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**PERFORMANCE MANAGEMENT SYSTEMS:  
A STATISTICAL ANALYSIS**

by

**James W. Kilby**

**September 1993**

**Principal Advisor:**

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A Statistical Analysis

by

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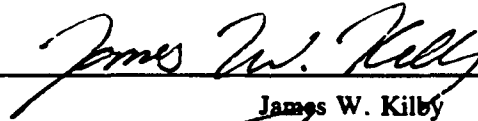
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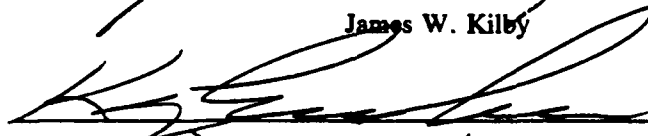
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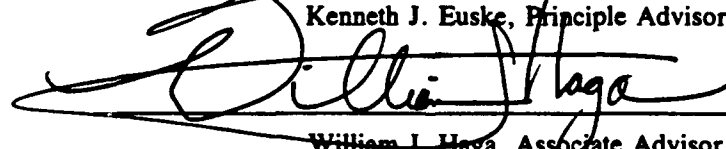
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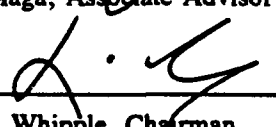
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## ABSTRACT

This study assessed the performance management systems used by companies, in an effort to identify the evolution of new management techniques in corporations. The sample consisted of 119 individual survey respondents from "high performing" entities. The data collected was part of a larger performance measurement study conducted by Euske, Lebas and McNair (1993). "High performing" entities were identified by the management of companies included in this study. Companies selected for the study were identified by the CAM-I research consortia or directly identified by Euske, Lebas or McNair.

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## **I. INTRODUCTION**

In 1990, Harvard Business review conducted a managerial survey in order to explore practices used by companies internationally. After compiling the survey results, the single message pointed to managerial change everywhere, regardless of country, culture or corporation (Kanter, 1991, pg.152). A study by Selto and Young (1991) indicates that in response to increasing competitive pressure from European and Asian competitors within the last ten years, that U.S. firms have adopted new production methods. Another study by Schaffer and Thomson (1992) argues that companies are discarding new production methods almost as quickly as they are adopting them when expected gains in productivity are immediately met.

A common tie between all of these studies is a continuing effort by companies to increase productivity through the adoption of "cutting edge" management practices such as just in time (JIT), total quality management (TQM), and socio-technical design.

### **A. OBJECTIVE**

The purpose of this thesis is to examine the extent of implementation of new production methods and managerial practices in the corporate environment. This study uses

survey data already collected as a part of a larger study (Euske, Lebas and McNair, 1993) of performance measurement systems in 17 multinational companies. This study provides a snapshot view of these companies, and an initial stage from which to conduct future comparative studies designed to measure changes in performance measurement systems.

## **II. METHODOLOGY**

The data used in this research were taken from 119 surveys filled out by individuals from 17 companies in diverse industries located at 22 sites located throughout the United States and Europe. A blank survey is included as the Appendix of this study. The population of survey subjects was made up of volunteers from eight general management positions: supervisor of the site manager, site manager, managerial staff-other, materials manager, production manager, site controller, quality manager, line manager, and product development. The respondents were all assured anonymity, before any data were collected. This study is based on statistical analysis of the data collected from the surveys using SPSS release 4.1. This chapter discusses the methodology used in the preparation and analyses of the data.

### **A. THE SURVEY**

The survey used in this study was written by Euske, McNair and Lebas (The Appendix) to gather data which would be used in a larger study of performance measurement systems. The survey was pilot tested on a small sample of managers and was written to complement questions used in the interview portion of their study.

## **B. COLLECTION OF DATA**

As questionnaires were received they were assigned a unique serial number. This serialization process facilitated the process of tying a survey to an individual while still retaining individuals' confidentiality. After serialization, the surveys were coded into 117 line records containing all the data of the survey as well as the serial number for identification. The format of the data file was selected to facilitate the complete coding of all 64 questions, whether the data contained in a question was a letter, number or an alphabetic string. Each piece of data was tagged with a unique identifier to facilitate the use of SPSS later in the study. For example, question 1 has 9 components, they were identified as Q1A - Q1I, so that individual components of questions could be manipulated. Just as components of questions were identified with an alpha character, so were sub-components identified with a number (e.g., Q45A1 represents the percentage of Line Workers who have been continuously employed for 1 to 3 years). Upon completion of coding on a personal computer, the data were downloaded into the AMDAHL 5990-500 mainframe computer.

## **C. DATA VALIDATION AND PREPARATION**

Initially, the data were corrected for obvious errors such as incorrect record length and general format. The data file was then run through an SPSS template and each coded

survey was checked against an ideal model; field lengths and data types were checked to ensure there were no obvious errors. Errors discovered by the program were corrected with the Xedit editor function VM/CMS.

Following this, a validation process was devised to eliminate errors which occurred during the coding of responses from the surveys to their representative data records. Initially, descriptive statistics were run on all questions to become familiar with the nature of the data. Data found to be beyond the parameters was identified for subsequent investigation by hand. Coding errors were corrected through soft code corrections. A soft code correction is simply a line of code which would be incorporated into the system file before analysis began (e.g., IF COMPANY= 101 AND INDIVIDUAL =02 THEN Q1A=010).

Additional SPSS programming was used to discover errors undetected through previous methods. The first stage involved questions whose components should have added up to one hundred percent (e.g., question 1). Simply running descriptive statistics did not cover these cases of inequality. An SPSS program identified surveys which fell into this category by printing out a list of questionnaires by serial number and the question's sub-components whose summation did not equal one hundred percent. As indicated previously, coding errors were corrected through soft coding.

Once the percentage questions were corrected, the remaining questions that lent themselves to "logic" coding were checked and corrected as necessary. For example, question 41, which queried the respondent about the number of years of professional experience, was validated for obvious coding errors through a process of checking responses greater than a selected value. A program was written to identify all surveys which indicated a response greater than a 50 years (this value was selected as an arbitrary cutoff). While this procedure would not ensure that all coding errors were discovered, it did point out some of the more obvious errors.

Following logic testing, a final validation technique was used, where all the non-percentage questions were printed out using the LIST VARIABLES Command in SPSS and checked manually. (The percentage questions were not printed out under the assumption that if the summation of their components equaled 100 percent, they were coded correctly). As previously stated only coding errors were corrected in this manner.

In a few cases, out-of-parameter data were discovered to be correctly coded with the error caused by the subject in completion of the survey. In the majority of cases this did not appear that it would have a significant effect on the analysis and as a result these responses were left to stand (e.g., sections of a percentage question whose summation equaled 99% vice 100%). In the few cases where a subject's apparent misinterpretation of a question skewed the results

dramatically, the missing value function of SPSS was used, and that datum was not used in analyses.

During the manual phase of validation, it was discovered that in three of eight surveys collected from a single company, the majority of responses were identical. An analysis was conducted comparing the whole population (119 surveys) to a modified population excluding the company in question (111 surveys), to determine the effect on measures of central tendency. Sample ordinal (questions 15 through question 22) and ratio scale questions (question 1 , sections A through H) were selected for this analysis. The difference between means and standard deviations for the ratio scale questions were less than a percentage point, while there was no difference between the median and range for the ordinal questions. The decision was made to leave the questionnaires in the study, with the realization that use of the data for a purpose other than this thesis would require that only one of the three questionnaires in this specific group should be used in the analysis.

Upon completion of the validation process, an SPSS system file was created which contained the data, soft code corrections and a data dictionary. The data dictionary specifies field lengths and data type that are found throughout the data record. Creating a system file facilitated the analysis phase in that each analysis program simply contained a command which retrieved the system file

followed by the individual commands which performed the desired statistical analysis techniques. When the command is issued retrieving the system file, the data definitions are read into memory, soft code corrections are assimilated and the appropriate data are then manipulated depending on the statistical operation executed.

#### **D. STATISTICAL ANALYSIS METHODS**

The statistical analysis of data is based on an exploratory, iterative approach stemming from hypotheses formed during the literature review of this study. Initial results provided the guidance to reanalyze the data to form a clearer picture of what the data represented. The analysis process cannot be described as a series of hypotheses that were stated and tested, but more as a continuing process of the author exploring areas that appeared consistent or contradictory to current literature. For example, in order to test the depth of TQM implementation, the extent that TQM was employed in a given unit was compared to several principles of TQM to measure the strength of association between these variables.

##### **1. Statistical Methods Employed**

Descriptive statistics were used to describe the nature of the data while the inferential measures of association were used to test the depth of implementation and usage of various performance measurement systems. Execution

of SPSS source code for a given analysis produced a listing file which contained analysis results as well as the original source code for that specific analysis. All listing files were printed and saved to form a permanent record of analyses conducted.

**a. Descriptives**

(1) Frequencies. Frequencies were run throughout the analyses to obtain mean, median, mode, variance, maximum response, minimum response, range of variables and coefficient of skewness. These functions were most useful when examining data such as compensation, sales growth and average product life cycle.

**b. Inferential Measures of Association**

(1) Chi-Square. The Pearson chi-square statistic was used to test whether two variables were related in the population (Norusis, 1987, pg. 239). The chi-square statistic evaluates the difference between a set of observed frequencies and a set of expected frequencies. While the associated significance identifies the confidence interval of finding that relationship in a random manner. This test is appropriate for nominal, interval, ordinal and ratio data (Euske, 1984, pg. 82).

(2) Pearson Product-Moment Correlation Coefficient. In order to test the correlation between interval or ratio scale variables, the Pearson product-moment correlation

coefficient was used (Siegel, 1956, pg 195). The correlation coefficient will have a value between -1 and 1. The associated significance of the Pearson correlation can also be obtained through SPSS. For example, the Pearson correlation coefficient was used when examining the existence of a correlation between critical success factors (question 1) and performance measures (question 10), both ratio scale data based on percentages.

