Employee Involvement in Quality Improvement: A Comparison of American and Japanese Manufacturing Firms Operating in the U.S.

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Abstract—**Considerable attention has been given in recent years to identifying and describing the elements which account for Japan's successful infiltration and dominance of the world market place. Eventually came the diagnosis that attention to quality would be critical to American firms to regain their world market position. Inherent in such a philosophical change in quality management must be a redistribution of responsibility for quality from a single QC department to workers throughout the production operation. Coupled with this change in responsibility must also be an increased use of appropriate tools [statistical quality control (SQC) tools] to enable workers to monitor and measure quality. The above two factors will help firms to achieve *atarimae hinshitsu,* (given quality, i.e., producing defect-free products). This research sought to determine whether firms classified as incorporating a Japanese quality management approach had significantly higher levels of worker involvement in the quality effort as well as higher utilization of SQC tools. The three types of firms represented in this study were traditional American firms, Japanese firms operating in the U.S., and nontraditional American firms (firms emulating the Japanese approach to quality management). Results suggest that Japanese and nontraditional American firms 1) have a significantly higher level of worker involvement and 2) use simple SQC tools to a significantly higher than traditional American firms. In addition, Japanese firms operating in the U.S. showed results comparable to these American firms practicing Japanese quality management techniques. Finally, it was concluded that many Japanese firms and nontraditional American firms are gearing up for the second phase of quality, referred to as *miryokuteki hinshitsu,* (the charm of quality, i.e, the personality of products).**

Keywords—**Quality improvement programs; total quality control (TQC); statistical quality control (SQC) techniques; production workers involvement; and management of quality.**

I. Introduction

INTEREST in how America lost its position of dominance in the American and world marketplace has continued to gain momentum over the years since the shift was first recognized. Market shares have been lost to producers from a number of countries, but the greatest impact has been from Japanese products. Initially, in the early 1970's, American firms simply responded defensively to the apparent threat posed by the Japanese by maintaining the Japanese were using unfair pricing practices or were deliberately flooding the market with cheap goods in order to capture market share. This defensive attitude represented a denial that a problem really existed.

As early as 1961 Juran [1] identified the potential Japanese threat to America's world market position. His observations of Japanese manufacturing convinced him that Japanese attention to quality would be the impetus that would catapult them to the forefront of the world marketplace. Drucker [2] found similar evidence that the Japanese approach to the management of their operations was contributing to their success. It wasn't until the late 1970's, however, that American management began to recognize and accept that the successful Japanese infiltration into the American market was, in fact, a result of high quality products coupled with low prices.

The realization that quality management and quality control were critical elements in Japan's market success finally led American industry to focus on the quality management and statistical techniques proposed by such people as Feigenbaum [3], Deming [4], Crosby [5], Juran [6], and Deming and Geoffrey [7]. Further impetus was provided by Hayes [8] who identified the importance of such things as daily preventive maintenance on machines and equipment, less than maximum capacity production, and "thinking quality" into the product. Wheelwright [9] noted that the strategic importance of quality by pointing out that the Japanese have recognized the long-term benefits of a strategic operations policy that stresses high quality. Garvin [10] directed further attention to the management of quality as a critical element for the successful recovery of market share by U.S. firms. These ideas, however, represented a dramatic philosophical change from the traditional approach to quality management professed by American industry.

The significance of the Japanese quality management approach and its associated use of statistical quality control (SQC) tools has been noted repeatedly in the literature [11]–[16]. As a result, some researchers have been studying the utilization of these elements in manufacturing firms. A

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case study by Bushe [11] reported the SQC implementation process within a single plant. Another study has attempted to identify whether the new approach to quality management is being fully utilized in American manufacturing firms [17].

This new quality management approach depends heavily upon the use of statistical methods to identify and disclose the causes of production and quality problems. According to the literature, a primary reason why SQC tools have been so instrumental in achieving quality improvement in Japanese manufacturing firms relates to the comprehensive and consistent usage of these tools by all levels of workers in these firms [4], [14], [18], and [19]. Consequently, in order to evaluate whether U.S. manufacturing firms may be accomplishing the implementation of SQC one must determine whether the use of such tools has filtered down to the production workers. While some research has provided an indication of the use of SQC tools among the various departments or functional areas within U.S. manufacturing firms, they do not specifically address the extent to which SQC techniques are being used by production workers. One case study [11] did examine production worker utilization of SQC tools in a single industry.

