customer feedback systems.	11.051	9.49	*
2. Analyze customer feedback.	17.303	9.49	*
3. Trace variation through manufacturing system.	12.810	9.49	*
Application			
1. Communication			
a. Write understandable reports/proposals.	10.263	5.99	*
b. Speak/discuss clearly.	6.203	5.99	*
2. Leadership			
a. Motivate subordinates and peers.	3.519	7.82	
b. Delegate responsibilities.	7.549	9.49	
c. Perform training sessions.	8.545	9.49	
3. Management			
a. Plan activities.	3.056	7.82	
b. Organize resources.	2.672	7.82	
4. Statistical			
a. Apply descriptive statistics.	13.068	9.49	*
b. Apply inferential statistics.	16.163	9.49	*
c. Design experiments.	11.708	9.49	*
5. Computer			
a. Design/select computer programs.	8.196	9.49	
b. Utilize available software.	9.592	7.82	*
6. Technical/Scientific			
a. Design/improve processes.	12.322	7.82	*
b. Evaluate product materials.	8.119	9.49	
c. Apply design procedures.	18.905	9.49	*

Note: Confidence interval is 95% (alpha=.05).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

6. Assist Vendors with Quality System Development/Revision
7. Develop/Implement Customer Feedback Systems
8. Analyze Customer Feedback
9. Trace Variation Through Manufacturing System
10. Write Understandable Reports/Propoals
11. Speak/Discuss Clearly
12. Apply Descriptive Statistics
13. Apply Inferential Statistics
14. Design Experiments
15. Utilize Available Software
16. Design/Improve Processes
17. Apply Design Procedures

Table 65 presents a chi-square analysis of the frequency of performance of each task comparing Group II in the present (Table 11) to Group II in the future (Table 41). This comparison indicates that 20 (59%) of the tasks are perceived to be more frequently performed in the future. These 20 tasks include eight which were not included on the importance list. They are:

1. Relate Specifications to Process
2. Develop Pilot-Run Quality Procedures
3. Develop/Select Statistical Tests
4. Analyze Statistical Data
5. Develop/Utilize Computer Data Bases/Programs
6. Motivate Subordinates and Peers

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 65

Chi-Square Analysis for Frequency of Task Comparing Group II Present to Group II Future

	Chi Square	Critical Value (K)	x >K
Design Review			
1. Review quality specifications.	7.175	9.49	
2. Relate specifications to process.	15.826	9.49	*
3. Identify potentially significant variables.	7.462	9.49	
4. Develop pilot-run quality procedures.	12.883	9.49	*
Process Capability			
1. Identify potential controlling variables.	13.092	9.49	*
2. Develop/select statistical tests.	11.024	9.49	*
3. Analyze statistical data.	13.374	9.49	*
4. Develop/utilize computer data bases/programs.	14.501	9.49	*
Process Control			
1. Develop/implement inspection/audit procedures.	9.135	9.49	
2. Develop/implement control chart procedures.	13.681	9.49	*
3. Establish control limits.	9.512	9.49	
4. Review/revise control procedures.	6.697	9.49	
5. Develop/revise control reporting procedures.	3.212	9.49	
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	6.856	9.49	
2. Develop vendor quality systems.	12.284	9.49	*
3. Assist vendors with quality system development/revision.	23.488	9.49	*
Customer Relations			
1. Develop/implement customer feedback systems.	12.326	9.49	*
2. Analyze customer feedback.	13.917	9.49	*
3. Trace variation through manufacturing system.	22.842	9.49	*
Application			
1. Communication			
a. Write understandable reports/proposals.	1.572	7.82	
b. Speak/discuss clearly.	5.898	7.82	
2. Leadership			
a. Motivate subordinates and peers.	17.245	7.82	*
b. Delegate responsibilities.	15.882	9.49	*
c. Perform training sessions.	10.869	9.49	*
3. Management			
a. Plan activities.	.280	7.82	
b. Organize resources.	1.643	7.82	
4. Statistical			
a. Apply descriptive statistics.	13.250	9.49	*
b. Apply inferential statistics.	18.502	9.49	*
c. Design experiments.	27.916	9.49	*
5. Computer			
a. Design/select computer programs.	4.733	9.49	
b. Utilize available software.	11.238	7.82	*
6. Technical/Scientific			
a. Design/improve processes.	9.022	7.82	*
b. Evaluate product materials.	5.317	9.49	
c. Apply design procedures.	7.765	9.49	

Note: Confidence interval is 95% (alpha=.05).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

7. Delegate Responsibilities
8. Perform Training Sessions

Table 66 presents a chi-square analysis of the sum of the importance and the frequency of performance of each task comparing Group II in the present (Table 12) to Group II in the future (Table 42). The results of this comparison are very similar to those made for importance (Table 64) and for frequency of performance (Table 65), with one exception. Identify Potentially Significant Variables, which had not been forecast to increase in importance or frequency, is now forecast to increase in the future.

Table 67 presents a chi-square analysis of the importance of each task comparing both groups combined in the present (Table 22) to both groups combined in the future (Table 52). The comparison indicates that 27 (79%) of the tasks were considered to be more important in the future. There were, therefore, seven tasks which were not forecast to be more important in the future. They are:

1. Identify Potentially Significant Variables
2. Develop/Select Statistical Tests
3. Analyze Statistical Data
4. Establish Control Limits
5. Motivate Subordinates and Peers
6. Perform Training Sessions
7. Plan Activities

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 66

Chi-Square Analysis for the Sum of Importance and Frequency of Task Comparing Group II Present to Group II Future

	Chi Square	x >K (5.99)
Design Review		
1. Review quality specifications.	7.802	*
2. Relate specifications to process.	11.896	*
3. Identify potentially significant variables.	7.767	*
4. Develop pilot-run quality procedures.	6.440	*
Process Capability		
1. Identify potential controlling variables.	5.433	
2. Develop/select statistical tests.	8.122	*
3. Analyze statistical data.	12.420	*
4. Develop/utilize computer data bases/programs.	9.781	*
Process Control		
1. Develop/implement inspection/audit procedures.	2.558	
2. Develop/implement control chart procedures.	11.108	*
3. Establish control limits.	5.403	
4. Review/revise control procedures.	3.750	
5. Develop/revise control reporting procedures.	5.353	
Vendor Relations		
1. Develop/implement acceptance sampling procedures.	4.544	
2. Develop vendor quality systems.	12.452	*
3. Assist vendors with quality system development/revision.	20.802	*
Customer Relations		
1. Develop/implement customer feedback systems.	10.769	*
2. Analyze customer feedback.	17.727	*
3. Trace variation through manufacturing system.	12.482	*
Application		
1. Communication		
a. Write understandable reports/proposals.	7.743	*
b. Speak/discuss clearly.	10.347	*
2. Leadership		
a. Motivate subordinates and peers.	1.410	
b. Delegate responsibilities.	3.249	
c. Perform training sessions.	6.164	*
3. Management		
a. Plan activities.	.334	
b. Organize resources.	2.240	
4. Statistical		
a. Apply descriptive statistics.	13.740	*
b. Apply inferential statistics.	10.500	*
c. Design experiments.	14.535	*
5. Computer		
a. Design/select computer programs.	2.824	
b. Utilize available software.	6.190	*
6. Technical/Scientific		
a. Design/improve processes.	11.018	*
b. Evaluate product materials.	5.465	
c. Apply design procedures.	10.984	*

Note: Confidence interval is 95% (alpha=.05).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 67

Chi-Square Analysis for Importance of Task Comparing Both Groups Combined Present to Both Groups Combined Future

	Chi Square	Critical Value (K)	x >K
Design Review			
1. Review quality specifications.	16.593	9.49	*
2. Relate specifications to process.	9.574	9.49	*
3. Identify potentially significant variables.	8.450	9.49	
4. Develop pilot-run quality procedures.	13.846	9.49	*
Process Capability			
1. Identify potential controlling variables.	22.274	9.49	*
2. Develop/select statistical tests.	5.642	9.49	
3. Analyze statistical data.	5.316	9.49	
4. Develop/utilize computer data bases/programs.	19.618	9.49	*
Process Control			
1. Develop/implement inspection/audit procedures.	10.544	9.49	*
2. Develop/implement control chart procedures.	11.185	9.49	*
3. Establish control limits.	7.576	9.49	
4. Review/revise control procedures.	11.187	9.49	*
5. Develop/revise control reporting procedures.	12.445	9.49	*
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	10.349	9.49	*
2. Develop vendor quality systems.	17.898	9.49	*
3. Assist vendors with quality system development/revision.	24.862	9.49	*
Customer Relations			
1. Develop/implement customer feedback systems.	16.136	9.49	*
2. Analyze customer feedback.	16.289	9.49	*
3. Trace variation through manufacturing system.	19.132	9.49	*
Application			
1. Communication			
a. Write understandable reports/proposals.	16.802	7.82	*
b. Speak/discuss clearly.	12.764	7.82	*
2. Leadership			
a. Motivate subordinates and peers.	.345	7.82	
b. Delegate responsibilities.	13.162	9.49	*
c. Perform training sessions.	9.336	9.49	
3. Management			
a. Plan activities.	5.812	7.82	
b. Organize resources.	11.886	7.82	*
4. Statistical			
a. Apply descriptive statistics.	18.852	9.49	*
b. Apply inferential statistics.	19.744	9.49	*
c. Design experiments.	14.253	9.49	*
5. Computer			
a. Design/select computer programs.	13.837	9.49	*
b. Utilize available software.	18.066	7.82	*
6. Technical/Scientific			
a. Design/improve processes.	19.763	7.82	*
b. Evaluate product materials.	18.168	9.49	*
c. Apply design procedures.	16.268	9.49	*