### (3) Spearman Rank Order Correlation Coefficient.

The Spearman rank order correlation coefficient was used when testing the correlation between variables measured at least at an ordinal scale (Siegel, 1956, pg. 202). The conditions for the Spearman correlation coefficient are the same as the Pearson product moment correlation coefficient. For instance, The Spearman correlation coefficient was used when testing correlation between likert-type scale questions (e.g., questions 15 - 31) and other questions that showed some order (e.g., question 4).

### (4) Analysis of Variance (ANOVA).

Analysis of variance use sub-samples when dividing the population of respondents into different sub-groups and examining how they responded to interval data type questions. An example of how this function was used is the analysis of how people felt about critical success factors after being divided into

technical and non-technical categories based on the nature of the last degree obtained.

#### **E. ORGANIZING THE RESULTS**

When the results from the analysis were examined it became apparent that the findings were grouped into three areas: modern management practices, organizational characteristics and corporate environment. The following three chapters present these results.

### **III. MODERN MANAGEMENT PRACTICES**

During the 1980's a management revolution overtook the industrial world, it particularly affected American manufacturers, who realized that in order to remain competitive, new management styles and techniques would have to be adopted. However, researchers are now beginning to discover that the transition to new management disciplines is more difficult than was originally imagined. For example, McNair and Stasey (1990. pg. 126) point out that the adoption of just-in-time manufacturing (JIT) is not simply procedural but attitudinal, that managers must consciously give up some control so that the workers can form an autonomous unit which in turn will control a process. Some researchers go further and state that often migration to new management techniques are not successful (Schaffer and Thomson, 1992).

The analyses discussed in this chapter are an attempt to define the attitudes of respondents from the companies surveyed toward this revolution of modern management techniques.

#### **A. EMPOWERMENT**

Traditional management practices supported by Taylor's time and motion studies, dictate that bureaucracy or "order by rule" is the most efficient form of managing large groups

of people (Peters and Waterman, 1982, pg. 92). Contrast the traditional management approach with a study of competitive advantage by Ulrich and Lake (1991) who state that employees from the most successful companies feel empowered to think and act as leaders within their areas of responsibility. Lawler and Bowen (1992, pg. 32) define empowerment as supplying line employees with four organizational elements; (1) information about organizational performance, (2) reward's based on the organizations' performance, (3) knowledge that enables employees to contribute to an organizations' performance and finally, (4) power to make decisions to influence the organizations direction.

Given the relative importance placed on empowerment in recent literature we hypothesized that there should be a positive association between properties of empowerment illustrated in the survey. Question 19 in the survey measured the extent that production workers have control over the decisions on the plant floor, as a result this question became the key variable with which other tenets of empowerment would be correlated. Two other questions: question 21 , which measured the extent that production workers maintain records on the shop floor, and question 30, which queried whether or not production workers are included in regular production briefings were compared to question 19 with the expectation that they would result in positive correlations. Table 1 below indicates the result of the analyses.

## Empowerment Correlation Table

TABLE 1

| QUESTIONS CORRELATED | SPEARMAN CORR. | SIGNIFICANCE |
|----------------------|----------------|--------------|
| Q19 with Q21         | .4546          | < .001       |
| Q19 with Q30         | .4674          | < .001       |

The analyses rejected the null hypotheses that there is no relationship between the variables. The results above indicate that there is a positive relationship between production worker decision making on the plant floor and production workers being included in production meetings. Additionally, the relationship between production worker decision making and production worker record maintenance is consistent with the principles of empowerment, in that those personnel most familiar with information are included in the decision making process.

The results indicate an association between the degree with which production workers make decisions and how well informed they are (e.g., production meetings and record maintenance). These results support the argument that managers are placing production workers in participative roles which will ultimately influence the success of the company. These results also indicate that managers responded that they are allowing production and line workers some voice in how operations are conducted in their respective areas. Contrast this finding to an environment which prevailed in corporate

America not so long ago, where workers would not volunteer any information on operating conditions much less suggest ways to improve a process (Womack, Jones and Roos, 1990, pg. 32).

## **B. TEAMWORK**

Teamwork is a pillar of many modern management techniques (e.g., JIT, socio-technical design and lean production). Team-building can exist in many forms, for example it can exist in manufacturing teams as illustrated by the Volvo plant located in Udevalla Sweden or by problem solving teams created to answer the "five why's" in Toyota plants (Womack, Roos and Jones, 1990). Hirschhorn and Gilmore address the benefits of teams by stating "teams provide a mechanism for bringing people together with different but complementary skills and tying them to a single goal..." (Hirschhorn and Gilmore, 1992 pg. 108).

Given the amount of literature based on teamwork today, we expected to find evidence supporting team usage and implementation. Our hypothesis was that there would be evidence of team usage throughout the respondent population. The measure of central tendency for the extent of problem solving team usage (question 26) on a 0 to 7 likert-type scale was found to be a median of 6 with a coefficient of skewness of -.968, supporting our hypothesis of team usage.

Our hypothesis was that there would be a positive association between the extent of problem solving team usage

(question 26) and the amount that production workers were included in problem solving teams (question 24). Table 2 illustrates the results of this analysis.

**Teamwork Correlation Table**

**TABLE 2**

| QUESTIONS CORRELATED | SPEARMAN CORR. | SIGNIFICANCE |
|----------------------|----------------|--------------|
| Q24 with Q26         | .6840          | < .001       |

The analysis rejects the null hypothesis that there is no relationship between these questions. The respondents indicated that there is a relationship between problem solving team usage and production worker involvement in those teams.

Teamwork in itself is a departure from Taylor's theory of scientific management, where managers rarely seek any input from line workers. Whether it be in the Volvo plant or efficiency teams used in the Eddystone Generating Station of Philadelphia Electric, teams compare quite favorable to individual efforts (Womack, Roos, Jones, 1990, Schaffer and Thomson, 1992). The survey results indicating team usage is consistent with literature declaring a growing and widespread use of teams for a variety of functions (Hirschhorn and Gilmore, 1992 and Ost, 1990).

### **C. TOTAL QUALITY MANAGEMENT (TQM)**

Olian and Rynes (1991, pg. 304) state that Total Quality Management (TQM) is often mistaken as a tool or a technique when in reality it is a management system that changes the way

companies view and interact with each of their primary stakeholders: customers, employees, suppliers and shareholders. While TQM is perhaps better known than any of the modern management "cutting edge techniques", to some it is a meaningless acronym and to cynics a title for "what we are already doing".

In order to test how companies view TQM as well as the depth of understanding of TQM, analyses were conducted on how a subject responded to TQM (question 57 part E) as compared to how the subject responded to some principles that TQM embraces. We hypothesized we would find evidence of TQM employment by the respondents of the study. The measure of central tendency for TQM employment (question 57 part E) on a 0 to 7 likert-type scale was a median of 5 with a coefficient of skewness of  $-.837$ , supporting our hypothesis.

The principles that were compared to TQM will be listed in Table 3 with an explanation in following paragraphs. All associations were hypothesized to result in a positive correlation.

The first analysis correlated responses dealing with how the subject responded to TQM employment (question 57 part E) and the extent that workers participated in efforts to improve the production process (question 29). Oljan and Rynes (1991, pg. 306) cite continuous process improvement (CPI) as a characteristic of TQM. The positive correlation coefficient shown in the Table 3 confirms our expectations,

### TQM Correlation Table

TABLE 3

| QUESTIONS CORRELATED | SPEARMAN CORR. | SIGNIFICANCE |
|----------------------|----------------|--------------|
| Q57E with Q29        | .4067          | < .001       |
| Q57E with Q30        | .2713          | .002         |
| Q57E with Q28        | .3472          | < .001       |
| Q57E with Q31        | .3290          | < .001       |
| Q57E with Q57F       | .4781          | .001         |
| Q57E with Q22        | .3290          | < .001       |

that managers from our sample set state that there is a relationship between TQM and CPI.

How strongly the subject responded to TQM employment was correlated with the amount production worker were included in production briefings (question 30). Olian and Rynes, (1991 pg. 309) stress the importance of communication with respect to TQM. Including production workers in briefings is an indication that management is attempting to disseminate word to the production workers in order to strengthen these communication lines. While this correlation coefficient indicated in Table 3 was not as strong as we had originally expected, the positive coefficient indicates support for our original supposition.

How subjects responded to TQM employment was then compared to whether or not production workers maintained their own equipment (question 28). This analysis was conducted due to the frustration of production workers not being able to

maintain their own equipment as pointed out by Deming (1982, pg. 80). If companies were truly embracing TQM, it would follow that workers would become more responsible for their own equipment. The results in Table 3 indicate that there is some relationship between the adoption of TQM principles and the amount that workers maintain their own equipment.

How a subject responded to TQM employment was correlated with the extent that production workers have a say in how the factory is run (question 31). Olian and Rynes (1991, pg. 306) stress the importance of empowerment in any successful TQM movement. Olian and Rynes (1991), and Deming (1982) lead us to believe that there should be a positive correlation between these two variables. The positive correlation coefficient in Table 3 supports our original hypothesis that empowerment is related to TQM.

Another analysis correlated responses towards TQM employment with how strongly the subject felt about statistical process control (SPC) (question 57 part F). Deming espouses the advantages of using SPC in order to accurately measure changes in systems (Deming, 1982, pg. 340). The results in Table 3 support our original hypothesis that TQM and SPC would be correlated.

TQM literature supports the communication of a corporate vision as well as the communication of a quantifiable way to measure progress in attainment of that vision (Olian and Rynes, 1991, pg. 306). As a result we expected to find a

positive association between the comparison of TQM employment and the extent that performance measures were posted in the production area (question 22). The results in Table 3 confirm our hypothesis, that the act of communicating goals to employees is related to emphasis of TQM.

The correlations listed in Table 3 support Olian and Rynes (1992, pg. 303) statement that TQM is seen by corporate leaders as one of the most important strategic tools at their disposal. The strong correlations between TQM and some of its tenet properties indicate that the managers in this study are well versed in some of the principles supported by TQM.