II. Research Questions

The research reported in this paper focused on two areas in an attempt to evaluate the utilization of the SQC approach: 1) production workers' knowledge and use of SQC tools, and 2) production workers' quality responsibilities. These two elements are components of the comprehensive approach to quality control management called Total Quality Control (TQC) originated by Feigenbaum in the 1950's. Information about the level of these two elements would be indicative of whether U.S. manufacturing firms will have the potential to reap any of the quality improvement benefits that have accrued to Japanese manufacturing firms. Additionally, interest in these two particular elements is stimulated by Bushe's contention that certain cultural attributes inherent in the American manufacturing environment can impede the successful use of statistical process control techniques in U.S. firms [11].

To see how manufacturing firms in the United States are faring in their implementation of SQC, this research sought to identify the degree of production worker involvement in quality responsibilities as well as the degree to which SQC techniques were being utilized by these production workers. The use of SQC tools at the production worker level would not normally occur in firms adhering to the traditional approach to quality management (i.e., those with a QC department responsible for inspections and evaluations) but should exist in firms who have explicitly embraced the ideal of TQC (i.e., those who have incorporated Japanese quality management techniques). Consequently, it would be necessary to categorize and evaluate the behavior of U.S. manufacturing firms according to whether they were traditional or nontraditional with respect to their quality management approach. Information about their relative behaviors in the two areas of concern should then provide an indication of the degree of SQC implementation in these U.S. manufacturing firms. For comparison purposes, however, the behavior of Japanese firms operating in the U.S. would also be needed.

The specific research questions which the authors hoped to answer were:

- Are U.S. manufacturing firms that are following a nontraditional approach to quality management utilizing SQC techniques 1) to a significantly greater extent than firms who follow the traditional approach to quality control; and 2) to an extent comparable to that used by Japanese firms operating in the U.S.?
- Have American firms that have implemented Japanese manufacturing management techniques delegated more quality responsibilities to production workers than their traditional U.S. counterparts and as much as their role model Japanese counterparts in the U.S.?

It was expected that American firms following the traditional approach to quality control would show little progress in either of the two study areas. However, for those American firms that have incorporated many Japanese manufacturing management concepts, it was expected that results would reveal a significantly higher rate of usage of SQC techniques associated with a higher transference of responsibility for quality to production workers. Finally, Japanese firms operating in the U.S. were expected to reflect high utilization of Japanese management techniques as indicated by their high use of SQC tools and the delegation of responsibility for quality to production workers.

At this point it is important to mention that the focus of this study is on those aspects of quality which are related to the internal (shopfloor) activities in the manufacturing firms. These aspects of quality are referred to as *atarimae hinshitsu* which means given or granted quality (i.e., producing defect-free product) versus the relatively new idea of *miryokuteki hinshitsu* which means the charm of quality (i.e., measuring variables such as appearance, sound, and touch that give personality to a product) [20].

III. Methodology

A. Sample Selection

The population for the study consisted of all manufacturing firms operating in the United States with Standard Industrial Classification (SIC) codes from 3500 to 3870. These codes represented firms in the following industries: machinery, electrical, and electronic (including computer and semiconductors), transportation equipment, and measuring and analyzing devices (including photographic and optical). To maximize variation on the use of Japanese style manufacturing techniques, i.e., companies using just-in-time (JIT) and total quality control (TQC) systems, the sample was stratified by three types of firms: American-owned firms (type A firms), Japanese-owned firms using Japanese manufacturing techniques (type J firms), and American-owned firms using Japanese manufacturing techniques (type AJ firms).

Due to the nature of the samples, the following process was used to initially identify the firms by type. For type J firms, using the directory of the Affiliates and Offices of

Japanese Firms in the U.S., a complete list of these firms within the appropriate industries and which were actually manufacturing and operating in the U.S., was compiled ($N = 323$). American firms (type AJ) using Japanese manufacturing techniques (JIT and/or TQC) were identified from lists provided by two consulting companies specializing in Japanese manufacturing techniques. This group contained 174 firms. For type A firms a random sample of 500 was selected from those firms on the membership list of the American Society for Quality Control. All sample firms fell within the SIC codes noted above. These three groups comprised the total sample ($n = 997$).