Note: Confidence interval is 95% (alpha=.05).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 68 presents a chi-square analysis of the frequency of performance of each task comparing both groups combined in the present (Table 23) to both groups combined in the future (Table 53). The comparison indicates that 27 (79%) of the tasks would be performed more frequently in the future. There were, therefore, seven tasks which were not forecast to be performed more frequently in the future. They are:

1. Review Quality Specifications
2. Develop/Implement Inspection/Audit Procedures
3. Write Understandable Reports/Proposals
4. Speak/Discuss Clearly
5. Motivate Subordinates and Peers
6. Plan Activities
7. Organize Resources

Table 69 presents a chi-square analysis for the sum of the importance and frequency of each task comparing both groups combined in the present (Table 24) to both groups combined in the future (Table 54). The comparison indicates that the combined groups expect 31 (97%) of the 34 tasks to be more important and performed more frequently in the future. There were, therefore, three tasks which were not forecast to be more important and performed more frequently in the future. They are:

1. Develop/Implement Inspection/Audit Procedures
2. Motivate Subordinates and Peers

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 68

Chi-Square Analysis for Frequency of Task Comparing Both Groups Combined Present to Both Groups Combined Future

	Chi Square	Critical Value (K)	x >K
Design Review			
1. Review quality specifications.	9.328	9.49	
2. Relate specifications to process.	22.382	9.49	*
3. Identify potentially significant variables.	15.393	9.49	*
4. Develop pilot-run quality procedures.	21.753	9.49	*
Process Capability			
1. Identify potential controlling variables.	24.932	9.49	*
2. Develop/select statistical tests.	12.407	9.49	*
3. Analyze statistical data.	13.256	9.49	*
4. Develop/utilize computer data bases/programs.	24.549	9.49	*
Process Control			
1. Develop/implement inspection/audit procedures.	6.912	9.49	
2. Develop/implement control chart procedures.	15.674	9.49	*
3. Establish control limits.	16.948	9.49	*
4. Review/revise control procedures.	26.811	9.49	*
5. Develop/revise control reporting procedures.	9.688	9.49	*
Vendor Relations			
1. Develop/implement acceptance sampling procedures.	15.749	9.49	*
2. Develop vendor quality systems.	28.377	9.49	*
3. Assist vendors with quality system development/revision.	38.118	9.49	*
Customer Relations			
1. Develop/implement customer feedback systems.	23.879	9.49	*
2. Analyze customer feedback.	27.920	9.49	*
3. Trace variation through manufacturing system.	42.355	9.49	*
Application			
1. Communication			
a. Write understandable reports/proposals.	3.770	7.82	
b. Speak/discuss clearly.	6.169	7.82	
2. Leadership			
a. Motivate subordinates and peers.	5.797	9.49	
b. Delegate responsibilities.	20.820	9.49	*
c. Perform training sessions.	27.441	9.49	*
3. Management			
a. Plan activities.	4.117	9.49	
b. Organize resources.	7.686	9.49	
4. Statistical			
a. Apply descriptive statistics.	14.266	9.49	*
b. Apply inferential statistics.	27.289	9.49	*
c. Design experiments.	43.550	9.49	*
5. Computer			
a. Design/select computer programs.	13.157	9.49	*
b. Utilize available software.	14.806	9.49	*
6. Technical/Scientific			
a. Design/improve processes.	24.165	9.49	*
b. Evaluate product materials.	20.658	9.49	*
c. Apply design procedures.	23.758	9.49	*

Note: Confidence interval is 95% (alpha=.05).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 69

Chi-Square Analysis for the Sum of Importance and Frequency Comparing Both Groups Combined Present to Both Groups Combined Future

	Chi Square	x >K (5.99)
Design Review		
1. Review quality specifications.	9.198	*
2. Relate specifications to process.	23.557	*
3. Identify potentially significant variables.	13.771	*
4. Develop pilot-run quality procedures.	18.673	*
Process Capability		
1. Identify potential controlling variables.	27.252	*
2. Develop/select statistical tests.	7.711	*
3. Analyze statistical data.	8.610	*
4. Develop/utilize computer data bases/programs.	15.027	*
Process Control		
1. Develop/implement inspection/audit procedures.	4.404	
2. Develop/implement control chart procedures.	10.941	*
3. Establish control limits.	10.536	*
4. Review/revise control procedures.	18.619	*
5. Develop/revise control reporting procedures.	11.232	*
Vendor Relations		
1. Develop/implement acceptance sampling procedures.	14.035	*
2. Develop vendor quality systems.	22.491	*
3. Assist vendors with quality system development/revision.	30.366	*
Customer Relations		
1. Develop/implement customer feedback systems.	18.034	*
2. Analyze customer feedback.	14.358	*
3. Trace variation through manufacturing system.	27.206	*
Application		
1. Communication		
a. Write understandable reports/proposals.	12.027	*
b. Speak/discuss clearly.	12.193	*
2. Leadership		
a. Motivate subordinates and peers.	4.181	
b. Delegate responsibilities.	11.415	*
c. Perform training sessions.	15.078	*
3. Management		
a. Plan activities.	5.081	
b. Organize resources.	11.345	*
4. Statistical		
a. Apply descriptive statistics.	9.804	*
b. Apply inferential statistics.	30.062	*
c. Design experiments.	21.978	*
5. Computer		
a. Design/select computer programs.	7.983	*
b. Utilize available software.	9.494	*
6. Technical/Scientific		
a. Design/improve processes.	20.631	*
b. Evaluate product materials.	16.488	*
c. Apply design procedures.	24.705	*

Note: Confidence interval is 95% (alpha=.05).

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

3. Plan Activities

Correlation Among Groups

Table 70 presents Spearman rank correlations for the two groups for the importance of tasks, frequency of performance of tasks, and sum of the two within the two groups in the present and the future, as well as between the two groups from the present to the future. These comparisons show a high degree of correlation between groups and between the present and the future as the correlations range from a high of .9523 and a low of .7238.

A significance test for these correlations using the Student's distribution shows a critical value for t of 2.45 where alpha is .01 with 32 degree of freedom. The calculated value for the lowest correlation is 5.93.

This indicates that the two groups have a high degree of agreement on the importance and frequency of these tasks at present and in the future.

Catalysts that Induce Change

This section of the findings is directed at the last research question; What catalysts are anticipated to influence any future changes? That question will be dealt with within each group and by both groups combined.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 70

Rank Correlation Comparison of Groups

	Rank Correlation
Importance	
1. Group I Present to Group II Present	.8228
2. Group I Present to Group I Future	.7960
3. Group II Present to Group II Future	.7604
4. Group I Future to Group II Future	.8750
5. Combined Groups Present to Combined Groups Future	.8254
Frequency	
1. Group I Present to Group II Present	.9523
2. Group I Present to Group I Future	.7459
3. Group II Present to Group II Future	.7952
4. Group I Future to Group II Future	.7238
5. Combined Groups Present to Combined Groups Future	.8497
Sum of Importance and Frequency	
1. Group I Present to Group II Present	.9020
2. Group I Present to Group I Future	.7973
3. Group II Present to Group II Future	.7791
4. Group I Future to Group II Future	.8529
5. Combined Groups Present to Combined Groups Future	.8234

Table 71 includes a list of the catalysts that could induce an increase in quality engineering activity in the future as reported by Group I (engineers from leading companies) during round three of the study. The table then reports the mean and rank of each of these catalysts. For comparison, the table reports the count of the number of times that a respondent picked that catalyst as one of the two most important and the rank of that count. The rank correlation between these two measures was calculated and is reported as .9242. That correlation indicates that there is a very high degree of agreement between the two measures. The two most important catalysts were An Increase in Consumer Quality Requirements and Increased

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 71

Catalysts that Could Induce an Increase in Quality Engineering Activity in the Future as Reported in Round Three by Group I

Factor	Rank	Mean	Most Important Count	Rank
1. An increase in consumer quality requirements.	4.313	1	45	1
2. Increased quality offered by competitors on the international market.	4.237	2	42	2
3. Increased quality offered by competitors on the national market.	3.802	4	10	5.5
4. An increased emphasis placed on quality by top management of my company.	3.372	6	11	4
5. An increase in quality requirements called for by subcontractees.	2.812	9	4	9
6. An increase in quality requirements caused by federal or state legislation.	2.052	10	2	10
7. Increased quality required of the presently used manufacturing processes.	3.316	7	10	5.5
8. Increased quality engineering activity due to the installation of new equipment and/or processes.	3.434	5	8	7
9. Increased quality engineering activity due to the introduction of new products and/or new product options.	3.872	3	14	3
10. Increased quality engineering activity due to the installation of new production and inventory control systems.	3.217	8	5	8
Rank Correlation	.9242			

Note: Rating scale 0=no influence; 5=major influence.

Quality Offered by Competitors on the International Market. The least important catalyst was An Increase in Quality Requirements Caused by Federal or State Legislation.