#### **D. CONTINUOUS PROCESS IMPROVEMENT**

Continuous process improvement (CPI) is an integral part of many new management techniques (e.g., TQM and JIT). Schroeder and Robinson define continuous process improvement programs as those programs designed to implement a system whose natural equilibrium is constant improvement and change (Schroeder and Robinson, 1991, pg.67). Our hypothesis was that there would be evidence of continuous process improvement throughout the respondent population. The measure of central tendency for the use of continuous process improvement goals (question 16) on a 0 to 7 likert-type scale was found to be a median of 5 with a coefficient of skewness of -1.061, supporting our hypothesis of emphasis of continuous process improvement goals.

In order to measure the depth of support of continuous process improvement, the relationship between continuous improvement goals (question 16) and the extent that personnel were encouraged to meet preset performance objectives (question 15) was measured. It was expected that this comparison would result in a negative correlation, because preset performance objectives are contrary to the tenets of CPI. The result of our analysis are listed in Table 4.

**Continuous Process Improvement Correlation Table**

**TABLE 4**

| QUESTIONS CORRELATED | SPEARMAN CORR. | SIGNIFICANCE |
|----------------------|----------------|--------------|
| Q15 WITH Q16         | .3973          | < .001       |

The analysis above did not reject the null hypothesis. A possible explanation of this result is supplied from Schroeder and Robinson, who argue that though many CPI programs were developed in the United States, few U.S. companies have invested the effort in CPI equivalent to that of their Japanese competitors (Schroeder and Robinson, 1991).

#### **E. QUALITY**

Traditional quality assurance implemented by Henry Ford in his assembly lines involved special inspectors who once they discovered defects would correct them at the end of the line (Womack, Jones and Roos, 1990 pg. 55). In the Toyota manufacturing design the workers who discover quality defects stop the production line, remove and the defective part and

send it to the quality department for investigation (Womack, Jones and Roos 1990, pg. 79). The vast difference between these two methods, inspecting workers versus trusting them, is a fundamental difference between traditional manufacturing approaches and new techniques like TQM and JIT.

In an effort to measure this, the extent that production workers are allowed to stop the line if they sense a problem (question 23) was compared with the extent that quality management is a function of a single department (question 25). We expected for these variables to be negatively correlated, if a production line relies on workers to maintain quality, then quality would not be a function of single department.

**Quality Correlation Table**

**TABLE 5**

| QUESTIONS CORRELATED | SPEARMAN CORR. | SIGNIFICANCE |
|----------------------|----------------|--------------|
| Q23 with Q25         | -.1286         | .092         |

While the statistical significance of the result is not as high as some of the other results, the results do indicate that the respondents replied that as companies rely more on production workers to discover defects the emphasis on a single quality department is decreased.

#### **F. JUST IN TIME (JIT)**

Just in time delivery is sometimes looked at solely as a method with which to deal with suppliers and inventory techniques (McNair and Stasey, 1990 pg. 13). In reality it is

much more than that. JIT is comprised of waste reduction, defect prevention and premium quality. JIT is constantly concerned with the elimination of waste, waste being defined as unneeded, non-value added activity at any stage of the production cycle (McNair and Stasey, 1990, pg. 11). In order to measure the usage and knowledge of JIT several analysis techniques were employed.

Our hypothesis was that there would be evidence of JIT throughout the respondent population. The measure of central tendency for the use of continuous process improvement goals (question 16) on a 0 to 7 likert-type scale was found to be a median of 4 with a coefficient of skewness of  $-.457$ , giving weak support to our hypothesis of emphasis of JIT.

McNair and Stasey (1990) point out that both the Kanban inventory system and statistical process control (SPC) are integral parts of the JIT manufacturing implementation. Both the extent of Kanban (question 57 part G) and SPC implementation (question 57 part F) were correlated with the extent of JIT implementation (question 57 part A). Because of the reference in literature to these two techniques, we expected to find a positive relationship for each correlation.

**JIT Correlation Table**

**TABLE 6**

| QUESTIONS CORRELATED | SPEARMAN CORR. | SIGNIFICANCE |
|----------------------|----------------|--------------|
| Q57A with Q57G       | .3199          | < .001       |
| Q57A with Q57F       | .5358          | < .001       |

The results in Table 6 reject the null hypotheses. Table 6 shows a positive correlation between JIT and Kanban as well as JIT and SPC techniques, supporting our original hypotheses.

#### **G. FINANCIAL INFORMATION AND ACCOUNTABILITY**

McKinnon and Bruns (1992, pg. 42) highlight a contradiction between production managers stressing the content of daily reports but later stating that the most useful reports are monthly financial or expense reports.

In order to examine the nature of financial information, we compared the frequency with which people receive financial information (question 13) to the degree that they are held accountable for financial performance (question 14). The points highlighted by McKinnon and Bruns lead us to hypothesize that there should be a positive correlation between the two variables.

Table 7 shows that there is a strong relationship between the frequency of receiving financial information (question 13) and the degree to which individuals are held accountable for it (question 14). Based upon the literature reviewed (McKinnon and Bruns, 1992) the results do not give rise to any surprising conclusions. For example, the median for question 13 part A is 4 and the median for question 14 part A is 2; this implies that overall Line Workers "occasionally" receive financial information and "to a small extent" are held accountable for financial performance. While the median for

## Financial Information Correlation Table

TABLE 7

| PERSONNEL CATEGORY         | SPEARMAN CORR. | SIGNIFICANCE |
|----------------------------|----------------|--------------|
| Line Workers               | .4940          | < .001       |
| 1 <sup>st</sup> Level Mgt. | .5026          | < .001       |
| Middle Mgt.                | .3704          | < .001       |
| Unit Top Mgt.              | .4288          | < .001       |
| Unit Manager               | .3310          | < .001       |

question 13 part E is 7 and the median for question 14 part E is 7, implying that Unit Managers overall frequently receive financial information and are held "to a very great extent" accountable for financial performance. While this does not address the contradiction advanced by McKinnon and Bruns, it does support the argument that managers think they are receiving financial data at the proper frequency.

### H. CRITICAL SUCCESS FACTORS AND PERFORMANCE DIMENSIONS

An article by Schneier, Shaw and Beatty (1991, pg. 288) states that the performance measurement and management process should be developed to support a companies' critical success factors. The relationship between a unit's critical success factors (CSF) and measured performance dimensions was examined, with the expectation that there would be a positive correlation between the two. The same list of CSFs (question 1) and performance dimensions (question 10) was given to each

subject for a relative percentage ranking of importance for each of the items within each question.

**Critical Success Factors and Performance Dimensions  
Correlation Table**

TABLE 8

| CSF AND PERFORMANCE AREAS | PEARSON CORR. | SIGNIFICANCE |
|---------------------------|---------------|--------------|
| Respon. to Customer needs | .4993         | < .001       |
| Continuous Process Imp.   | .3004         | .001         |
| Product Innovation        | .5020         | < .001       |
| First to Market           | .4285         | < .001       |
| Cost                      | .2913         | .020         |
| Quality                   | .3136         | .001         |
| On Time Delivery          | .4376         | < .001       |
| Productivity              | .5188         | < .001       |

Table 8 shows a consistent positive correlation between critical success factors and performance dimensions, supporting our original hypothesis. The relationship in Table 8 illustrates that the respondents indicated that in most cases companies are measuring performance on what they consider critical to the success of the company.

**I. SUMMATION**

The factors listed above give evidence that an evolution if not a revolution of management change is underway in the corporate environment. On the most elemental level there is evidence that the manufacturing industry as a whole is going away from more mechanistic forms of management and moving

towards empowering the production worker to form autonomous quality driven teams. Additional evidence gives some credence that practices like TQM and JIT are not just buzzwords, but are concepts which are in the process of being implemented. The quality process is evolving from something that is checked by a foreman to something that is built in to a product and ensured by a workgroup. Finally, the close correlation between critical success factors and performance dimensions leads one to believe that companies are rewarding personnel for behavior that they feel will ensure the success of the company.

#### IV. ORGANIZATIONAL CHARACTERISTICS

A portion of the survey was devoted to identifying organizational characteristics. Though all of these characteristics do not necessarily deal with "cutting edge management techniques" directly, they present an intriguing array of descriptive data. The following sections assist in the understanding the "snapshot" view of these corporations provided by the survey.

##### A. LENGTH OF CONTINUOUS EMPLOYMENT

In their study of the automotive industry, Womack, Jones and Roos contrast lifetime employment by Japanese automobile companies with the transitory nature of employment seen in U.S. automobile companies (Womack, Jones and Roos, 1990). Question 45 indicated length of employment of categories of personnel. We looked at this to see how these companies compared to the findings articulated by Womack, Jones and

##### Descriptive Statistics on Continuous Employment

TABLE 9

| PERSONNEL CATEGORIES       | 1-3 yrs | 3-5 yrs | 5-10 yrs | > 10 yrs |
|----------------------------|---------|---------|----------|----------|
| Line Worker                | 16.7 %  | 17.7 %  | 26.5 %   | 38.0 %   |
| 1 <sup>st</sup> Level Mgt. | 9.5 %   | 14.0 %  | 31.6 %   | 45.0 %   |
| Middle Mgt.                | 9.6 %   | 11.4 %  | 30.7 %   | 48.3 %   |
| Unit Top Mgt.              | 9.1 %   | 9.5 %   | 23.6 %   | 57.9 %   |
| Unit Manager               | 14.9 %  | 3.7 %   | 18.4 %   | 55.9 %   |

Roos. Analysis of Table 9 indicates that in all cases the majority of personnel in each category have been continuously employed for over five years. Additionally, the first four categories of positions in Table 9, show that successive year group category holds a higher percentage of people than the last. For example, Line Workers; 16.7 percent were employed for 1-3 years, 17.7 percent were employed for 3-5 years, 26.5 percent were for 5-10 years and 38.0 percent were employed for over 10 years. The only exception to this pattern is for the category of Unit Manager, where the percentage of people hired from 1-3 years is 14.9 percent and then drops to 3.7 percent in the successive 3-5 year category. There are no data from the survey which explains this anomaly.