This sample selection process allowed for preliminary placement of respondents into one of the three firm categories: type A firms, type J firms, and type AJ firms. Further refinement of the classification was performed based upon several scholars' contentions [4], [12], and [14] that total quality control (TQC) and just-in-time production systems (JIT) are two key elements found in firms practicing Japanese management. Therefore, respondents were asked if their plant used total quality control, total quality management, or Deming's approach. They were also asked if a just-in-time production system was employed. A positive answer to either question justified the classification of an American firm into the type AJ group whereas negative responses to both placed the firm into the type A category. As a result of this process, eight firms initially categorized as type A were reclassified as type AJ and one original type AJ firm was reclassified as type A. The same criterion was used to assure that the Japanese firms in this study were utilizing the above-mentioned approaches (Japanese techniques). Consequently, the two Japanese firms giving negative responses to both of the questions were eliminated from the sample. Sample selections based on these classification restrictions were necessary to achieve one objective of this study: to provide empirical evidence of the relationship between management's quality philosophy and production worker's involvement in the quality process.

B. Questionnaire Development

Respondents were queried concerning a variety of aspects of manufacturing management including those reported in this study. The questions were developed in a two-stage process. An initial draft of the questionnaire was reviewed by management professionals from several plants in a midsized midwestern city in the U.S. The managers' plants represented the range of industries eventually surveyed. After revision of the initial instrument, ten on-site interviews further indicated the clarity and importance of the questionnaire items. Based on these steps, a revised questionnaire was sent to the entire sample.

C. Data Analysis Procedures

Analyses were performed with regard to the firm's type, i.e., type A, type AJ, and type J. For each type, individual questions were analyzed, and the results were compared among the different firm types. Cross tabulations were done on all questions, and where it was statistically acceptable, a Chi-square test was used to check the existence of any differences and their significance.

IV. Analysis of Data

Questionnaires were sent to individual managers by name at all firms identified in the sample selection processes ($n = 997$). Usable questionnaires (after refinement and validation) were returned by 222 respondents resulting in an overall response rate of 22.3%. The preliminary analysis of these 222 usable questionnaires showed that 57.9% were from type AJ firms, 22.1% were from type A firms, and the remaining 20.0% were from type J firms. Individual responses were comprised of quality managers (53.8%), higher level management (29%), and others at approximately the same level as quality managers (17.2%). The distribution of job positions was not significantly different across industries or firm types.

Because organizational size is often related to many aspects of organizational functioning, two measures of size were used as control variables [21]. The respondents were queried about the number of employees in the plant, which provided a local measure of size, and the annual sales of the corporation, which provided a measure of the parent company's scale of operation. Table I shows the average and standard deviations of sales and employees based on the type of firms. As Table I indicates, among the companies that provided these data, the average number of employees in Type A, J, and AJ firms were about 2080, 1538, and 2074, respectively. The mean sales for the three types of firms were about 502, 629, and 1015 million U.S. dollars for type A, J, and AJ, respectively. However, firm types did not differ significantly in terms of annual sales for the parent company nor by number of employees in the plant. The distribution of firm types across industries was not significantly different.

A. Production Workers' Involvement

Via a series of questions the respondents were asked to identify their production workers' involvement in quality activities. The results of the analyses of these questions are shown in Tables II through VII. Information in Tables II through VI not only provided evidence about the delegation of quality responsibility down to the production worker level but also provided further validation for the classification of firms into one the the three types. Table VII deals specifically with the use of the various SQC tools.

The first three questions dealt, either directly or indirectly, with the quality activities of employees on the shop floor. Question one asked respondents whether employees have the authority to stop the production line. The next question asked respondents whether machine operators in their firms perform daily checks and routine maintenance. The third question dealt with the workers' responsibility for quality: Respondents were asked to indicate whether production workers carry the main responsibility for quality. The cross tabulation and Chi-square results for these three questions are provided in Tables II, III, and IV, respectively. For the purposes of the Chi-square test, responses of "Yes–All Areas" were combined with "Yes–Some Areas" for com-

TABLE I
COMPANY SIZE (EMPLOYEES AND SALES)

Type of Firm	Sales (00,000) Average	*SD*	Employees Average	*SD*
A	501.64	1769.16	2080.05	4094.09
J	626.85	1818.2	1537.89	3318.95
AJ	1014.6	2742.17	2074.06	4302.69

TABLE II
WORKERS HAVE THE AUTHORITY TO STOP PRODUCTION LINE

Type	Yes All Areas	Yes Some Areas	No	Don't Know
A	20.9%	20.9%	53.5%	4.7%
J	40.0	35.6	22.2	2.2
AJ	28.6	41.3	27.8	2.4

Chi-Square Type	A	J	AJ
A			
J	11.42*		
AJ	13.28*	0.55	

Note: * = Significant at 1% level.

parison with combination "No" and "Don't Know" responses among the three firm types. As shown in these tables, significant differences were found between type A and AJ firms and between type A and J firms for all three questions.