Table 72 presents the same information for Group II (engineers from nonleading companies) that Table 71 presented for Group I. The rank correlation is .8394 which is somewhat lower than the .9242 reported for Group I, but

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 72

Catalysts that Could Induce an Increase in Quality Engineering Activity in the Future as Reported in Round Three by Group II

Factor	Rank	Mean	Most Important Count	Rank
1. An increase in consumer quality requirements.	4.053	1	40	2
2. Increased quality offered by competitors on the international market.	3.934	2	42	1
3. Increased quality offered by competitors on the national market.	3.639	3	26	4
4. An increased emphasis placed on quality by top management of my company.	3.421	4	27	3
5. An increase in quality requirements called for by subcontractees.	2.430	9	7	6
6. An increase in quality requirements caused by federal or state legislation.	1.933	10	2	10
7. Increased quality required of the presently used manufacturing processes.	3.863	7	5	7
8. Increased quality engineering activity due to the installation of new equipment and/or processes.	3.106	6	13	5
9. Increased quality engineering activity due to the introduction of new products and/or new product options.	3.390	5	4	8.5
10. Increased quality engineering activity due to the installation of new production and inventory control systems.	2.848	8	4	8.5
Rank Correlation	.8394			

Note: Rating scale 0=no influence; 5=major influence.

is still high enough to represent a high degree of agreement between the two measures. The two top ranked and the last ranked catalysts were the same for both groups. One interesting note involves Increased Quality Engineering Activity Due to the Introduction of New Products and/or New Product Options. Group I (engineers for leading companies) ranked it three of ten on both measures, while Group II ranked it five of ten on the first measure and eight and

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Table 73

Catalysts that Could Induce an Increase in Quality Engineering Activity in the Future as Reported in Round Three by Both Groups Combined

Factor	Rank	Mean	Most Important Count	Rank
1. An increase in consumer quality requirements.	4.176	1	85	1
2. Increased quality offered by competitors on the international market.	4.077	2	84	2
3. Increased quality offered by competitors on the national market.	3.716	3	36	4
4. An increased emphasis placed on quality by top management of my company.	3.398	5	38	3
5. An increase in quality requirements called for by subcontractees.	2.610	9	11	8
6. An increase in quality requirements caused by federal or state legislation.	1.990	10	4	10
7. Increased quality required of the presently used manufacturing processes.	3.077	7	15	7
8. Increased quality engineeing activity due to the installation of new equipment and/or processes.	3.261	6	21	5
9. Increased quality engineering activity due to the introduction of new products and/or new product options.	3.618	4	18	6
10. Increased quality engineering activity due to the installation of new production and inventory control systems.	3.023	8	9	9
Rank Correlation	.9273			

Note: Rating scale 0=no influence; 5=major influence.

one-half of ten on the second measure. Perhaps the engineers from leading companies expect more new products and product options to be introduced in the next five years.

The rank correlation between the ranking by Group I and the ranking of Group II is .9394, which indicates a high degree of agreement between the two groups. Therefore, the two groups were combined to create the data

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

for Table 73. Table 73 reports the ranking of the two groups combined. An Increase in Consumer Quality Requirements was ranked first. Increased Quality Offered by Competitors on the International Market was ranked a very close second. An Increase in Quality Requirements Caused by Federal or State Legislation was ranked last. These rankings were confirmed by both scales of measure, rating individual catalysts and the most important count. The rank correlation between the two measures is reported as .9273, which indicates there is a high degree of agreement between them.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The problem of this study was to compare the level of importance and the frequency of performance of selected quality assurance tasks in the present and in the future and to determine potential catalysts for any change between the present and the future. Practicing certified quality engineers working for manufacturing companies in the United States were surveyed in three rounds to obtain this information.

Two sample groups were used to secure information related to this problem. Group I consisted of 86 practicing certified quality engineers working for companies that had been identified as leaders in product quality in a 1985 Gallup study. The second sample, Group II, consisted of 96 practicing certified quality engineers working for companies other than those identified as being leaders.

The study attempted to answer the following research questions:

1. What are the tasks presently performed by quality engineers, how important are they, and how frequently are they performed?

2. Is there a statistically significant difference between tasks performed in leading companies and other companies at present?

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

3. Of the selected tasks, how important will they be and how frequently will they be performed, five years hence?

4. Is there a statistically significant difference between the perceptions of the tasks performed within each group between the present and the future?

5. Is there a statistically significant difference in the perception of the tasks performed between leading companies and others, five years hence?

6. Is there a statistically significant difference in the perceptions of the tasks performed by both groups combined, treating the two groups as if they were one, between the present and the future?

7. What catalysts are anticipated to induce any future changes?

Summary of the Procedures

The 12,000 practicing quality engineers, certified by the American Society for Quality Control (ASQC), were considered for participation in the study. Two hundred-fifty were randomly selected by company for potential participation in each of the two groups. One group of companies included those identified as leaders in quality in the Gallup study, the other group consisted of companies not identified as leaders in quality. These individuals were asked if they would or would not

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

participate in the study. Eighty-nine percent indicated that they would.

As the participants were being identified, a comprehensive review was made of current literature, job descriptions, and ASQC information, for the purpose of identifying potential tasks. Thirty-four tasks in six categories were selected to be included in the study. These tasks were incorporated into the first questionnaire, which was then sent to the participants. Data from the returns were collected and analyzed. The results of the first round were incorporated into the questionnaire for the second round. The second round questionnaire was sent and data from the returns were collected and analyzed. The results indicate that there will be significant changes in the importance and frequency of performance of almost all of the selected tasks.

Therefore, the third round was necessary. A comprehensive review of literature was made to identify potential reasons for the expected change. Ten potential factors were identified and incorporated into the third questionnaire. The third questionnaire was sent and data from the returns collected and analyzed.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Summary of the Findings

Round One--The Present

The first round attempted to answer two research questions:

1. What are the tasks presently performed by quality engineers, how important are they, and how frequently are they performed?

2. Is there a statistically significant difference between tasks performed in leading companies and other companies at present?

The findings of the first round indicate that the 34 tasks identified in the literature review were inclusive of those performed by quality engineers, because only a very few were added by the respondents and none of those added were added by more than one individual. The two groups agreed that the most important task was Speak/Discuss Clearly. Of the purely quality related tasks, both groups agreed that Relate Specifications to Process was most important.

Both groups identified Speak/Discuss Clearly as the most frequently performed. Of the purely quality related tasks, Analyze Statistical Data was the most frequently performed. Analyze Statistical Data was ranked first of the purely quality related tasks for the sum of the two measures by both groups.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

With one exception, the task category Application was ranked first by both groups on both measures in the present and in the future. That exception was with the frequency of performance measure, where Group I (engineers from leading companies) ranked the category Process Capability as number one.

The chi-square analysis of the comparison of the two groups' responses showed 9 (27%) differences in importance and 3 (9%) differences in frequency of performance among the 34 tasks. When the two measures were summed, only 2 (6%) differences were recognized between the two groups. Develop Pilot-Run Quality Procedures and Identify Potential Controlling Variables were rated higher by engineers from nonleading companies.

These findings indicated that there were only minor differences between the two groups and between the two measures. Therefore, the two groups were combined to determine the overall rankings of the tasks. The task Speak/Discuss Clearly and the category Application were ranked first. Of the purely quality related tasks Analyze Statistical Data was ranked on top.

Round Two--The Future

The second round attempted to answer two research questions:

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

1. Of the selected tasks, how important will they be and how frequently will they be performed, five years hence?

2. Is there a statistically significant difference in the perception of the tasks performed between leading companies and others, five years hence?

The data from the second round indicate that both groups find the two tasks Write Understandable Reports/Proposals and Speak/Discuss Clearly at the top of the list of importance and for frequency of performance. Of the purely quality related tasks, both groups ranked Relate Specifications to Process number one for importance, but ranked Analyze Statistical Data first for frequency of performance. As well, the same two tasks were ranked first and second by both groups combined on the sum of the two measures scale.

Group I (engineers from leading companies) ranked the Application category first in importance and frequency of performance. Group II (engineers from nonleading companies) ranked Customer Relations first for importance and Process Capability first for frequency of performance. For the sum of the measures, Group II ranked Process Capability number one and therefore, the most important category overall.

The chi-square comparison of the two groups indicated 5 (15%) significant differences in importance and 6 (18%)

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

differences in frequency of performance of the 34 tasks. The sum of the two measures found 6 (18%) differences. Because of the high degree of agreement between the two groups, the two groups were combined to determine the overall ranking of the tasks.

Both groups combined ranked Communication as the number one category. Of the purely quality related tasks, Relate Specifications to Process was ranked first, while Review Quality Specifications, Identify Potential Controlling Variables, and Analyze Customer Feedback were highly ranked for importance. For frequency of performance, Analyze Statistical Data was ranked first and Develop/Utilize Computer Data Bases/Programs was ranked second. For the sum of the two measures, Analyze Statistical Data was ranked first among the purely quality related tasks.

The category Customer Relations was ranked first for importance and the category Process Capability was ranked first for frequency of performance by both groups combined. The sum of the two scales measure found the combined groups ranking the Application category as number one.

Comparison of Present to Future

The comparison of the present to the future attempted to answer two research questions:

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

1. Is there a statistically significant difference between the perceptions of the tasks performed within each group between the present and the future?

2. Is there a statistically significant difference in the perceptions of the tasks performed by both groups combined, treating the two groups as if they were one, between the present and the future?

The chi-square comparison of Group I present to Group I future found that 11 (32%) of the tasks would become more important in the future, while 23 (68%) of the tasks would be performed more frequently. The same comparison for Group II found 17 (50%) tasks more important in the future, while 20 (59%) would be performed more frequently. By summing the two measures, Group II was found to perceive 22 (65%) tasks as more important and frequent in the future.

To get an overall picture of the comparison of the present to the future, both groups combined in the present was compared to both groups combined in the future. This analysis found 27 (79%) tasks more important and 27 (79%) tasks more frequently performed in the future. The sum of the two scales found 31 (91%) of the tasks more important and frequent in the future.

Correlation Between Groups

A high degree of correlation was found between the two groups and between the present and the future. The average rank correlation was calculated as .8201.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Catalysts that Induce Change

The results of the comparisons between the present and the future indicated that there are expected changes in the importance and frequency of performance of the selected tasks and established the final research question: What catalysts are anticipated to induce any future changes? A comprehensive literature review identified potential catalysts. These catalysts were incorporated in a questionnaire for the third round. The two groups were asked to rate each of the catalysts on two scales.

Both groups agreed that the two catalysts An Increase in Consumer Quality Requirements and Increased Quality Offered by Competitors on the International Market were the most important.