The descriptive data on employment pertaining to the survey respondents were analyzed. The respondents were placed into one of 10 categories based on job description. Question 43 asked how long the respondents have been employed by the company they are currently working for. Table 10 lists the mean and standard deviation for all 10 categories. Although the standard deviations are relatively large, the mean employment in years is greater than sixteen years in all categories with the exception of Site Controller. The large standard deviations are in keeping with the theories forwarded by Womack, Jones and Roos, that individual employment with a single company has a transitory nature. It would be interesting to compare Table 10 to a similar study conducted

**Descriptive Statistics on Continuous Employment of  
Management Personnel**

TABLE 10

| POSITION TITLE          | MEAN YEARS | STANDARD DEV. |
|-------------------------|------------|---------------|
| Site Manager            | 16.0       | 9.96          |
| Production Manager      | 17.4       | 9.58          |
| Site Controller         | 8.3        | 4.34          |
| Managerial Staff-Other  | 16.5       | 8.7           |
| Quality                 | 21.1       | 10.68         |
| Supervisor of Site Mgr. | 19.8       | 8.26          |
| Material Manager        | 16.8       | 10.75         |
| Line Manager            | 20.4       | 10.45         |
| Project Development     | 16.5       | 19.09         |
| TOTAL                   | 16.4       | 9.65          |

on Japanese automobile companies, based on Womack, Jones and Roos one would expect to see much smaller standard deviations.

**B. EDUCATION ATTAINMENT**

While the level of attainment and quality of education of personnel traditionally has not been the responsibility of a companies, it is clear that modern management techniques require greater forethought, insight, and responsibility demonstrated by employees than traditional management practices. In her study exploring business boundaries, Rosabeth Kanter points out that managers single out the quality of education as the most significant issue affecting their organizations (Kanter, 1991, pg. 156).

The median response of question 46 were examined in order to measure the levels of educational attainment for five categories of personnel in each company (Table 11).

**Average Educational Attainment by Personnel Category**

TABLE 11

| PERSONNEL CATEGORIES       | AVERAGE EDUCATION IN YEARS |
|----------------------------|----------------------------|
| Line Workers               | 12 years                   |
| 1 <sup>st</sup> Level Mgt. | 13-14 years                |
| Middle Mgt.                | 15-16 years                |
| Unit Top Mgt.              | 16 or more years           |
| Unit Manager               | 16 or more years           |

Line Workers have attained an average of 12 years of education while higher levels of education have been obtained by more senior personnel. However, it is important to remember that the values illustrated in Table 11, are medians. It is estimated that 20 percent of adult Americans are functionally illiterate and that 25 percent of our high school students do not graduate (Hitt, Hoskisson and Harrison, 1991, pg. 9). Hitt, Hoskisson and Harrison (1991, pg. 9) point out that one plant had difficulty implementing computer integrated manufacturing and statistical process controls because the workers were unable to operate the equipment due to poor educational background.

### C. COLLEGE DEGREE

An analysis was conducted to see if the nature of the college degree obtained by managers had any influence on how they responded to the weighing of critical success factors and performance dimensions. It was hypothesized that there would be appreciable differences in areas where the nature of a degree might have a tendency to influence the position held by an individual. For example, if non-technical degree holders tended to work in sales they might feel differently about product cost than technical degree holders who worked in research and development.

Question 39 and 46 queried the respondent about bachelor and masters degrees. From these responses a list was compiled of the last degree obtained for each respondent and classified as either technical or non-technical. Once this list was created, an analysis of variance (ANOVA) was conducted on critical success factors (question 1) and performance dimensions (question 10) to identify any existing relationship between these factors and degree type.

The first analysis conducted was between degree type and performance dimensions (question 10). As one can see from Table 12, there did not appear to be a statistically significant difference between the populations. The statistically significant (P values) relationships that existed in the areas of "responsiveness to customer needs", "first to market" and "productivity", could be a function of

current position held and not a reflection on the type of educational degree type.

**Nature of College Degree and Performance Dimensions Analysis of Variance (ANOVA)**

**TABLE 12**

| PERFORMANCE DIMENSION AREAS    | F-VALUE | SIGNIFICANCE |
|--------------------------------|---------|--------------|
| Responsiveness to Customer     | 6.270   | .014         |
| Continuous Process Improvement | 2.731   | .101         |
| Product Innovation             | .085    | .771         |
| First to Market                | 3.772   | .055         |
| Cost                           | .008    | .927         |
| Quality                        | .650    | .422         |
| On time delivery               | 1.479   | .227         |
| Productivity                   | 7.494   | .007         |

**Nature of College Degree and Critical Success Factors Analysis of Variance (ANOVA)**

**TABLE 13**

| CRITICAL SUCCESS FACTOR AREAS  | F-VALUE | SIGNIFICANCE |
|--------------------------------|---------|--------------|
| Responsiveness to Customer     | .6980   | .009         |
| Continuous Process Improvement | 3.154   | .079         |
| Product Innovation             | .110    | .741         |
| First to Market                | .308    | .580         |
| Cost                           | 1.332   | .251         |
| Quality                        | .327    | .569         |
| On Time Delivery               | 12.338  | .001         |
| Productivity                   | 3.703   | .057         |

As one can see from Table 13, the strongest relationships between degree type and critical success factors are

"responsiveness to customer needs", "continuous process improvement", "on time delivery" and "productivity".

While some of the relationships displayed in Tables 12 and 13 indicate statistically significant results, the analyses of variance do not indicate that there is large difference in the ways the person's holding technical versus nontechnical degrees view these factors.

#### **D. UNIT'S PROFESSIONAL EXPERIENCE**

Peters and Waterman (1982) comment " Without exception the dominance and coherence of culture proved to be an essential quality of the excellent companies". In order to examine this, an analysis was conducted to see how individuals from units of different professional experience responded to the importance of performance dimensions and critical success factors. It was hypothesized that personnel from different areas would weight critical success factors and performance dimensions differently.

Question 47 queried the respondent as to the professional experience of the members of the unit (unit being defined by question 2). Respondents were asked to select one of the following professional experience groups: General Management, Operations Management, Engineering, Marketing/Sales, Finance/Accounting or Other. The analysis technique used was the same approach employed in the college degree analyses.

**Area of Professional Experience and Critical Success Factors  
Analysis of Variance (ANOVA)**

TABLE 14

| CRITICAL SUCCESS FACTOR AREAS  | F-TEST | SIGNIFICANCE |
|--------------------------------|--------|--------------|
| Responsiveness to Customer     | 3.022  | .014         |
| Continuous Process Improvement | 1.176  | .326         |
| Product Innovation             | 1.745  | .130         |
| First to Market                | 1.795  | .120         |
| Cost                           | .923   | .469         |
| Quality                        | 1.627  | .159         |
| On Time Delivery               | 1.55   | .179         |
| Productivity                   | .208   | .958         |

**Area of Professional Experience and Performance Dimension  
Analysis of Variance (ANOVA)**

TABLE 15

| PROFESSIONAL EXPERIENCE ANOVA  | F-TEST | SIGNIFICANCE |
|--------------------------------|--------|--------------|
| Responsiveness to Customer     | 5.757  | < .001       |
| Continuous Process Improvement | .361   | .874         |
| Product Innovation             | .794   | .556         |
| First to Market                | 2.524  | .033         |
| Cost                           | .738   | .596         |
| Quality                        | 1.530  | .186         |
| On Time Delivery               | .998   | .423         |
| Productivity                   | .203   | .961         |

There is only one statistically significant relationship in the Table 14, it is the relationship between professional experience and "responsiveness to customer needs" (as a CSF).

While the only statistically significant relationships in Table 15 are the relationships between professional experience and "responsiveness to customer needs" as well as "first to market".

Descriptive statistics were run on the areas of professional experience in order to see how the groups differed in their response to "responsiveness to customer needs". Table 16 displays these mean and standard deviations for CSF (question 1) and performance dimensions (question 10).

**"Responsiveness to Customer Needs" for Critical Success Factors (question 1) and Performance Dimensions (question 10) by area of Professional Experience**

TABLE 16

| PROFESSIONAL EXPERIENCE AREA | N  | CSF (Q1) (mean and std. dev.) | PERF. DIM. (Q10) (mean and std. dev.) |
|------------------------------|----|-------------------------------|---------------------------------------|
| Gen. Management              | 10 | 32.5% (14.2%)                 | 15.5% (10.2%)                         |
| Operations                   | 28 | 22.3% (11.1%)                 | 11.6% (9.9%)                          |
| Engineering                  | 69 | 22.8% (14.3%)                 | 10.5% (11.5%)                         |
| Marketing/Sales              | 3  | 13.3% (2.9%)                  | 8.3% (7.6%)                           |
| Finance/Acctng.              | 5  | 46.3% (39.0%)                 | 45.0% (40.4%)                         |
| Other                        | 3  | 30.0% (18.0%)                 | 21.7% (24.7%)                         |

As Table 16 indicates, the groups who most heavily weighted "responsiveness to customer need " were general management and finance and accounting. Marketing and sales weighted "responsiveness to customer needs" the least heavily of all the professional experience groups.

One of the keys to modern management practices is the ability to convey a commonly held vision to all units of professional experience within a company. The results indicated in Tables 14 and 15 did not demonstrate that different units of professional experience view critical success factors and performance dimensions differently. However, these results in themselves do not indicate that these groups share a common vision.

#### **E. PLANNING HORIZON**

Planning horizons at various levels were compared to average product life cycle in Table 17, in order to measure their relationship. Planning horizons were defined as follows: "individual planning horizon" (question 61), "unit planning horizon" (question 62), and "unit plan revision" (question 63). We expected to find some correlation in this areas, indicating that planning horizons were set up to coincide with a products expected life cycle.

**Planning Horizons and Product Life Cycle Correlation Table**

**TABLE 17**

| PLANNING HORIZON TYPE       | CHI-SQR  | SIGNIFICANCE |
|-----------------------------|----------|--------------|
| Ind. Planning Horizon (IPH) | 61.41977 | .0512        |
| Unit Planning Horizon (UPH) | 52.76181 | .19912       |
| Unit Plans Revised (UPR)    | 83.18788 | .02547       |

As Table 17 indicates, only the relationship between "unit planning horizon" and product life cycle did not result in the

rejection of the null hypothesis. "Individual planning horizon" and "unit plan revision" have a statistically significant relationship with product life cycle, supporting our original expectations.