The remaining questions addressed the issue of how quality problems or defects are resolved. Question four addressed the timing of corrective action whereas question five addressed responsibility for the corrective action. Tables V and VI, respectively, provide the cross tabulation and Chi-square results for these two questions. For the question when corrective action is taken, the intent was to isolate responses reflecting immediate correction policies. Therefore, Chi-square tests were conducted to compare responses of action taken "When Discovered" with all other responses combined. With respect to who performs corrective action, responses of "Person Who Made It" were compared against all other responses combined. No significant differences were found among the firm types for either question.

The questionnaire results reported in Tables II through IV strongly support the assignment of the various firms into the three firm types. While Tables V and VI did not show any significant differences, they do contribute to justifying the classification scheme. Both types J and AJ firms had much higher proportions taking corrective action "When Discovered" than "At A Later Time." This behavior is consistent with the policies and expectations of the state management philosophy.

B. QC Tool Utilization

The second portion of the questionnaire sought to identify the degree of utilization of various statistical quality control (SQC) techniques within the three firm types. A series of questions was used to determine which, if any, of seventeen different SQC techniques were used by production workers. Table VII lists these seventeen techniques and presents the

TABLE III
MACHINE OPERATORS PERFORM DAILY CHECKS

Type	Yes All Areas	Yes Some Areas	No	Don't Know
A	20.9%	32.6%	30.2%	16.3%
J	36.2	53.2	8.5	2.1
AJ	25.0	52.4	16.9	5.6

Chi-Square Type	A	J	AJ
A			
J	17.38*		
AJ	9.57*	2.97	

Note: * = Significant at 1% level.

TABLE IV
WORKERS ARE RESPONSIBLE FOR QUALITY

Type	Yes All Areas	Yes Some Areas	No	Don't Know
A	30.2%	18.6%	51.2%	0.0%
J	36.2	38.3	23.4	2.1
AJ	34.6	37.0	27.6	0.8

Chi-Square Type	A	J	AJ
A			
J	6.70*		
AJ	6.76*	0.14	

Note: * = Significant at 1% level.

degree of utilization of each by the different firm types. Within each firm category the techniques are ranked in order of decreasing frequency of use. In addition, these findings will help demonstrate whether various types of firms differ with regard to the first phase of quality, i.e., *atarimae hinshitsu*. High utilization rates for larger subsets of the arrayed SQC tools provide an indication of the intention of various firms to manufacture defect-free products.

The data in Table VII reveal that the seven most frequently used tools within each firm type are the same. There is only a small variation in the rank ordering of these seven tools among the three firm types. These top seven techniques are generally considered easy-to-understand and simple-to-use tools [14]. This would seem to suggest a universal applicability of these tools to quality control management. These utilization rates reflect the proportion of firms in each firm type classification using each tool. Another interesting result reported by all three firm types is the unexpected low utilization rate for histograms and Pareto charts. For most SQC tools, utilization rates by type A firms fell below those reported by either type J or type AJ firms. This relationship was expected by virtue of the characteristics of the firms' respective quality management philosophies. In only two cases (sampling plan acceptance and statistical inference) did type A firms use tools at a greater rate than their type AJ and type J counterparts. This result is not surprising since these two tools are commonly used in the traditional quality control department by QC specialists who inspect the production line.

Statistical tests on the rates of usage by firm type were done using the Chi-square test. Since a condition of "no

TABLE V
WHEN CORRECTIVE ACTION IS TAKEN

Type	When Discovered	At a Later Time	No Action	Other
A	48.9%	44.4%	2.2%	4.4%
J	66.7	33.3	0.0	0.0
AJ	60.3	26.7	3.1	9.9

Chi-Square Type	A	J	AJ
A			
J	2.86		
AJ	1.76	1.11	

TABLE VI
WHO PERFORMS CORRECTIVE ACTION

Type	Person Who Made It	A Separate Team	No Action	Other
A	31.8%	45.5%	2.3%	20.5%
J	52.3	38.6	0.0	9.1
AJ	43.4	45.5	1.4	9.8