Conclusions

This study identified 34 tasks in 6 categories in the field of quality engineering. The conclusions reached here are based on an analysis of responses of two groups of practicing certified quality engineers in three phases of the study. Group I consisted of 86 engineers working for companies in the United States identified as leading in quality by a Gallup study. Group II consisted of 96 engineers working for companies not identified as leaders by the Gallup study.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Following are the major conclusions of this study, based on the analysis of the data collected.

1. The first research question asked: What are the tasks presently performed by quality engineers, how important are they, and how frequently are they performed? This study identified 34 tasks in 6 categories that are inclusive of the tasks presently performed by those engineers, as only a few were added by the respondents and of those added, none were added by more than one individual.

2. The Gallup study implied that leading companies produce better quality than other companies. It might therefore be assumed that the tasks performed by quality engineers at those companies might be different than those performed at other companies. That potential difference generated the second research question: Is there a statistically significant difference between tasks performed in leading companies and others at present? The data gathered in this study indicate that there are only minor differences in the perception of the importance of or the frequency of the performance of the selected quality engineering tasks between leading and other companies. Those minor differences may be enough to cause a change in the quality of products produced and sold to the ultimate consumer.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Among the differences noted was a disparity in how the category of Customer Relations was perceived. Engineers from leading companies rated the tasks in that category higher than did engineers from nonleading companies. That difference may be enough to cause consumers to consider products of those companies to be of better quality.

3. The third research question stated: Of the selected tasks, how important will they be and how frequently will they be performed, five years hence? This study found that the quality engineers working for leading companies will see little if any change in the relative importance and frequency of performance among the selected tasks. The quality engineers working for companies other than those identified as leading, will see a change in the relative importance of the task category of Customer Relations, which will move from a ranking of three to a ranking of one. That is to say that Customer Relations will become the number one priority. Along with that change, process capability determination will become the most frequently performed of the task categories.

4. Those tasks identified by this study will be very similar to the tasks performed by quality engineers in five years. The study did not reveal any new tasks for the future. However, with only a few exceptions, the tasks selected will be more important and will be performed more frequently in five years. This should provide a

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

significant number of job openings in the field of quality engineering. Post secondary schools should tool up to provide potential quality engineers with the training required to perform in that field. As well, industrial trainers should provide training for present employees who might be in jeopardy of losing their present jobs due to automation or some other factor.

5. Overall the most important tasks are those that are in the Applications category. Of special note is the consistently high ranking of the communications skills of writing and speaking. Educational curricula and training programs must emphasize speaking and writing skills.

6. Of those tasks related to specific quality engineering functions, the analysis of statistical data appears to be the most important and the most frequently performed at present and in the future. Therefore, the means to analyze that data will have to be provided. Computers, software, and training will have to be provided to those individuals required to perform the analysis of data. Of particular note will be the need to provide training in application of fundamental statistical techniques.

7. The ten catalysts identified as potential influences on any expected change in the importance or frequency of performance of tasks between the present and

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

the future are the major ones for consideration as none were added during the survey process.

8. The two potential catalysts that will have the greatest influence on changing quality engineering tasks in the future are consumer quality requirements and international competition. Not only did both groups rank these as the highest, but the quality engineers of the nonleading companies forecasted that the priority of consumer relations would greatly increase in the future.

Recommendations

The purpose of this study was to provide information to managers, educators, and industrial trainers so that they could make better decisions about quality assurance programs, job descriptions, courses of study, and training programs. Based on the analysis of the data generated by this study, the following recommendations are made:

1. Instructors, developers of curricula, and administrators of institutions of higher education with quality technology related programs should determine if current curricula provide appropriate instruction for the development of the competencies needed to perform the tasks identified by this study as being at least "somewhat important" five years hence.

All of the tasks studied are expected to be of some importance and some level of frequency of performance in

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

the future. Therefore, it is recommended that all of these tasks be included in curricula and/or courses of study. To omit learning experiences from a quality technology curriculum because the tasks or categories of tasks were rated less than "very important" and "important" or are rated less than "very frequently" and "frequently" performed, invites less than comprehensive student preparation.

2. Educators, trainers, and planners of continuing education in the field of quality technology should examine the findings of this study to determine if current learning activities and planned future learning activities focus on the development of competencies implied by the tasks identified by this study.

3. Instructors, developers of courses and curricula, administrators of higher education, and directors of training with quality technology programs of study should use the identified levels of importance and frequency of performance of the tasks, and task categories to establish priorities for the allocation of time and other resources, to assure an effective use of those resources.

4. Personnel directors should use the findings of this study as a reference when developing job descriptions and job specifications for personnel working in the quality technology field.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

5. Supervisors of employees in the field of quality technology might use these findings in the process of weighing criteria when performing job performance appraisals.

6. Managers of industrial firms should use the data of this study to plan for future increases in the resources that will be required in the functional area of quality assurance. Of primary concern will be the technology and skills required to process and analyze large volumes of statistical data.

Recommendations for Further Related Research

1. A replication of this study on an international basis to determine if the results differ from those observed within the United States. This replication would most certainly have to include quality engineers working for companies in Japan.

2. A replication of this study with samples from companies stratified by standard industrial code.

3. A replication of this study with samples from companies stratified by size, such as small, medium, and large.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

REFERENCES

American Society for Quality Control. (1984). Quality Engineer-in-training certification program. Milwaukee, WI.

Butcher, J. (1983). Britain's national campaign for quality. Quality Progress, 16(11), 39-41.

Career employment opportunities directory. (1980). Ready Santa Monica, CA: Reference Press.

College placement council annual 1984. (1983). College Bethlehem, PA: Placement Council.

Crosby, P. B. (1984). Quality without tears. NW: McGraw-Hill.

Crosby, P. C. (1984). The state of quality in the U.S. today. Quality Progress, 17(10), 32-37.

Dayton, C. M., & Stunkard, C. L. (1971). Statistics for problem solving. New York: McGraw-Hill Book Co.

Dictionary of business and management, second edition. (1983). New York: Wiley.

Dictionary of occupational titles. (1977). United States, Employment Service. U.S. Department of Labor.

Dorsky, L. R. (1984). Management commitment--to Japanese apple pie. Quality Progress, 17(2), 14-18.

Emory, C. W. (1980). Business research methods. IL: D. Erwin, Homewood.

Encyclopedia of careers and vocational guidance sixth edition. (1984). Chicago: J. G. Ferguson

Fine, S. A., Holt, A. M., & Hutchinson, M. F. (1974). Functional job analysis. How to standardize task statements. Washington, D.C.: W. E. Upjohn Institute for Employment Research.

Gael, S. (1983). Job analysis a guide to assessing work activities. San Fransisco: Jossey-Basee Inc.

Gallup Organization, Inc. (1985). Consumer perceptions concerning the quality of american products and services. September, GO05172: Princeton, NJ.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Hagan, J. T. (1984). The mangement of quality: preparing for a competitive future. Quality Progress, 17(10), 44-50.

Harwood, C. C. (1984). The view from the top. Quality Progress, 17(10), 26-30.

Kume, H. (1985). Business management and quality cost: The Japanese view. Quality progress, 18(5), 13-18.

Leedy, P. D. (1974). Practical research: planning and design. New York: Macmillian.

McCormick, E. J. (1979). Job analysis: methods and applications. New York: AMACOM.

McDermott, T. C. (1983). Education and training: an opportunity for quality improvement. Quality Progress, 16(10), 30-32.

McGrath, J. H., & Watson, D. G. (1970). Research methods and designs for education. Scranton: International.

Occupational outlook handbook. (1982). United States, Bureau of Labor Statistics. Washington, D.C.: U.S. Department of Labor.

Olson, J. E. (1985). James E. Olson on quality, cost, and customer satisfaction. Quality Progress, 18(7), 32-36.

Ripp, F. J. (1983). Management commitment to quality: Xerox Corp. Quality Progress, 16(8), 12-17.

Sinha, M. N., & Willborn, W. O. (1985). The management of quality assurance. New York: Wiley.

Terry, D. R., & Evans, R. N. (1973). Methodological study for determining the task content of dental auxiliary education programs. NO. HRP 000-4628 Bethesda, MD: Bureau of Health Manpower Education, National Institute of Health.

Thurow, L. C. (1985, August/September). A world-class economy: getting back into the rink. Technology Review, pp. 27-37.

West, B. R. (1976). Task analysis for performance based vocational education. Unpublished.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Worsham, J.P. (1980). Application of the delphi method. Monticello, IL: Vance.

Yost, C. E. (1984). A study to identify the importance of tasks performed by manufacturing engineers for manufacturers in the state of Wisconsin. Dissertation Abstracts International, 45, 1377A.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX A

List of Leading Companies

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Chrysler Corporation
General Electric Company
General Motors
The Procter & Gamble Company
International Business Machines Corporation
Del Monte Corporation
Ford Motor Company
Kraft, Inc.
RCA Corporation
Zenith Electronics Corporation
General Mills, Inc.
Westinghouse Electric Corporation
American Telephone & Telgraph Company
Campbell Soup Company
General Foods Corporation
Kellogg Company
The Maytag Company
Nabisco Brands, Inc.
Whirlpool Corporation
Chevrolet Motor Division
Johnson & Johnson
Levi Strauss & Company
Colgate-Palmolive Company
Eastman Kodak Company
Libby McNeill & Libby, Inc.
The Black & Decker Manufacturing Company
Oldsmobile Division
Coca Cola Company
Magnovox Government & Indst Electric Company
Green Giant Company
Pillsbury Company
Sears Roebuck & Company
PepsiCo, Inc.
GTE Corporation
Minnesota Mining & Manufacturing Company
Curtis Mathis Home Entr Center
Digital Equipment
Hotpoint
Burroughs Corporation
Swift & Company
Beatrice Companies, Inc.
Trans World Airlines
Hunt-Wesson Foods, Inc.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX B

Texts Related to Quality Control/Assurance

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Aft, L. E. (1986). Fundamentals of industrial quality control. Reading, MA: Addison-Wesley.