An additional analysis was conducted to measure the correlation between how subjects responded among the three planning horizon areas (questions 61 - 63). We expected to find a strong positive correlations between the "unit planning

**Planning Horizons Correlation Table**

TABLE 18

| PLANNING TYPES CORRELATED                              | SPEARMAN | SIGNIFICANCE |
|--------------------------------------------------------|----------|--------------|
| Individual Planning Horizon with Unit Planning Horizon | .4376    | < .001       |
| Unit Planning Horizon with Unit Plan Revision          | .1555    | .050         |
| Individual Planning Horizon with Unit Plan Revision    | .0989    | .159         |

horizon" and "unit plan revision". We also expected to find a slightly weaker positive correlation between "individual planning horizon" and "unit planning horizon" as well as "individual planning horizon" and "unit plan revision".

The relationship between "individual planning horizon" and "unit plan revision" failed to support rejection of the null hypothesis. However, as hypothesized there was a significant relationship between "unit planning horizon" and "unit plan revision". Unpredictably though, the strongest relationship was between "individual planning horizon" and "unit planning

horizon". This relationship illustrates that subjects indicated that their individual planning horizons are roughly the same as their units.

#### **F. TRAINING**

Drucker (1991, pg. 68) states that the greatest benefit from training comes not from learning something new but from doing better what we already do well. In order to examine the state of training in these companies, the extent of training received (question 32) and the specificity of the training (question 33) were compared. The analysis distinguished between the five personnel categories used in previous analyses (e.g., Line Worker, First Level Mgt.). We hypothesized that in companies adopting new management practices that two types of relationships would be observed. First, that the lower categories of personnel, such as line workers, would receive a relatively greater amount of specific training resulting in a positive correlation. Second, that the higher levels of personnel, such as unit managers, would receive a relatively greater amount of general training resulting in a negative correlation.

Our hypothesis was correct, it appears that for Line Workers and First Level managers that there is a positive correlation between personnel category and the amount of training and specificity of training. However, the association weakens after these first two levels. While the

## Training Correlation Table

TABLE 19

| PERSONNEL CATEGORY         | SPEARMAN | SIGNIFICANCE |
|----------------------------|----------|--------------|
| Line Worker                | .2537    | .003         |
| 1 <sup>st</sup> Level Mgt. | .1768    | .029         |
| Middle Mgt.                | .0531    | .288         |
| Unit Top Mgt.              | -.0521   | .294         |
| Unit Manager               | -.1229   | .099         |

statistical significance (P value) of the analysis for the last three levels is small, the correlation coefficient goes from positive to negative values with each successive level of "personnel category", indicating that for the higher management levels, the more training one receives, the more general in nature it is.

While the training levels seems commensurate with the management levels within the companies, the results do not describe the history of the training, so no comment can be made as to whether or not training has always been this way or if these results reflect training in new management techniques. However, review of current literature reveals one certainty, adoption of new "cutting edge" management techniques requires commitment and training at all levels.

### G. INCENTIVES

As indicated in the narrative study of the "Banyon" corporation, McNair and Stasey (1990) indicate that many

traditional incentive systems are designed to reward individual effort. However, many new management techniques (e.g., JIT) are based on team or work group performance. As indicated by Ost, team based pay incentives are built on the following premises: (1) goals that can only be achieved through teamwork, (2) team based reward system based on the successful attainment of goals, (3) reward perceived by employee for contributions he or she has made, (4) the reward must be perceived as fair and (5) behaviors promoted by reward must be perceived as "good behavior" (Ost, 1990, pg.19). While not all the incentives systems of the companies surveyed were expected to meet Ost's premises, the evidence supporting existing "cutting edge management techniques" would lead one to believe that there should be some evidence of the existence of team-based reward incentive structures. Incentives were examined under several different categories: compensation, rewards, and consideration for promotion. The respondents were asked to consider these categories for five basic levels of personnel in their companies.

In Table 20, the top figure in each cell is the mean percentage of total salary that column represents while underneath this figure in parenthesis is the standard deviation. Line workers on the whole are compensated primarily by salary, while increasingly higher levels of each company receive greater benefits from, bonuses, gain-sharing

## Personnel Compensation Composition by Percentage

TABLE 20

| PERSONNEL<br>CATEGORY      | SALARY             | BONUS              | PROFIT<br>SHARING | GAIN<br>SHARING  |
|----------------------------|--------------------|--------------------|-------------------|------------------|
| Line Worker                | 94.0 %<br>(11.6 %) | 1.4 %<br>(4.8 %)   | 1.4 %<br>(3.0 %)  | .6 %<br>(1.7 %)  |
| 1 <sup>st</sup> Level Mgt. | 94.0 %<br>(12.2 %) | 2.4 %<br>(7.0 %)   | 1.3 %<br>(2.9 %)  | .6 %<br>(2.2 %)  |
| Middle Mgt.                | 94.0 %<br>(7.8 %)  | 3.2 %<br>(5.6 %)   | 1.4 %<br>(2.8 %)  | .7 %<br>(2.8 %)  |
| Unit Top Mgt.              | 86.2 %<br>(10.9 %) | 9.9 %<br>(10.0 %)  | 2.1 %<br>(4.5 %)  | .7 %<br>(2.8 %)  |
| Unit Manager               | 81.1 %<br>(15.4 %) | 14.1 %<br>(14.2 %) | 2.2 %<br>(4.3 %)  | 1.0 %<br>(4.6 %) |

and profit-sharing. However, there is evidence of profit and gain sharing in incentive systems at all levels in the companies. One cannot determine from the data on what factors the bonus system is dependent on (e.g., individual or team effort).

As can be seen in Table 21, line worker rewards are primarily dependent on individual performance, while more senior positions are rewarded for individual performance as well as the performance of their unit. Ost (1990) points out that while many programs were initiated in the 1980's, adoption of fully functional team-based pay systems takes time. The fact that 16.1 percent of the factors considered for rewarding line workers are based on team performance lends some evidence to the migration in support of team based reward systems. However, it must be remembered that Table 21

# Personnel Monetary Reward Composition by Percentage

TABLE 21

| TYPE OF PERSON             | INDIVID PERF.      | TEAM PERF.         | UNIT PERF.         | CORP. PERF.        | MGT. DISCR.       |
|----------------------------|--------------------|--------------------|--------------------|--------------------|-------------------|
| Line Work.                 | 38.9 %<br>(40.8 %) | 16.1 %<br>(27.6 %) | 19.4 %<br>(33.9 %) | 14.7 %<br>(32.9 %) | 4.7 %<br>(18.0 %) |
| 1 <sup>st</sup> level Mgt. | 41.6 %<br>(40.4 %) | 10.2 %<br>(17.9 %) | 19.0 %<br>(32.5 %) | 16.8 %<br>(34.6 %) | 9.9 %<br>(24.7 %) |
| Middle Mgt.                | 38.1 %<br>(38.9 %) | 10.4 %<br>(19.1 %) | 23.6 %<br>(34.2 %) | 15.2 %<br>(31.9 %) | 9.9 %<br>(24.3 %) |
| Unit Top Mgt.              | 26.6 %<br>(32.9 %) | 8.4 %<br>(15.2 %)  | 36.2 %<br>(34.8 %) | 15.5 %<br>(26.6 %) | 9.8 %<br>(22.1 %) |
| Unit Mgr.                  | 23.0 %<br>(32.8 %) | 3.5 %<br>(8.3 %)   | 39.3 %<br>(35.2 %) | 21.0 %<br>(30.1 %) | 9.3 %<br>(21.8 %) |

represents consideration for rewards beyond base salary. This is significant, because while the rewards are important, they are not a substitute for a team-based salary system.

The large standard deviations in Table 21 indicate a lack of consensus by respondent across companies in the weighting of factors in consideration for financial reward. The size of the standard deviations could be caused by several factors, a difference in the stage of program execution, or support of different programs all together, the data do not indicate a specific cause for this.

As with Table 21, the standard deviations in Table 22 are large, indicating a lack of consensus by the respondents across companies surveyed on the weighting of factors when considering an individual for promotion. A greater emphasis

**Emphasis of Factors by Percentage in Consideration of  
Promotion of Personnel**

TABLE 22

| TYPE OF PERSON             | INDIVID PERF.      | TEAM PERF.         | UNIT PERF.         | CORP. PERF.       | MGT. DISCR.       |
|----------------------------|--------------------|--------------------|--------------------|-------------------|-------------------|
| Line Work.                 | 67.1 %<br>(33.1 %) | 13.9 %<br>(17.5 %) | 5.6 %<br>(16.5 %)  | .4 %<br>(2.4 %)   | 2.7 %<br>(11.1 %) |
| 1 <sup>st</sup> level Mgt. | 65.4 %<br>(28.0 %) | 19.2 %<br>(19.9 %) | 8.4 %<br>(15.5 %)  | 1.7 %<br>(7.1 %)  | 5.0 %<br>(12.7 %) |
| Middle Mgt.                | 63.0 %<br>(29.6 %) | 18.4 %<br>(20.9 %) | 11.0 %<br>(17.0 %) | 1.3 %<br>(6.2 %)  | 6.0 %<br>(14.2 %) |
| Unit Top Mgt.              | 50.9 %<br>(30.1 %) | 15.6 %<br>(18.2 %) | 22.1 %<br>(23.2 %) | 3.2 %<br>(9.3 %)  | 7.7 %<br>(17.8 %) |
| Unit Mgr.                  | 39.5 %<br>(32.4 %) | 8.6 %<br>(14.1 %)  | 35.2 %<br>(31.2 %) | 6.9 %<br>(15.2 %) | 9.6 %<br>(21.6 %) |

is placed on individual effort in consideration for promotion (Table 22) than granting monetary awards beyond base salary (Table 21). Personnel are being rewarded for unit performance while individual performance is more heavily weighted when considering promotion. While it is natural to consider an individual's personal qualities when considering promotion and the team-performance when rewarding a member of the team, the different emphases are likely to promote different behaviors.