Chi-Square Type	A	J	AJ
A			
J	2.89		
AJ	2.03	1.03	

response'' to any question was classified as a ''no'' response, the sample size and the results in Table VII reflect the total sample size for each firm type (i.e., no missing values). Results for the Chi-square analyses revealed significant differences for six SQC tools: histogram, scatter chart, fishbone chart, run chart, inspection plan acceptance, and stratification. These results are reported in Table VII. Furthermore, these six SQC tools are those normally classified as easy-to-understand, simple-to-use tools. It is noteworthy that four out of these six tools constitute four of the seven top tools used by all three firm types. In each case the significant difference occurred between type A and either type AJ or type J firms. These results indicate that production workers in either type J or AJ firms use these simple tools at a significantly higher rate than their counterparts in type A firms. This pattern would be expected if, in fact, type AJ firms were successfully ''mimicking'' their Japanese counterparts in terms of SQC tool utilization.

V. DISCUSSION

Since firms classified as type A use a traditional approach to quality control (i.e., a QC department having most or all responsibility for production quality), it was anticipated that these firms would report very low levels of production worker involvement in quality control efforts. Concomitantly, it was expected that production worker knowledge and usage of QC tools would be low.

The results of this survey revealed somewhat higher levels of worker involvement in type A firms than had been expected. While it appears that QC departments retain ultimate responsibility for quality in the majority of type A firms, a larger proportion than expected gave workers varying degrees of responsibility for influencing the quality of production (roughly 42% of type A firms give workers the authority to stop production (*andon*); daily maintenance checks on equipment is done by production workers in about 54% of these firms; and approximately 49% of these firms indicated that their workers carry primary responsibility for quality). This result may be explainable by differences among firms in classifying inspection workers. If a firm classifies its QC department inspection workers as production workers, then responses to the questions regarding degree of worker responsibility and involvement in quality efforts would overstate the true degree to which responsibility has been delegated to the actual production workers on the shop floor.

Responses about worker knowledge and use of SQC tools must be interpreted with care. Since the utilization rates reflect the percentage of firms reporting production worker use of SQC tools and not the proportion of their production workers using the tool, it is not possible to draw conclusions about the actual magnitude of production workers within a firm type using these tools. The information about rates of SQC tool utilization must be considered with the information about the degree of worker responsibility for quality.

For American firms making use of Japanese quality management approaches as well as for Japanese firms operating in the U.S., it was anticipated that a significantly higher level of production worker involvement in quality efforts would exist. According to the survey results, both type J and AJ firms had a significantly higher degree of worker participation and responsibility for quality than that reported by type A firms. More than 70% of each type firms (J and AJ) reported that workers could practice *andon* (stop production), did daily maintenance on their equipment, and had been explicitly given major responsibility for production quality.

With respect to workers' knowledge and use of statistical quality control tools, the survey results must again be interpreted in conjunction with the level of worker involvement reported by the respective firm types. Type J and AJ firms reported higher rates of utilization than type A firms for 15 of the 17 SQC tools. These higher rates of utilization were significant for six of the most basic SQC tools.

The higher levels of production worker involvement in the quality effort coupled with their higher utilization rates for SQC tools would support the contention that type AJ and J firms are attempting to achieve better control over quality. According to the literature, firms that have failed to achieve improvement in quality are those that delegate responsibility for quality to their production workers without providing these workers with the means to control quality [15], [16], and [23]. The results of this survey appear to validate this situation: Type A firms are delegating more responsibility to their production workers but are not giving them the tools they will need to meet this responsibility. These results are consistent with the 1990 ASQC/Gallup survey on quality which indicates that in many American firms there is a widening gap between words and action on the issue of production workers' involvement regarding quality activities [22]. In contrast, type AJ firms, to a degree comparable to their type J counterparts, not only delegate responsibility for quality but provide better employee preparation for assuming