Besterfield, D. H. (1986). Quality control-second edition. Englewood Cliffs, NJ: Prentice-Hall.

Crosby, P. B. (1984). Quality without tears. NW: McGraw-Hill.

Enrick, N. L. (1983). Manufacturing analysis for productivity and quality. Brooklyn, NY: Industrial Press.

Enrick, N. L. (1985). Quality, reliability and process improvement. Brooklyn, NY: Industrial Press.

Feigenbraum, A. V. (1983). Total quality control. New York: McGraw-Hill.

Guespari, J. (1985). I know it when I see it: nine modern fables about quality. New York: American Management Association.

Guildner, F. J. (1987). Statistical quality assurance. Albany, NY: Delmar.

Guralink, D. B., Editor. (1972). Webster's new world dictionary. 2nd Edition. New York: World

Hagan, J. T. (1984). "The mangement of quality: preparing for a competitive future," Quality progress, 17(10), 44-50.

Hansen, B. L., & Ghare, P. M. (1984). Quality control and application. Englewood Cliffs, NJ: Prentice-Hall.

Ishikawa, K. (1985). Guide to quality control. New York: Asian Productivity Organization.

Ishikawa, K. (1985). What is total quality control? Englewood Cliffs, NJ: Prentice-Hall.

Johnson, R. H. (1985). Buying quality. Danbury, CT: Franklin Watts.

Montgomery, D. C. (1985). Introduction to statistical quality control. New York: John Wiley & Sons.

Pall, G. A. (1987). Quality process management. Englewood Cliffs, NJ: Prentice-Hall.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Roberts, G. W. (1983). Quality assurance in research and development. New York: Dekker.

Sinka, M. N. and Willborn, W. O. (1985). The management of quality assurance. New York: Wiley.

Society of Manufacturing Engineers. (1985). In W. H. Klippel (Ed.), Statistical quality control. Dearborn, MI: Society of Manufacturing Engineers.

Wadsworth, H. M., Stephens, K. S., & Godfrey, A. B. (1986). Modern methods for quality control and improvement. New York: Wiley.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX C

Letter Requesting Job Descriptions

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

UNIVERSITY OF WISCONSIN
STOUT
MENOMONIE WISCONSIN 54751

March 17, 1986

Dear:

The Industrial Management Department of the University of Wisconsin-Stout is in the process of developing a program in the area of quality assurance. In the interest of implementing a program that meets the needs of industry, we are soliciting input from (company name). The input we would like are the job descriptions fore positions related to the general area of quality assurance. Typical job titles might include quality engineer, reliability engineer, mechanical inspector, quality analyst, and quality technician.

Any other information relating to quality assurance would be greatly appreciated.

Please address job descriptions and/or other information to:

Zenon Smolarek
Industrial Management Department
115 Technology Wing-Jarvis Hall
University of Wisconsin-Stout
Menomonie, WI 54751

Thank you for your assistance.

Sincerely,

Zenon Smolarek, Associate Professor
Industrial Management Department

gsw

UNIVERSITY OF WISCONSIN-STOUT IS AN EQUAL OPPORTUNITY AND AFFIRMATIVE ACTION UNIVERSITY.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX D

List of Individuals to Which a Request Of Job Descriptions Was Sent

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Mr. Glenn E. White
VP, Personnel & Organization
Chrysler Corporation
12000 Chrysler Drive
Highland Park, MI 48203

Mr. Roland W. Schmitt
VP Research & Development
General Electric Company
3135 Easton Turnpike
Fairfield, CT 06431

Mr. William P. MacKinnon
VP Personnel Adm & Dev
General Motors
3044 West Grand Boulevard
Detroit, MI 48202

Mr. Samual H. Pruett
VP Personnel
The Procter & Gamble Company
301 East Sixth Street
Cincinnati, OH 45202

Mr. Walton E. Burdick
VP Personnel
International Business Machines Copporation
Old Orchard Road
Akrmonk, NY 10504

Mr. John W. Argabright
VP Corp Plng & Dev
Del Monte Corp.
1 Market Plaza
San Francisco, CA 94105

Mr. Peter J. Sherry
VP, Personnel & Organization
FORD Motor Company
The American Road
Dearborn, Mi 48121

Mr. John J. Tucker
Sr. VP Human Resources
Kraft Inc.
Kraft Ct.
Glenview, IL 60025

Mr. Paul E. Wright
Corp Plng & Dev
RCA Corporation
30 Rockefeller Plaza
New York, NY 10020

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Mr. David W. Denton
VP Human Resources
Zenith Electronics Corporation
1000 Milwaukee Avenue
Glenview, IL 60025

Mr. John L. Frost
Sr VP Emp Rl Prs
General Mills Inc.
9200 Wayzata Boulevard
Minneapolis, MN 55440

Mr. Richard L. Reinhart
VP Human Resources
Westinghouse Electric Corporation
Westinghouse Building, Gateway Center
Pittsburgh, PA 15222

Mr. H. W. Clarke Jr.
Sr VP Personnel
American Telephone and Telegraph Company
550 Madison Ave
New York, NY 10022

Mr. Joseph W. Reddy
VP, Personnel
Campbell Soup Company
Campbell Place
Camden, NJ 08101

Mr. C. Richard Blundell
VP, Personnel
General Foods Corporation
250 North Street
White Plains, NY 10625

Mr. N. P. Ellery
Personnel
Kellogg Company
235 Porter Street
Battle Creek, MI 49016

Mr. J. R. Story
Vice President, Personnel
The Maytag Company
403 West Fourth Street, North
Newton, IA 50208

Mr. Andrew S. Barrett
Senior Vice President, Personnel
Nabisco Brands, Inc.
Nabisco Brands Plaza
Parsippany, NJ 07054

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Mr. Charles D. Putnam
Sr VP Admn Personnel
Whirlpool Corporation
2000 U.S. 33 North
Benton Harbor, MI 49022

Mr. Robert Burger
General Manager
Chevrolet Motor Division
3007 Van Dyke Ave.
Detroit, MI 48090

Mr. J. J. Heldrick
VP Administration
Johnson & Johnson
One Johnson & Johnson Plaza
New Brunswick, NJ 08933

Mr. David K. Lelewer
VP and Director of Personnel
Levi Strauss & Co.
1155 Battery Street
San Francisco, CA 94111

Mr. John Mr. Watkins
Sr Ex VP, Strtgc Bus Dev.
Colgate-Palmolive Company
300 Park Avenue
New York, NY 10022

Mr. Harry W. Coover Jr.
Research & Development Div.
Eastman Kodak Co.
343 State St.
Rochester, NY 14650

Mr. James E. Hakes
Sec. Gen. Counsil
Libby McNeill & Libby Inc.
200 S. Michigan Ave
Chicago, IL 60604

Mr. Donald G. Revelle
Sr. VP Personnel
The Black and Decker Manufacturing Company
701 East Jappa Road
Towson, MD 21204

Mr. William W. Lane
Gen. Man. Olds Div.
Oldsmobile Division
920 Townsend St.
Lansing MI, 48921

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Mr. Earl T. Leonard Jr.
Sr VP Corp Affairs
Coca Cola Company
310 North Avenue N.W.
Atlanta, GA 30313

Mr. Brant W. Hill
Sr VP Admn
Magnovox Govt & Indst Elec Co.
1313 Production Road
Fort Wayne, IN 46802

Mr. K. Reis, General Manager
Green Giant Co.
200 S. 6th St.
Minneapolis, MN 55402

Ms. Virginia L. Ward
VP Human Resources
Pillsbury Co.
200 S. 6th St
Minneapolis, MN 55402

Mr. William E. Sanders
VP Corp Personnel
Sears Roebuck & Company
Sears Tower
Chicago, IL 60684

Mr. J. Roger King
VP Personnel
PepsiCo, Inc.
Purchase, NY 10577

Mr. Bruce Carswell
Sr VP Personnel
GTE Corp.
One Stamford Forum
Stamford, CT 06904

Mr. Christopher J. Wheeler
VP Human Resources
Minnesota Mining & MFG Co.
3M Center
St. Paul, MN 55414

Mr. John R. Mocek Jr.
Curtis Mathis Home Entr Ctr
4605 W. Waco Dr.
Waco, TX 76710

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Mr. John L. Sims
VP Corp Personnel
Digital Equipment
146 Main Street
Maynard, MA 01754

Mr. C. Richard Blundell
VP Personnel
General Foods Corp.
250 North St.
White Plains, NY 10605

Mr. Richard H. Bierly
VP Human Resources
Burroughs Corporation
Burroughs Place
Detroit, MI 48232

Mr. Edward T. McCabe
VP Sec & Gen Council
Swift & Company
1919 Swift Dr.
Oak Brook, IL 60521

Mr. Reuben W. Berry
Sr VP Human Resources
Beatrice Companies, Inc.
2 N La Salle St
Chicago, IL 60602Mr. Berry

Mr. D. Jack Ryan
Sr VP,Personnel
Trans World Airlines
605 Third Avenue
New York, NY 10158

Mr. Donald Rohdy
Research & Development
Hunt-Wesson Foods Inc.
1645 W.Valencia Dr.
Fullerton, CA 92631

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX E

Job Descriptions

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

QUALITY ENGINEER POSITION DESCRIPTION T-3
SENIOR QUALITY ENGINEER

OBJECTIVE

To perform tasks resulting from approved self-initiated or assigned programs to achieve desired results.

ORGANIZATIONAL RELATIONSHIPS

Usually reports to a supervisor or manager.