Another interesting observation is that in all cases with the exception of Line Worker, "Team Performance" is given more weight in consideration for promotion than in consideration for financial reward. An explanation of this could be that behaviors conducive to team performance among line workers are

not necessarily those that management seeks to engender among managers.

## **V. CORPORATE ENVIRONMENT**

The last chapter of findings concentrates on the environment, or factors that individuals or the company can effect but do not control directly. For example, a company's adoption of a new manufacturing technique can affect sales and consequently will affect the company's impact on the environment. Conversely, just as the organization can influence the environment, the environment can influence the system. The factors considered in this chapter are competitive pressure, sales growth, and performance measures changing in response to the market and manufacturing environments.

### **A. COMPETITIVE PRESSURE**

Question 59 ranked the respondents opinion of competitive pressure on an 8 point scale. The degree of competitive pressure was compared to various management techniques and practices (question 57) in Table 23.

Most of the results with the exception of CAD/CDM are associated with a relatively high levels of significance or P values. However, the median value for competitive pressure (question 59) was 6 (on a scale of 0 to 7), and 82 percent of the population responded to this question with either a "7" or a "6". In other words the majority of respondents consider

**Competitive Pressure and Management/Marketing Techniques  
Correlation Table**

**TABLE 23**

| <b>MGT. AND MANUF. TECHNIQUES</b> | <b>SPEARMAN CORR.</b> | <b>SIGNIFICANCE</b> |
|-----------------------------------|-----------------------|---------------------|
| Just-In-Time-Delivery             | .2724                 | .002                |
| Computer-Integrated Mfg.          | .1144                 | .116                |
| Flexible Manufacturing            | .2100                 | .016                |
| Cellular Manufacturing            | .1390                 | .084                |
| TQM                               | .2329                 | .007                |
| Statistical Process Control       | .2513                 | .004                |
| KANBAN Inventory Cont.            | .1822                 | .030                |
| MRP                               | -.1567                | .064                |
| CAD/CDM                           | .0120                 | .451                |
| Design for Manufacturability      | .1888                 | .025                |
| Robotics                          | .3121                 | .001                |

**Competitive Pressure and Accounting Techniques Correlation  
Table**

**TABLE 24**

| <b>MANAGEMENT ACCOUNTING TOOLS</b> | <b>SPEARMAN</b> | <b>SIGNIFICANCE</b> |
|------------------------------------|-----------------|---------------------|
| Budgets                            | .1401           | .066                |
| Flexible Budgets                   | .0955           | .168                |
| Variance Analysis                  | .1454           | .063                |
| Standard Costing                   | .1672           | .042                |
| Activity-Based Costing             | .2390           | .006                |
| Contribution Margin Analysis       | .1289           | .092                |
| Formal Capital Budgeting           | .2695           | .002                |
| Cost-Volume-Profit Analysis        | .0962           | .169                |
| Segment Analysis                   | .2304           | .009                |
| Responsibility Center Analysis     | .1561           | .052                |

themselves to be in a highly competitive environment.

Competitive pressure was then compared to management accounting tools as illustrated in Table 24. While all accounting tools appear to have an associated significance or P value of less than .2, it is interesting to note that some of the strongest correlations take place in some of the more progressive techniques, such as Activity-Based Costing. Perhaps a movement to more progressive accounting methods is linked to the migration to modern management techniques evidenced in Chapter III.

#### **B. SALES GROWTH**

The relationship between perception of the respondents unit in terms of profitability within the company (question 4) and the respondents ranking of the unit in terms of internal and external sales within the company (question 5) was examined. We hypothesized that these two questions would be positively correlated. The results of Table 25 reject the

**Unit Profitability and Sales Ranking Correlation Table**

**TABLE 25**

| QUESTIONS CORRELATED | SPEARMAN CORR. | SIGNIFICANCE |
|----------------------|----------------|--------------|
| Q4 with Q5           | .6557          | < .001       |

null hypothesis, supporting our hypothesis that unit profitability and unit sales ranking are positively correlated.

Sales growth emphasis (question 64 part G) and sales growth averaged over the last five years (question 53) were correlated testing our initial hypothesis that the analysis would results in positive correlation.

**Sales Growth Emphasis and Average Annual Sales Growth  
Correlation Table**

TABLE 26

| QUESTIONS CORRELATED | CHI SQR | SIGNIFICANCE |
|----------------------|---------|--------------|
| Q64G with Q53        | 22.254  | .38498       |

As the significance of the analysis in Table 26 indicates, the null hypothesis was not rejected. An explanation of the results could be that units with low sales growth might receive a greater degree of attention than units with above average sales growth. Additionally, the fact that respondent knowledge of annual average sales growth was not consistent within companies (Table 27) may have affected the relationship illustrated in Table 26.

Finally, descriptive statistics were developed for each company for the subjects knowledge of average annual sales growth (question 53). It is important to note that only 96 of 119 respondents elected to answer this question. Another important observation is the relatively large standard deviations in Table 27. This inconsistency could be caused by several factors such as sales growth not being a publicized figure or different departments measuring sales differently.

Whatever the reason, it appears that managers from different units within companies do not share a common focus of how to measure this variable.

**Descriptive Statistics of Sales Growth by Company**

**TABLE 27**

| COMPANY SITES | NUMBER OF RESPONDENTS | 5 YEAR AVERAGE SALES GROWTH | STANDARD DEVIATION |
|---------------|-----------------------|-----------------------------|--------------------|
| 101           | 4                     | 15.75                       | 10.905             |
| 102           | 6                     | 11.167                      | 3.764              |
| 103           | 6                     | 11.0                        | 5.441              |
| 201           | 4                     | 17.5                        | 5.568              |
| 202           | 4                     | 13.25                       | 5.377              |
| 203           | 6                     | 15.833                      | 4.916              |
| 204           | 3                     | 23.33                       | 2.887              |
| 205           | 1                     | 2.0                         | N/A                |
| 206           | 3                     | 14.0                        | 15.1               |
| 207           | 4                     | 25.75                       | 27.609             |
| 208           | 4                     | 8.0                         | 8.1248             |
| 209           | 2                     | 9.5                         | 7.778              |
| 210           | 2                     | 5.75                        | 4.349              |
| 211           | 6                     | 13.667                      | 3.83               |
| 212           | 18                    | 7.000                       | 4.391              |
| 213           | 5                     | 10.8                        | 4.357              |
| 214           | 3                     | 1.667                       | 2.887              |
| 215           | 3                     | 57.667                      | 28.919             |
| 216           | 4                     | 7.0                         | 4.761              |
| 217           | 0                     | missing                     | N/A                |
| 301           | 2                     | 19.0                        | 19.799             |
| 302           | 4                     | 30.0                        | 28.284             |

### C. MARKETING AND MANUFACTURING'S EFFECT ON PERFORMANCE DIMENSIONS

The amount by which performance dimensions have changed within the last three years (question 7) was compared to changes in a unit's manufacturing and marketing environments (question 8 parts A and B). The hypothesis was that both analyses would result in positive correlations.

#### Marketing and Manufacturing Correlated with Change in Performance Dimensions Table

TABLE 28

| QUESTIONS CORRELATED | SPEARMAN CORR. | SIGNIFICANCE |
|----------------------|----------------|--------------|
| Q7 with Q8A          | .5165          | < .001       |
| Q7 with Q8B          | .5524          | < .001       |

Both the relative change in the marketing and manufacturing environment appear to have a strong correlation with the change in performance dimensions. If the sample size from each company were larger, it would be interesting to see if the correlation coefficients by each company were statistically significant in either the manufacturing or marketing environment but not both.

## VI. CONCLUSION

The results chapters indicate there is ample evidence to support the belief that corporations are adopting new or "cutting edge" methods of manufacturing, marketing, production and management (Hirschhorn and Gilmore, 1992; Olian and Rynes, 1992; and Ost, 1990). Sources cite everything from reduced quality, changing demographics, globalization of markets, instantaneous communications, corporate alliances and technological gains as catalysts that have sparked this transition (Young and Selto, 1991 and Kanter, 1991). Whether any or all the reasons listed above have had an effect on corporate climate cannot be supported with the data from this study. The results of the survey illustrate the attitudes of managers at a particular point in time and therefore are cross-sectional in nature. However, one can obtain a picture of how a sample of managerial respondents view themselves and their organizations during this period of corporate transition. The respondents from the companies surveyed indicated strong support for many of the new "cutting edge" management techniques like TQM, Team-building, Empowerment, SPC, JIT and Kanban.

While many of the practices and principles of "cutting edge" management techniques appear to be supported by the respondents, some findings indicate that the transition is not

yet complete. Some practices are deeply entrenched within corporations. For example, the composition of a compensation program is often arrived at after long struggles between corporate management and unions and does not readily change. These are facets of an organization which have taken a long time to create and are often difficult items to deal with when implementing change. However, the large standard deviations associated with these practices indicates that the managers perceive variation in these areas. In a separate study, Edward Ost found that the number of firms that have implemented gain-sharing programs are four times what they were in 1980 (Ost, 1990, pg. 20). The results from our analyses involving compensation concur with Ost in that there is evidence of gain-sharing within our population.

While the studies cited in this thesis support the evolution to accept modern management techniques, several authors point out that progress in this direction is not uniform. Several studies have addressed a fear of managers that the full adoption of programs and full disclosure of all information, will eventually cause their position to become obsolete (Kanter, 1990, pg. 159, McKinnon and Bruns, 1992, pg. 183 and Ost, 1990, pg. 25). Another study indicates that managers have implemented "activity-centered" programs without creating a results-driven improvement process, and that continuing to follow this course of action will contribute little or nothing to bottom-line performance (Schaffer and

Thomson, 1992, pg. 80). Others claim that productivity increases will come with adoption of a system which eliminates the preponderance of activities which take up the majority of managerial and employee time but contribute little value to the actual end product (Drucker, 1990, pg. 74 and Womack, Jones and Roos, 1990).