TABLE VII
RANKING OF QUALITY CONTROL TECHNIQUES USED BY PRODUCTION WORKERS

Technique	Type A Firms		Type J Firms		Type AJ Firms		Significance Tests
	Rank	Utilization	Rank	Utilization	Rank	Utilization	
Checklist	1	62.9%	1	82.5%	2	66.7%	
Inspection Plans	4	31.4%	2	77.5%	1	74.8%	(A-J)*** (A-AJ)***
Stratification	6	20.0%	3	45.0%	4	55.0%	(A-J)*** (A-AJ)***
Run Chart	3	34.3%	4	37.5%	3	61.3%	(A-AJ)**
Fishbone Chart	7	14.3%	4	37.5%	5	45.0%	(A-J)*** (A-AJ)***
Sampling Plan Acceptance	2	37.1%	6	35.0%	7	34.2%	
Analysis of Variance	5	25.7%	7	32.5%	6	36.0%	
Scatter Chart	12	5.7%	8	30.0%	8	26.1%	(A-AJ)* (A-J)*
Basic Reliability Formulas	12	5.7%	9	27.5%	9	21.6%	
Reliability Sampling Plan	12	5.7%	10	25.8%	11	19.8%	
Confidence Limit	12	5.7%	11	25.0%	9	21.6%	
Control Charts	8	11.4%	12	20.0%	14	14.4%	
Design of Experiment	12	5.7%	13	17.5%	14	14.4%	
Histograms	17	0.0%	13	17.5%	16	9.0%	(A-AJ)* (A-J)*
Pareto Chart	11	8.6%	15	15.0%	13	16.2%	
Probability Distribution	8	11.4%	15	15.0%	11	19.8%	
Statistical Inferences	8	11.4%	17	2.5%	17	8.1%	

Note: All significant levels are from Chi-Square test. However, for items with < 5 observations in a cell, Fisher's exact test was executed.*$p < .05$; **$p < .01$; ***$p < .001$

this responsibility as indicated by the higher rates of SQC tool utilization.

With respect to the research questions posed in this study, several observations can be made from the survey results:

- SQC tool utilization by U.S. firms classified as using Japanese management as well as by their Japanese counterparts operating in the U.S. is higher than that found in the traditional U.S. firm.
- Delegation of responsibility for quality to production workers by U.S. firms classified as using Japanese management as well as by their Japanese counterparts operating in the U.S. is higher than that found in the traditional U.S. firm.

These survey results are consistent with expectations concerning the quality policies and behavior of firms and provide empirical evidence of the relationship between quality philosophy and worker involvement. The data do reveal that firms purporting to use either of the two key elements typically associated with Japanese management (i.e., TQC or JIT) have higher levels of worker involvement in the quality effort as well as higher utilization of SQC tools.

VI. CONCLUSIONS AND IMPLICATIONS

This study was conducted to ascertain the degree of production worker involvement in certain quality-related activities which occur in manufacturing firms. Differences in level of participation and use of SQC tools were anticipated based on the type of quality management approach used by the firms. However, the degree to which a particular quality management philosophy actually manifests itself in production worker involvement and use of SQC tools has not previously been demonstrated empirically. In order to establish these relationships, the survey responses were segregated into three groups for analyses based on their quality management philosophy: U.S. firms that utilize a traditional approach to quality management; U.S. firms that utilize Japanese quality management techniques; and Japanese firms operating in the U.S. that utilize Japanese quality management techniques. The survey questionnaire solicited information about employee participation as well as about their use of specific quality control tools.

The results of this survey should be interpreted in consideration of the survey's limitations:

- The survey was a cross-sectional assessment of quality management practice at a particular point in time.
- The classification of firms into the three types (A, J, and AJ) was strictly a result of the criteria described in Sample Selection above.
- The survey results reflect the views and perceptions of managers within the firms surveyed.
- While only two of the elements purported to be needed for a successful TQC impelemention are considered in this study, this does not imply that utilizing either or both is a panacea for quality problems. Significant

improvements in U.S. product quality can only arise from an integrated approach which appropriately utilizes all of the elements of a TQC system [19].

Although the findings of this study suggest that all three types of firms place a high level of importance on employee responsibility for quality, the actual delegation of responsibility and use of SQC proved to be inconsistent. Only type AJ and J firms showed evidence of providing tools to the workers so they could meet their delegated quality responsibilities. Actual delegation of responsibility can only be deduced in the cases where workers were provided with the means to carry out their responsibilities. However, the connection between SQC tool utilization and delegated responsibility did not occur in type A firms.

The results of this study also demonstrate that the same seven SQC tools were used to the greatest degree by all three firm types and these seven tools are all basic SQC tools. Firms professing to embrace a nontraditional approach to quality management demonstrated a higher level of production work responsibility and involvement in quality efforts (including greater usage of SQC tools) than their traditional counterparts. This is evidence that these nontraditional firms have a higher potential for controlling quality.