POSITION REQUIREMENTS

This classification is considered the introductory level for inexperienced PhD graduates in the Physical, Biological, or Engineering Sciences, or individuals with B.S. or M.S. degrees in those sciences, plus applicable experience or individuals with equivalent related work experience.

Must be an innovator and a developer of new methods and techniques and as a Quality Resource, assist in determining the procedures basic to identifying, quantifying, and controlling quality costs, systems and processes.

TECHNICAL FACTORS

Initiates ideas and has significant responsibility to make well considered and sound decisions in establishing project and program objectives and criteria. Performs major assignments with appreciable latitude in responsibility for unreviewed action or decisions.

Develops and implements quality and reliability programs and systems of major complexity.

Uses knowledge of statistical techniques, quality technology and science to arrive at practical and cost effective solutions to problems of major complexity.

Develops statistically valid tests; implements inspection and audit procedures; and supports process capability studies on projects of major complexity.

Initiates design reviews and other supporting activities for new or revised product. Helps establish or revise quality specifications.

Obtains, records, and analyzes quality data and observations. Develops and uses computer data bases and programs for efficient data analysis.

Establishes, implements and maintains systems to control vendor quality.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Analyzes or assists in handling customer complaints.

Prepares written and oral progress reports that are organized to best communicate results of evaluations and investigations.

Initiates creative and innovative ideas and suggests appropriate program changes.

Performs analysis, testing and evaluation on projects of major complexity.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

QUALITY ENGINEER POSITION DESCRIPTION

T-1
QUALITY ENGINEER

OBJECTIVE

To perform assigned tasks with supervision, within a specific timetable.

ORGANIZATION

Usually reports to a supervisor or a senior technical individual.

POSITION REQUIREMENTS

This classification is considered the introductory level for inexperienced B.S. graduates in the Physical, Chemical, Biological, and Engineering Sciences or equivalent related work experience.

TECHNICAL FACTORS

Makes useful suggestions and independent minor decisions on problems and reaches technical conclusions. Provides input in planning and setting priorities.

Develops and implements quality and reliability programs of lesser complexity.

Uses knowledge of statistical techniques, quality technology and science to arrive at practical and cost effective solutions to problems of lesser complexity.

Develops statistically valid tests, implements inspection and audit procedures; and supports process capability studies on projects of lesser complexity.

Participates in design reviews and other supporting activities for new or revised products. Helps establish or revise quality specifications.

Obtains, records, and analyzes quality data and observations. Uses computer data bases and programs for efficient data analysis.

Implements and maintains systems to control vendor quality. Analyzes or assists in handling customer complaints.

Prepares written and oral progress reports that are organized to best communicate results of evaluations and investigations. Gives oral presentations.

Is aware of technical/quality and economic opportunity and takes initiative to test ideas.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Performs analysis, testing and evaluation on projects of lesser complexity.

INTERPERSONAL SKILLS

Functions as an effective member of Quality Action teams, and adds to harmonious and efficient working relations.

Participates in quality awareness and other Total Quality Process activities.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

QUALITY ENGINEER POSITION DESCRIPTION T-2
ADVANCED QUALITY ENGINEER

OBJECTIVE

To perform assigned tasks with limited supervision, within a specific timetable.

ORGANIZATIONAL RELATIONSHIPS

Usually reports to a supervisor or a senior technical individual.

POSITION REQUIREMENTS

This classification is considered the introductory level for experienced M.S. graduates in the Physical, Chemical, Biological, and Engineering Sciences or individuals with B.S. degree in those sciences plus applicable experience or individuals with equivalent related work experience.

TECHNICAL FACTORS

Performs varied and somewhat difficult assignments, has some latitude for unreviewed action and decision making. Assists in establishing project objectives and priorities.

Develops and implements quality and reliability programs and systems of moderate complexity.

Uses knowledge of statistical techniques, quality technology and science to arrive at practical and cost effective solutions to problems of moderate complexity.

Develops statistically valid tests, implements inspection and audit prodedures, and supports process capability studies on projects of moderate complexity.

Participates in design reviews and other supporting activities for new or revised products. Helps establish or revise quality specifications.

Obtains, records, and analyzes quality data and observations, using computer data bases and programs for efficient data analysis.

Implements and maintains systems to control vendor quality.

Analyzes or assists in handling customer complaints.

Prepares written and oral progress reports that are organized to best communicate results of evaluations and investigations.

Initiates creative and innovative ideas and suggests appropriate program changes.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Performs analysis, testing and evaluation on projects of moderate complexity.

INTERPERSONAL SKILLS

Functions as an efficient member of Quality Action Teams, and adds to harmonious and efficient working relations. May train, guide, or counsel others in technical skills, quality awareness, or other Total Quality Process activities.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

POSITION SPECIFICATION

TITLE: QUALITY CONTROL COORDINATOR

CODE 069.127-6

STATUS Exempt

Develops and organizes the statistical quality control program in designated inspection operations, explains principles of program to personnel concerned and develops required forms, charts and instruction sheets. Analyzes specifications and illustrations of materials to establish quality inspection requirements, reviews inspection reports to determine nature and extent of reported defects, and advises of action required. Examines operations where statistical quality control has been installed to determine adequacy of program and make adjustments. Instructs and assigns Quality Control Checkers on methods to be used, reviews statistical quality control reports, charts and graphs and compares with previous reports. Analyzes inspection reports, material quality records, and related data to ascertain quality trends being developed by individual suppliers. Prepares reports showing progress, recommended changes, and related information, and confers with vendors' representatives relative to failure of parts to meet specifications. Performs related duties as required.

Experience Preferred:

Equivalent to five years' general automotive experience, preferably including two years' in inspection and quality control activities of the Company.

Education Preferred:

Equivalent to a high school education plus two years' specialized training in statistics.

Revised 5/1/77

The above statement reflects general details necessary for performance of the job and is not to be construed as being all inclusive

IND. REL. NOV '66 4870-C0

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

POSITION SPECIFICATION

TITLE: STAFF QUALITY ENGINEER C

CODE 082.389-8

STATUS Exempt

Reviews and analyzes designated Company and vendor quality control problems related to one or more components of the product to determine causes of quality problems and recommend appropriate corrective action. Conducts special quality studies and tests to obtain data to be used in the development of new or revised quality standards, inspection methods, and organizational and test procedures; prepares, compiles, and analyzes pertinent data to be used in the over-all review and evaluation of divisional and plant performance; compiles necessary background information for reconciling disputed quality standards and inspection methods of forward and future model Quality Control Programs; analyzes and compiles basic data to be used in staff evaluation and approval of new divisional projects as they pertain to Quality Control; investigates proposed changes in specifications to determine their effect on quality standards, materials inspection, and production methods, and makes recommendations to affected staffs and divisions. Renders technical assistance and advice to the Office of the General Counsel in legal and service claims involving Ford Motor Company products; reviews preliminary drafts of Company policies, standards, systems, and training courses relative to the analysis and improvement of product quality and provides revisions or additional material as required; develops procedures to standardize quality testing methods on a Company-wide basis. Performs related duties as required.

Experience Preferred:

Equivalent to eight years experience in Manufacturing and/or Engineering Activities, preferably including five years in Quality Control Operations.

Education Preferred:

Equivalent to four years of college training in Mechanical Engineering or related engineering courses.

The above statements reflect general details necessary for performance of the job and is not to be construed as being all inclusive

IND REL NOV '57 4870-CO

Reviewed 5/1/77

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Title

Sr. Quality Assurance Representative

Position Concept

In the area of procurement, quality assurance achieves and maintains, at minimum cost, the required quality level of mechanical or electrical product procured from a supplier. Possesses knowledge in several commodity areas with specific knowledge required in more complex/critical commodities such as modules, complex electrical assemblies, etc. Provides technical direction to other department personnel in training and complex problem solving.

Responsibilities

1. Provides technical work direction to procurement quality assurance personnel.

2. Coordinates the work assignments of quality assurance representatives to insure that deadlines are met, projects are completed, required reports are filed, and a balanced workload is maintained.

3. Represents procurement quality assurance in technical meetings with supplies, engineering functions, procurement, and corporate procurement quality assurance.

4. Monitors, resolves, and controls, manufacturing quality problems on procured components/products.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX F

Letter Requesting Participation in Study

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

UNIVERSITY OF WISCONSIN
STOUT
MENOMONIE WISCONSIN 54751

September 29, 1986

Dear _____:

The University of Wisconsin-Stout is in the process of developing a program in quality technology. In an effort to design the best possible program, information about you and your job are needed. We will be surveying approximately 200 practicing Certified Quality Engineers in an attempt to determine the importance and frequency of various tasks performed on the job. We are also asking you to predict what tasks will be important in the future.

The survey process will require three rounds of questionnaires. The first relative to the present, the second relative to the future, and the third relative to reasons for anticipated changes. Each round will require about fifteen to twenty minutes of your time.

No one in your company will have access to your responses, nor will they receive any information supplied by you or any other individual respondents. Your name and address have been supplied by the American Society for Quality Control.

Your assistance will be greatly appreciated. Please return the enclosed prepaid postcard indicating your decision to participate.

Thank you for your time.

Sincerely,

Zenon T. Smolarek, Associate Professor
Industrial Management Department

UNIVERSITY OF WISCONSIN-STOUT IS AN EQUAL OPPORTUNITY AND AFFIRMATIVE ACTION UNIVERSITY.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

1. I would like to participate in the study.
   _____Yes _____No

2. Years of experience in quality control.
   _____Yrs.

3. Years in present position. _____Yrs.

4. Formal training in quality engineering:
   _____No Formal Training
   _____Seminars/Workshops (How many?_____)
   _____College/Tech School Courses
   (How many?_____)

Zenon Smolarek
115 Tech. Wing
University of Wisconsin-Stout
Menomonie, Wisconsin 54751

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX G

Cover Letter and Questionnaire for Round One

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

UNIVERSITY OF WISCONSIN
STOUT
MENOMONIE WISCONSIN 54751

September 29, 1986

Dear _____:

You have agreed to participate in the quality engineering task survey sponsored by the Industrial Management Department of the University of Wisconsin-Stout. Thank you.