The arguments raised above do lead to an interesting question: is the implementation of "cutting edge" management techniques a response to a desire to make the lowest levels of companies more productive or are companies truly embracing the tenets of these practices? Stated another way, is the fear of losing their authority preventing managers from fully implementing "cutting edge" management programs?

#### **A. RECOMMENDATIONS**

A similar survey should be conducted in the future, covering the same topics addressed in this survey. Similar analyses should be conducted in order to measure: 1) change in the correlations supporting "cutting edge" management practices and 2) the state of those elements (e.g., education, training and compensation) which appeared to be in a state of transition. It is understood that the results from this future study would provide data on the responses of managers at a single point in time. However, the results from a comparison between these two studies should provide

information on whether the management revolution outlined by this thesis is progressing or stagnating.

# APPENDIX

## CAM-I Performance Management Questionnaire

1. What are the critical success factors for your unit?

(Assume you have 100 points; please allocate them to the various critical success factors that apply to reflect their relative importance. Please make sure you allocate all 100 points.)

|                                     |     |
|-------------------------------------|-----|
| Responsiveness to customer needs    |     |
| Continuous process improvement      |     |
| Product innovation                  |     |
| First to market                     |     |
| Cost                                |     |
| Quality                             |     |
| On time delivery                    |     |
| Productivity                        |     |
| Other: please list those that apply |     |
|                                     |     |
|                                     | 100 |

2. Please define what you mean by "unit": (Please mark one answer.)

- ☐ Division
- ☐ Subsidiary
- ☐ Strategic business unit
- ☐ Plant
- ☐ Other, please specify \_\_\_\_\_

3. How many such units are there in your company? \_\_\_\_\_

4. How would you rank your unit with respect to the other units in your company in terms of overall profitability? (Please mark one answer only.)

- ☐ Most profitable
- ☐ One of top three
- ☐ One of top five
- ☐ Not one of the top five
- ☐ Does not apply

5. How would you rank your unit with respect to the other units in your company in terms of total internal or external sales? (Please mark one answer.)

- ☐ Largest total dollar sales  
☐ One of top three  
☐ One of top five  
☐ Not one of the top five  
☐ Does not apply

*For the next three items, please circle the number that best reflects your answer.*

|                                                                                                                                               | Not<br>at all | To a<br>Very<br>Little<br>Extent |   |   | To<br>Some<br>Extent |   |   | To a<br>Very<br>Great<br>Extent |
|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------------|---|---|----------------------|---|---|---------------------------------|
| 6. Do the performance measures used to evaluate your areas of responsibility reflect the critical success factors of your unit?               | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 7. Have the performance measures used to evaluate your unit been changed within the last 3 years?                                             | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 8. Have the performance measures used to evaluate your unit been revised within the last three years in response to changes in your unit's... |               |                                  |   |   |                      |   |   |                                 |
| ... market environment?                                                                                                                       | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| ... manufacturing environment?                                                                                                                | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |

9. If performance measurements were changed, did the changes pertain to all or part of the measures? (Please mark one answer.)

- ☐ No changes were made  
☐ Less than one quarter of the measures were changed  
☐ Between one quarter and one half of the measures were changed  
☐ Between one half and three quarters of the measures were changed  
☐ All the measurements were changed

10. To what extent does the measurement system used to evaluate your unit focus on the following performance dimensions? (Assume you have 100 points; please allocate them to the various performance dimensions that apply to reflect their relative importance. Please make sure you allocate all 100 points).

|                                     |     |
|-------------------------------------|-----|
| Responsiveness to customer needs    |     |
| Continuous process improvement      |     |
| Product Innovation                  |     |
| First to market                     |     |
| Cost                                |     |
| Quality                             |     |
| On time delivery                    |     |
| Productivity                        |     |
| Other: please list those that apply |     |
|                                     |     |
|                                     | 100 |

11. In which of the following ways are these performance dimensions communicated to managers at your level in the unit? (Please check all that apply for each performance dimension.)

|                                     | Formally Measured | Discussed in Meetings | Discussed in Memos | Conveyed Informally | They Are A Given |
|-------------------------------------|-------------------|-----------------------|--------------------|---------------------|------------------|
| Responsiveness to customer needs    |                   |                       |                    |                     |                  |
| Continuous process improvement      |                   |                       |                    |                     |                  |
| Product Innovation                  |                   |                       |                    |                     |                  |
| First to market                     |                   |                       |                    |                     |                  |
| Cost                                |                   |                       |                    |                     |                  |
| Quality                             |                   |                       |                    |                     |                  |
| On Time Delivery                    |                   |                       |                    |                     |                  |
| Productivity                        |                   |                       |                    |                     |                  |
| Other: please list those that apply |                   |                       |                    |                     |                  |
|                                     |                   |                       |                    |                     |                  |

*For the next group of questions, please circle the number that best reflects your answer to the respective items.*

12. To what extent do you, in your area of responsibility, use the following management accounting tools?

|                                   | Not<br>at all | To a<br>Very<br>Little<br>Extent |   |   | To<br>Some<br>Extent |   |   | To a<br>Very<br>Great<br>Extent |
|-----------------------------------|---------------|----------------------------------|---|---|----------------------|---|---|---------------------------------|
| Budgets                           | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Flexible Budgets                  | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Variance Analysis                 | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Standard Costing                  | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Activity-Based Costing            | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Contribution Margin Analysis      | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Formal Capital Budgeting          | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Cost-Volume-Profit Analysis       | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Segment Analysis                  | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Responsibility Center<br>Analysis | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |

13. How often do the following individuals or groups receive financial information pertaining to the performance of the unit?

|                        | Never | Seldom |   |   | Occasionally |   |   | Frequently |
|------------------------|-------|--------|---|---|--------------|---|---|------------|
| Line Workers           | 0     | 1      | 2 | 3 | 4            | 5 | 6 | 7          |
| First Level Management | 0     | 1      | 2 | 3 | 4            | 5 | 6 | 7          |
| Middle Management      | 0     | 1      | 2 | 3 | 4            | 5 | 6 | 7          |
| Unit Top Management    | 0     | 1      | 2 | 3 | 4            | 5 | 6 | 7          |
| Unit Manager           | 0     | 1      | 2 | 3 | 4            | 5 | 6 | 7          |

14. To what extent are the following individuals/groups held accountable for financial performance?

|                        | Not<br>at all | To a<br>Very<br>Little<br>Extent |   |   | To<br>Some<br>Extent |   |   | To a<br>Very<br>Great<br>Extent |
|------------------------|---------------|----------------------------------|---|---|----------------------|---|---|---------------------------------|
| Line Workers           | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| First Level Management | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Middle Management      | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Unit Top Management    | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Unit Manager           | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |

*For the following questions, please circle the answer that most closely reflects your unit.*

|     |                                                                                                                                                 | Not<br>at all | To a<br>Very<br>Little<br>Extent |   |   | To<br>Some<br>Extent |   |   | To a<br>Very<br>Great<br>Extent |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------------|---|---|----------------------|---|---|---------------------------------|
| 15. | To what extent does your unit's performance measurement system encourage people to meet preset performance objectives?                          | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 16. | Does your unit's performance measurement system support continuous improvement goals, such as "zero defects" or reductions in total cycle time? | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 17. | Would you say that your unit's performance goals on the plant floor are based on engineered standards?                                          | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 18. | Would you say that your performance goals on the plant floor are based upon benchmarking performance against a target optimum?                  | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 19. | To what extent do the production workers in your unit have direct control over short term operational decisions on the plant floor?             | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 20. | Are machine operators responsible for their own quality monitoring?                                                                             | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |

|     |                                                                                                                                                    | Not<br>at all | To a<br>Very<br>Little<br>Extent |   |   | To<br>Some<br>Extent |   |   | To a<br>Very<br>Great<br>Extent |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------------|---|---|----------------------|---|---|---------------------------------|
| 21. | Do production workers maintain records while on the shop floor (e.g. changes in volume, quality, productivity . . .)?                              | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 22. | Are performance measurements posted in the production areas?                                                                                       | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 23. | Are production workers expected to stop the line if they detect quality problems?                                                                  | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 24. | Are production workers part of any ongoing, or ad hoc, problem-solving teams?                                                                      | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 25. | Is the quality management effort centralized in a single department?                                                                               | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 26. | Does your unit rely on teams for problem solving?                                                                                                  | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 27. | Do production workers ever directly interact with customers?                                                                                       | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 28. | Are production workers responsible for maintaining their own equipment?                                                                            | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 29. | Do workers participate in efforts to improve the production process?                                                                               | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 30. | Are production workers included in regular production briefings?                                                                                   | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 31. | Do production workers have a say in how the factory is run?                                                                                        | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| 32. | What is your estimate of the extent to which ongoing training and education is offered to individuals at each of the following levels of the unit? |               |                                  |   |   |                      |   |   |                                 |

|                        | Not<br>at all | To a<br>Very<br>Little<br>Extent |   |   | To<br>Some<br>Extent |   |   | To a<br>Very<br>Great<br>Extent |
|------------------------|---------------|----------------------------------|---|---|----------------------|---|---|---------------------------------|
| Line Workers           | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| First Level Management | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Middle Management      | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Unit Top Management    | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Unit Manager           | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |

33. In your opinion, is this training generalized or specific to the job performed by each individual at the various levels?

|                        | Specific<br>To The<br>Job |   |   | About<br>Half &<br>Half |   |   | General<br>In<br>Nature |
|------------------------|---------------------------|---|---|-------------------------|---|---|-------------------------|
| Line Workers           | 1                         | 2 | 3 | 4                       | 5 | 6 | 7                       |
| First Level Management | 1                         | 2 | 3 | 4                       | 5 | 6 | 7                       |
| Middle Management      | 1                         | 2 | 3 | 4                       | 5 | 6 | 7                       |
| Unit Top Management    | 1                         | 2 | 3 | 4                       | 5 | 6 | 7                       |
| Unit Manager           | 1                         | 2 | 3 | 4                       | 5 | 6 | 7                       |