Finally, the findings of this research indicate that most type A firms severely restrict the potential for achieving that aspect of quality recognized by type AJ and type J firms as *atarimae hinshitsu* (given or granted quality, i.e., producing defect-free products). Achieving *atarimae hinshitsu* would be the prerequisite for survival by many companies facing global competition. While type AJ and type J firms seem to be ready for the next phase of quality, referred to as *miryokuteki hinshitsu*, reflecting "product personality," (i.e, fine touches that impress consumer), type A firms still appear to be struggling with the very basic concept of quality (i.e., identifying quality problems to produce defect-free products). If these type A firms are to survive, the only choice seems to be an acceleration in adoption and implementation of the basic quality management concepts including basic SQC concepts which can lead to defect-free products. Only after achieving the first phase of quality could they move into the world of *miryokuteki hinshitsu*, the next phase of quality.

References

[1] J. Juran, "Japan revisited," *Industrial Quality Control*, vol. XVII, no. 9, p. 32, 1961.

[2] P. Drucker, "What we can learn from Japanese management," *Harvard Bus. Rev.*, March/April, pp. 110-122, 1971.

[3] A. Feigenbaum, *Total Quality Control: Engineering and Management*. New York: The McGraw-Hill Book Company, 1961.

[4] W. Deming, *Quality, Productivity, and Competitive Position*. Cambridge, MA: Massachusetts Institute of Technology Center for Advanced Engineering Study, 1982.

[5] P. Crosby, *Cutting the Cost of Quality*. Boston, MA: Industrial Education Institute, 1967.

[6] J. Juran, *Quality Control Handbook*, 4th ed., San Francisco, CA: McGraw-Hill Book Company, 1988.

[7] W. Deming and L. Geoffrey, "On sample inspection in the processing of census returns," *J. Amer. Statist. Ass.* vol. 36, pp. 351-360, 1941.

[8] R. Hayes, "Why Japanese factories work," *Harvard Bus. Rev.* pp. 57-66, July/Aug. 1981.

[9] S. Wheelwright, "Japan—Where operations really are strategic," *Harvard Bus. Rev.* pp. 67-74, July/Aug. 1981.

[10] D. Garvin, "Quality on the line," *Harvard Bus. Rev.* pp. 65-75, Sept./Oct. 1983.

[11] G. Bushe, "Cultural contradictions of statistical process control in American manufacturing organizations," *J. Management*, vol. 14, no. 1, pp. 19-31, 1988.

[12] M. Ebrahimpour, "An examination of quality management in Japan: Implications for management in the United States," *J. Operations Management*, vol. 5, no. 4, pp. 419-431, 1985.

[13] H. Gitlow and P. Hertz, "Product defects and productivity," *Harvard Bus. Rev.* pp. 131-141, Sept./Oct. 1983.

[14] R. Schonberger, *Japanese Management Techniques: Nine Hidden Lessons in Simplicity*. New York: The Free Press, 1982.

[15] M. Tribus, "Prize-winning Japanese firms' quality management programs pass inspection," *Management Review*, pp. 31-37, Feb. 1984.

[16] D. Garvin, "Quality problems, policies, and attitudes in the United States and Japan: An exploratory study," *Academy of Management Journal*, vol. 29, pp. 653-673, 1986.

[17] B. Modarress and A. Ansari, "Quality control techniques in U.S. firms: A survey," *Production and Inventory Management Journal*, vol. 30, pp. 58-62, Second Quarter, 1989.

[18] J. Juran, "Quality Control—a prescription in the West," *Management Review*, vol. 70, no. 5, pp. 9-14, 1981.

[19] S. Lee and M. Ebrahimpour, "An analysis of Japanese quality control systems: Implications for American manufacturing firms," *SAM Advanced Management Journal*, vol. 50, no. 2, pp. 24-31, 1985.

[20] "A new era for auto quality," *Business Week*, pp. 84-86 + , Oct. 22, 1990.

[21] J. Kimberly, "Organizational size and the structuralist perspective: A review, critique, and proposal," *Administrative Science Quarterly*, vol. 21, no. 4, pp. 571-597, 1976.

[22] "1990 ASQC/Gallup Survey," *On Q*, vol. V, no. 9, pp. 2-3, Nov. 1990.

[23] W. D. Reitsperger and S. J. Daniel, "Dynamic manufacturing: A comparison of attitudes in the U.S. and Japan," *Management International Review*, vol. 30, no. 3, pp. 203-216, 1990.

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