Enclosed you will find the survey instrument for round one. Please take your time in completing it, then return it in the enclosed envelope.

You should expect the survey instrument for round two in several weeks. Once again, thank you.

Sincerely,

Zenon Smolarek, Assistant Professor
Industrial Management Department

UNIVERSITY OF WISCONSIN-STOUT IS AN EQUAL OPPORTUNITY AND AFFIRMATIVE ACTION UNIVERSITY.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

QUALITY ENGINEERING STUDY

Round One - The Present

Directions: Listed below are tasks performed by quality engineers, followed by two categories of responses. Importance is a measure relating to the accomplishment of your job function. Frequency is a measure of how often you perform that task. Read over all of the tasks to get an overall view of them. If you feel any have been left out, add them in the space provided. Next, indicate your response by placing an X over the appropriate number. The scales are as follows:

Importance	Frequency of Performance
1 = Not Important	1 = Never
2 = Somewhat Important	2 = Seldom
3 = Important	3 = Somewhat Frequently
4 = Very Important	4 = Frequently
5 = Imperative	5 = Very Frequently

Task	Importance	Frequency
Design Review		
1. Review quality specifications	1 2 3 4 5	1 2 3 4 5
2. Relate specifications to process capability.	1 2 3 4 5	1 2 3 4 5
3. Identify potentially significant variables.	1 2 3 4 5	1 2 3 4 5
4. Develop pilot-run quality procedures.	1 2 3 4 5	1 2 3 4 5
5. _____ _____	1 2 3 4 5	1 2 3 4 5
Process Capability		
1. Identify potential controlling variables.	1 2 3 4 5	1 2 3 4 5
2. Develop/select statistical tests.	1 2 3 4 5	1 2 3 4 5
3. Analyze statistical data.	1 2 3 4 5	1 2 3 4 5

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Task	Importance	Frequency
4. Develop/utilize computer data bases/programs.	1 2 3 4 5	1 2 3 4 5
5. _____ _____	1 2 3 4 5	1 2 3 4 5
Process Control		
1. Develop/implement inspection/audit procedures.	1 2 3 4 5	1 2 3 4 5
2. Develop/implement control chart procedures.	1 2 3 4 5	1 2 3 4 5
3. Establish control limits.	1 2 3 4 5	1 2 3 4 5
4. Review/revise control procedures.	1 2 3 4 5	1 2 3 4 5
5. Develop/revise control reporting procedures.	1 2 3 4 5	1 2 3 4 5
6. _____ _____	1 2 3 4 5	1 2 3 4 5
Vendor Relations		
1. Develop/implement acceptance sampling procedures.	1 2 3 4 5	1 2 3 4 5
2. Develop vendor quality systems.	1 2 3 4 5	1 2 3 4 5
3. Assist vendors with quality system development/revision.	1 2 3 4 5	1 2 3 4 5
4. _____ _____	1 2 3 4 5	1 2 3 4 5
Customer Relations		
1. Develop/implement customer feedback systems.	1 2 3 4 5	1 2 3 4 5
2. Analyze customer feedback.	1 2 3 4 5	1 2 3 4 5

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Task	Importance	Frequency
3. Trace variation through manufacturing system.	1 2 3 4 5	1 2 3 4 5
4. _____	1 2 3 4 5	1 2 3 4 5

Applications

1. Communication		
a. Write understandable reports/ proposals.	1 2 3 4 5	1 2 3 4 5
b. Speak/discuss clearly	1 2 3 4 5	1 2 3 4 5
2. Leadership		
a. Motivate subordinates and peers.	1 2 3 4 5	1 2 3 4 5
b. Delegate responsibilities.	1 2 3 4 5	1 2 3 4 5
c. Perform training sessions.	1 2 3 4 5	1 2 3 4 5
3. Management		
a. Plan activities.	1 2 3 4 5	1 2 3 4 5
b. Organize resources.	1 2 3 4 5	1 2 3 4 5
4. Statistical		
a. Apply descriptive statistics.	1 2 3 4 5	1 2 3 4 5
b. Apply inferential statistics.	1 2 3 4 5	1 2 3 4 5
c. Design experiments.	1 2 3 4 5	1 2 3 4 5
5. Computer		
a. Design/select computer programs.	1 2 3 4 5	1 2 3 4 5
b. Utilize available software.	1 2 3 4 5	1 2 3 4 5
6. Technical/Scientific		
a. Design/improve processes.	1 2 3 4 5	1 2 3 4 5
b. Evaluate product materials.	1 2 3 4 5	1 2 3 4 5

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Task	Importance	Frequency
c. Apply design procedures.	1 2 3 4 5	1 2 3 4 5
7. Others		
a. _____	1 2 3 4 5	1 2 3 4 5
b. _____	1 2 3 4 5	1 2 3 4 5

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX H

Cover Letter and Questionnaires for Round Two

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

UNIVERSITY OF WISCONSIN
STOUT
MENOMONIE WISCONSIN 54751

February 11, 1987

Dear :

You have completed round one of the quality engineering task survey sponsored by the Industrial Management Department of the University of Wisconsin-Stout. Thank you.

Enclosed you will find the survey instrument for round two. It identifies the most frequent responses from the first round. The second round attempts to deal with the future and what quality assurance professionals will be concerned with in five years. Please take your time in completing it, then return it in the enclosed envelope.

You should expect the survey instrument for round three in several weeks. Once again, thank you.

Sincerely,

Zenon Smolarek, Assistant Professor
Industrial Management Department

ZS/kl

UNIVERSITY OF WISCONSIN-STOUT IS AN EQUAL OPPORTUNITY AND AFFIRMATIVE ACTION EMPLOYER

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Round Two Questionnaire for Group I

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

QUALITY ENGINEERING STUDY

Round Two - The Future; Five Years Hence

Directions: Listed below are tasks performed by quality engineers, followed by two categories of responses. Importance is a measure relating to the accomplishment of the job function. Frequency is a measure of how often the task is performed. Each category reports the mode value of the round one responses. Read over all of the tasks to get an overall view of them. If you feel any have been left out, add them in the space provided. Next, indicate your response by placing an X over the appropriate number. The scales are as follows:

SCALE

Importance	Frequency
1 = Not Important	1 = Never
2 = Somewhat Important	2 = Seldom
3 = Important	3 = Somewhat Frequently
4 = Very Important	4 = Frequently
5 = Imperative	5 = Very Frequently

Task	Importance Mode Round One	Response For Round Two Importance Will Be:	Frequency Mode Round One	Response For Round Two Frequency Will Be:
Design Review				
1. Review quality specifications	(5)	1 2 3 4 5	(3)	1 2 3 4 5
2. Relate specifications to process capability.	(5)	1 2 3 4 5	(3)	1 2 3 4 5
3. Identify potentially significant variables.	(3)	1 2 3 4 5	(3)	1 2 3 4 5
4. Develop pilot-run quality procedures.	(3)	1 2 3 4 5	(2)	1 2 3 4 5
5. _____ _____		1 2 3 4 5		1 2 3 4 5
Process Capability				
1. Identify potential controlling variables.	(4)	1 2 3 4 5	(3)	1 2 3 4 5
2. Develop/select statistical tests.	(4)	1 2 3 4 5	(3)	1 2 3 4 5
3. Analyze statistical data.	(4)	1 2 3 4 5	(4)	1 2 3 4 5
4. Develop/utilize computer data bases/programs.	(3)	1 2 3 4 5	(3)	1 2 3 4 5
5. _____ _____		1 2 3 4 5		1 2 3 4 5

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Task	Importance Mode Round One	Response For Round One Importance Will Be:					Frequency Mode Round One	Response For Round Two Frequency Will Be:				
Process Control												
1. Develop/implement inspection/audit procedures.	(4)	1	2	3	4	5	(4)	1	2	3	4	5
2. Develop/implement control chart procedures.	(4)	1	2	3	4	5	(4)	1	2	3	4	5
3. Establish control limits.	(4)	1	2	3	4	5	(3)	1	2	3	4	5
4. Review/revise control procedures.	(4)	1	2	3	4	5	(3)	1	2	3	4	5
5. Develop/revise control reporting procedures.	(3)	1	2	3	4	5	(3)	1	2	3	4	5
6. _____		1	2	3	4	5		1	2	3	4	5
Vendor Relations												
1. Develop/implement acceptance sampling procedures.	(3)	1	2	3	4	5	(3)	1	2	3	4	5
2. Develop vendor quality systems.	(4)	1	2	3	4	5	(1)	1	2	3	4	5
3. Assist vendors with quality system development/revision.	(3)	1	2	3	4	5	(2)	1	2	3	4	5
4. _____		1	2	3	4	5		1	2	3	4	5
Customer Relations												
1. Develop/implement customer feedback systems.	(4)	1	2	3	4	5	(3)	1	2	3	4	5
2. Analyze customer feedback.	(3)	1	2	3	4	5	(3)	1	2	3	4	5
3. Trace variation through manufacturing system.	(4)	1	2	3	4	5	(3)	1	2	3	4	5
4. _____		1	2	3	4	5		1	2	3	4	5
Applications												
1. Communication												
a. Write understandable reports/ proposals.	(5)	1	2	3	4	5	(4)	1	2	3	4	5
b. Speak/discuss clearly	(5)	1	2	3	4	5	(4)	1	2	3	4	5

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Task	Importance Mode Round One	Response For Round One — Importance Will Be:	Frequency Mode Round One	Response For Round Two — Frequency Will Be:
2. Leadership				
a. Motivate subordinates and peers.	(4)	1 2 3 4 5	(4)	1 2 3 4 5
b. Delegate responsibilities.	(4)	1 2 3 4 5	(3)	1 2 3 4 5
c. Perform training sessions.	(4)	1 2 3 4 5	(3)	1 2 3 4 5
3. Management				
a. Plan activities.	(4)	1 2 3 4 5	(4)	1 2 3 4 5
b. Organize resources.	(4)	1 2 3 4 5	(4)	1 2 3 4 5
4. Statistical				
a. Apply descriptive statistics.	(4)	1 2 3 4 5	(3)	1 2 3 4 5
b. Apply inferential statistics.	(4)	1 2 3 4 5	(3)	1 2 3 4 5
c. Design experiments.	(4)	1 2 3 4 5	(2)	1 2 3 4 5
5. Computer				
a. Design/select computer programs.	(3)	1 2 3 4 5	(2)	1 2 3 4 5
b. Utilize available software.	(4)	1 2 3 4 5	(4)	1 2 3 4 5
6. Technical/Scientific				
a. Design/improve processes.	(4)	1 2 3 4 5	(2)	1 2 3 4 5
b. Evaluate product materials.	(4)	1 2 3 4 5	(2)	1 2 3 4 5
c. Apply design procedures.	(3)	1 2 3 4 5	(3)	1 2 3 4 5
7. Other				
a. _____		1 2 3 4 5		1 2 3 4 5
b. _____		1 2 3 4 5		1 2 3 4 5

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Round Two Questionnaire for Group II

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

QUALITY ENGINEERING STUDY

Round Two - The Future; Five Years Hence

Directions: Listed below are tasks performed by quality engineers, followed by two categories of responses. Importance is a measure relating to the accomplishment of the job function. Frequency is a measure of how often the task is performed. Each category reports the mode value of the round one responses. Read over all of the tasks to get an overall view of them. If you feel any have been left out, add them in the space provided. Next, indicate your response by placing an X over the appropriate number. The scales are as follows:

SCALE

Importance	Frequency
1 = Not Important	1 = Never
2 = Somewhat Important	2 = Seldom
3 = Important	3 = Somewhat Frequently
4 = Very Important	4 = Frequently
5 = Imperative	5 = Very Frequently

Task	Importance Mode Round One	Response For Round Two Importance Will Be:	Frequency Mode Round One	Response For Round Two Frequency Will Be:
Design Review				
1. Review quality specifications	(4)	1 2 3 4 5	(3)	1 2 3 4 5
2. Relate specifications to process capability.	(4)	1 2 3 4 5	(3)	1 2 3 4 5
3. Identify potentially significant variables.	(4)	1 2 3 4 5	(3)	1 2 3 4 5
4. Develop pilot-run quality procedures.	(3)	1 2 3 4 5	(2)	1 2 3 4 5
5. _____		1 2 3 4 5		1 2 3 4 5
Process Capability				
1. Identify potential controlling variables.	(4)	1 2 3 4 5	(4)	1 2 3 4 5
2. Develop/select statistical tests.	(4)	1 2 3 4 5	(3)	1 2 3 4 5
3. Analyze statistical data.	(4)	1 2 3 4 5	(5)	1 2 3 4 5
4. Develop/utilize computer data bases/programs.	(4)	1 2 3 4 5	(3)	1 2 3 4 5
5. _____		1 2 3 4 5		1 2 3 4 5

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Task	Importance Mode Round One	Response For Round One Importance Will Be:					Frequency Mode Round One	Response For Round Two Frequency Will Be:				
Process Control												
1. Develop/implement inspection/audit procedures.	(4)	1	2	3	4	5	(3)	1	2	3	4	5
2. Develop/implement control chart procedures.	(4)	1	2	3	4	5	(3)	1	2	3	4	5
3. Establish control limits.	(4)	1	2	3	4	5	(3)	1	2	3	4	5
4. Review/revise control procedures.	(4)	1	2	3	4	5	(3)	1	2	3	4	5
5. Develop/revise control reporting procedures.	(4)	1	2	3	4	5	(3)	1	2	3	4	5
6. _____ _____		1	2	3	4	5		1	2	3	4	5
Vendor Relations												
1. Develop/implement acceptance sampling procedures.	(4)	1	2	3	4	5	(4)	1	2	3	4	5
2. Develop vendor quality systems.	(4)	1	2	3	4	5	(2)	1	2	3	4	5
3. Assist vendors with quality system development/revision.	(4)	1	2	3	4	5	(2)	1	2	3	4	5
4. _____ _____		1	2	3	4	5		1	2	3	4	5
Customer Relations												
1. Develop/implement customer feedback systems.	(4)	1	2	3	4	5	(2)	1	2	3	4	5
2. Analyze customer feedback.	(5)	1	2	3	4	5	(2)	1	2	3	4	5
3. Trace variation through manufacturing system.	(4)	1	2	3	4	5	(3)	1	2	3	4	5
4. _____ _____		1	2	3	4	5		1	2	3	4	5
Applications												
1. Communication												
a. Write understandable reports/ proposals.	(5)	1	2	3	4	5	(5)	1	2	3	4	5
b. Speak/discuss clearly	(5)	1	2	3	4	5	(5)	1	2	3	4	5

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Task	Importance Mode Round One	Response For Round One Importance Will Be:	Frequency Mode Round One	Response For Round Two Frequency Will Be:
2. Leadership				
a. Motivate subordinates and peers.	(4)	1 2 3 4 5	(4)	1 2 3 4 5
b. Delegate responsibilities.	(4)	1 2 3 4 5	(4)	1 2 3 4 5
c. Perform training sessions.	(5)	1 2 3 4 5	(3)	1 2 3 4 5
3. Management				
a. Plan activities.	(4)	1 2 3 4 5	(4)	1 2 3 4 5
b. Organize resources.	(4)	1 2 3 4 5	(4)	1 2 3 4 5
4. Statistical				
a. Apply descriptive statistics.	(4)	1 2 3 4 5	(5)	1 2 3 4 5
b. Apply inferential statistics.	(3)	1 2 3 4 5	(2)	1 2 3 4 5
c. Design experiments.	(4)	1 2 3 4 5	(3)	1 2 3 4 5
5. Computer				
a. Design/select computer programs.	(3)	1 2 3 4 5	(2)	1 2 3 4 5
b. Utilize available software.	(4)	1 2 3 4 5	(2)	1 2 3 4 5
6. Technical/Scientific				
a. Design/improve processes.	(4)	1 2 3 4 5	(4)	1 2 3 4 5
b. Evaluate product materials.	(4)	1 2 3 4 5	(4)	1 2 3 4 5
c. Apply design procedures.	(4)	1 2 3 4 5	(2)	1 2 3 4 5
7. Other				
a. _____		1 2 3 4 5		1 2 3 4 5
b. _____		1 2 3 4 5		1 2 3 4 5

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

APPENDIX I

Cover Letter and Questionnaire for Round Three

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

UNIVERSITY OF WISCONSIN
STOUT
MENOMONIE WISCONSIN 54751

June 2, 1987

Dear :

Rounds one and two of the Quality Engineering Survey have been completed. The first round identified the importance and frequency of performance of selected quality engineering tasks in the present. Round two did so for the future. The results of round two indicate that there will be a significant increase in quality engineering activity during the next five years.

Enclosed you will find a survey for the third and final round. Its purpose is to attempt to identify the major factors that will influence the expected increase in quality engineering activity. Your response will be greatly appreciated. If you respond, you will receive complete results of the survey.

Thank you for your time.

Sincerely,

Zenon T. Smolarek, Associate Professor
Industrial Management Department

ZS/kl

THE UNIVERSITY OF WISCONSIN-STOUT IS AN EQUAL OPPORTUNITY AND AFFIRMATIVE ACTION UNIVERSITY

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Round Three

Quality Engineering Survey

Directions: Following are listed the potential factors for the expected increase in the importance and frequency of performance of quality engineering tasks. Please read all ten and add any you feel should be added. Then rate each, including any you have added, on the scale provided. The rating scale is from zero (0) to five (5) where zero indicates that the factor will have no influence on the increase and five indicates that the factor will have a major influence. Indicate your response by placing a check (✓) mark on the line of the scale. After completing the rating, please circle the number of the two most influential factors.

POTENTIAL FACTOR	RATING SCALE (No Influence … Major Influence)
1. An increase in consumer quality requirements.	0 1 2 3 4 5
2. Increased quality offered by competitors on the international market.	0 1 2 3 4 5
3. Increased quality offered by competitors on the national market	0 1 2 3 4 5
4. An increased emphasis placed on quality by the top management of my company.	0 1 2 3 4 5
5. An increase in quality requirements called for by subcontractees.	0 1 2 3 4 5
6. An increase in quality requirements caused by federal or state legislation.	0 1 2 3 4 5
7. Increased quality required of the presently used manufacturing processes.	0 1 2 3 4 5

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

POTENTIAL FACTOR	RATING SCALE (No Influence ... Major Influence)
8. Increased quality engineering activity due to the installation of new equipment and/or processes.	0 1 2 3 4 5
9. Increased quality engineering activity due to the introduction of new products and/or new product options.	0 1 2 3 4 5
10. Increased quality engineering activity due to the installation of new production and inventory control systems.	0 1 2 3 4 5
11. _____	0 1 2 3 4 5
12. _____	0 1 2 3 4 5

After completing the rating, please circle the number of the two most influential factors for the expected increase.

Return to: Zenon Smolarek
Industrial Management Department
University of Wisconsin-Stout
Menomonie, Wisconsin 54751

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.