**GENERAL INFORMATION:**

**Individual Demographics:**

34. Please describe the percentage composition of your annual compensation. (Please note: Column should total 100%.)

|                    |     |
|--------------------|-----|
| Salary             |     |
| Bonus              |     |
| Profit Sharing     |     |
| Gainsharing        |     |
| Other: Please List |     |
|                    |     |
|                    |     |
|                    | 100 |

35. What is the average composition of the total annual compensation for individuals at each of the following levels in your unit? (Please note: Each row should total 100%.)

|                        | Salary | Bonus | Profit<br>Sharing | Gain<br>Sharing | Other:<br>Please<br>Specify | Total |
|------------------------|--------|-------|-------------------|-----------------|-----------------------------|-------|
| Line Workers           |        |       |                   |                 |                             | 100%  |
| First Level Management |        |       |                   |                 |                             | 100%  |
| Middle Management      |        |       |                   |                 |                             | 100%  |
| Unit Top Management    |        |       |                   |                 |                             | 100%  |
| Unit Manager           |        |       |                   |                 |                             | 100%  |

36. If your unit makes regularly scheduled monetary awards beyond the base salary, what is the influence of each of the following factors? (Please note: Each row should total 100%.)

|                           | Individual<br>Performance | Team<br>Performance | Unit<br>Performance | Corporate<br>Performance | Management<br>Discretion | Other<br>Please<br>Specify | Total |
|---------------------------|---------------------------|---------------------|---------------------|--------------------------|--------------------------|----------------------------|-------|
| Line Workers              |                           |                     |                     |                          |                          |                            | 100%  |
| First Level<br>Management |                           |                     |                     |                          |                          |                            | 100%  |
| Middle<br>Management      |                           |                     |                     |                          |                          |                            | 100%  |
| Unit Top<br>Management    |                           |                     |                     |                          |                          |                            | 100%  |
| Unit Manager              |                           |                     |                     |                          |                          |                            | 100%  |

37. When evaluating an individual for salary increases or promotions, what is the influence of each of the following factors? (Please note: Each row should total 100%.)

|                           | Individual<br>Performance | Team<br>Performance | Unit<br>Performance | Corporate<br>Performance | Management<br>Discretion | Other<br>Please<br>Specify | Total |
|---------------------------|---------------------------|---------------------|---------------------|--------------------------|--------------------------|----------------------------|-------|
| Line Workers              |                           |                     |                     |                          |                          |                            | 100%  |
| First Level<br>Management |                           |                     |                     |                          |                          |                            | 100%  |
| Middle<br>Management      |                           |                     |                     |                          |                          |                            | 100%  |
| Unit Top<br>Management    |                           |                     |                     |                          |                          |                            | 100%  |
| Unit Manager              |                           |                     |                     |                          |                          |                            | 100%  |

**Individual Demographics:**

38. How many years of formal education have you completed?

☐ 12 years or more  
☐ 12-15 years  
☐ 15-18 years  
☐ More than 18 years

39. What was your major course of study at the undergraduate level?

My major was: \_\_\_\_\_

40. If you hold advanced degrees, what was your major?

My major was: \_\_\_\_\_

41. How many years of professional experience do you have? \_\_\_\_\_ years

42. What was the title of your first job out of college? \_\_\_\_\_

43. How many years have you been employed by the company you currently work for? \_\_\_\_\_ years

44. Starting with your current position, please list the title of your last five positions (or as many as are relevant to your employment at this firm).

| Position | No. of Yrs/Mos in Position |
|----------|----------------------------|
| (1)      |                            |
| (2)      |                            |
| (3)      |                            |
| (4)      |                            |
| (5)      |                            |

**Organizational Characteristics:**

45. What is your estimate of the percentage of the following levels of employees who have been continuously employed by your unit for the period of time noted? (Please note: Each row now should total 100%)

|                        | 1-3 yrs | 3-5 yrs | 5-10 yrs | Over 10 yrs | Total |
|------------------------|---------|---------|----------|-------------|-------|
| Line Workers           |         |         |          |             | 100%  |
| First Level Management |         |         |          |             | 100%  |
| Middle Management      |         |         |          |             | 100%  |
| Unit Top Management    |         |         |          |             | 100%  |
| Unit Manager           |         |         |          |             | 100%  |

46. What is your estimate of the average level of educational attainment for each of the following groups of employees in your unit? (Please check one box on each line.)

|                        | Less than<br>12 yrs | 12 yrs | 13-14 yrs | 15-16 yrs | More Than<br>16 yrs |
|------------------------|---------------------|--------|-----------|-----------|---------------------|
| Line Workers           |                     |        |           |           |                     |
| First Level Management |                     |        |           |           |                     |
| Middle Management      |                     |        |           |           |                     |
| Unit Top Management    |                     |        |           |           |                     |
| Unit Manager           |                     |        |           |           |                     |

47. What do you believe is the dominant domain of professional experience for the members of the management group of your unit? (Please check one item)

- ☐ General Management  
☐ Operations Management  
☐ Engineering  
☐ Marketing/Sales  
☐ Finance/Accounting  
☐ Other. Please list. \_\_\_\_\_

48. What is your estimate of the extent to which the employees at each of the different levels of the unit have had significant hands-on experience with the dominant production technology of the unit? (Please circle one answer for each line)

|                        | Not<br>at all | To a<br>Very<br>Little<br>Extent |   |   | To<br>Some<br>Extent |   |   | To a<br>Very<br>Great<br>Extent |
|------------------------|---------------|----------------------------------|---|---|----------------------|---|---|---------------------------------|
| Line Workers           | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| First Level Management | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Middle Management      | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Unit Top Management    | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Unit Manager           | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |

49. What is the major industry in which your unit competes?

\_\_\_\_\_

50. Is the major industry in which your unit competes in a: (Please circle the situation that applies.)

- start-up stage
- growth stage
- maturity stage
- decline stage

51. What is your estimate of the number of different product lines offered by your unit? \_\_\_\_\_

52. What is your estimate of the number of different products offered by your unit? \_\_\_\_\_

53. What is your estimate of the average annual growth rate of the total sales for your unit over the last five years? \_\_\_\_\_

54. Please fill in as much of the following grid as you can with estimates for major product lines of your unit. Stop when you account for about 80% of your annual sales volume.

|   | Product Line | Annual Sales | Percentage of Sales In: |                 | Global Share Held By: |                       | Number of Major Customers |
|---|--------------|--------------|-------------------------|-----------------|-----------------------|-----------------------|---------------------------|
|   |              |              | North American Market   | European Market | Your Unit             | Your Major Competitor |                           |
| 1 |              |              |                         |                 |                       |                       |                           |
| 2 |              |              |                         |                 |                       |                       |                           |
| 3 |              |              |                         |                 |                       |                       |                           |
| 4 |              |              |                         |                 |                       |                       |                           |
| 5 |              |              |                         |                 |                       |                       |                           |

55. What is the length of the average life cycle (i.e., product launch to product retirement) for products in your industry?  
 \_\_\_\_\_ years

56. What percentage of your total production volume would you classify in each of the following categories?

PERCENTAGE

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 100%

PRODUCTION CHARACTERISTIC

Small batch/custom order  
 Small batch/repetitive order  
 Large batch/custom order  
 Large batch/repetitive order  
 Process Manufacturing  
 Continuous-flow manufacturing  
 Other: Please list \_\_\_\_\_

57. To what extent do you employ the following techniques in your unit? (Please circle one answer for each line.)

|                              | Not<br>at all | To a<br>Very<br>Little<br>Extent |   |   | To<br>Some<br>Extent |   |   | To a<br>Very<br>Great<br>Extent |
|------------------------------|---------------|----------------------------------|---|---|----------------------|---|---|---------------------------------|
| Just-In-Time Delivery        | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Computer-Integrated Mfg.     | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Flexible Manufacturing       | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Cellular Manufacturing       | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Total Quality Management     | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Statistical Process Control  | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| KANBAN Inventory Control     | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| MRP                          | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| CAD/CAM                      | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Design for Manufacturability | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Robotics                     | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |

58. In general, what percentage of product cost in your unit is due to: (Please note column should total 100%.)

Materials \_\_\_\_\_ %  
 Labor \_\_\_\_\_ %  
 Processing \_\_\_\_\_ %  
 Overhead \_\_\_\_\_ %  
 100%

59. What is the relative degree of competitive pressure faced by your unit? (Please circle the number that corresponds to your answer.)

Low                      Moderate                      Very High  
 1      2      3      4      5      6      7

60. What is the dominant dimension, or factor, of this competitive pressure? (Please rank the top three. Highest = 1)

\_\_\_\_\_ Price wars  
 \_\_\_\_\_ Market falling  
 \_\_\_\_\_ New and aggressive competition  
 \_\_\_\_\_ New products  
 \_\_\_\_\_ New manufacturing techniques  
 \_\_\_\_\_ New technologies  
 \_\_\_\_\_ Other: Please specify: \_\_\_\_\_

61. What is the average planning horizon you use to guide, or bound, your decision-making?  
(Please mark one answer.)

- ☐ Less than one year
- ☐ One year
- ☐ 1 - 3 years
- ☐ Longer than 3 years

62. What is the average planning horizon for decision-making in your unit? (Please mark only one answer.)

- ☐ Less than one year
- ☐ One Year
- ☐ 1-3 years
- ☐ Longer than 3 years

63. How often are unit plans revised? (Please mark one answer.)

- ☐ More frequently than monthly
- ☐ Monthly
- ☐ Quarterly
- ☐ Annually
- ☐ Less frequently than annually

64. To what extent are the following performance factors emphasized?

|                       | Not<br>at all | To a<br>Very<br>Little<br>Extent |   |   | To<br>Some<br>Extent |   |   | To a<br>Very<br>Great<br>Extent |
|-----------------------|---------------|----------------------------------|---|---|----------------------|---|---|---------------------------------|
| Quarterly Financials  | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Operating Performance | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Quality Levels        | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| On Time Delivery      | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Customer Satisfaction | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Market Share          | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |
| Sales Growth          | 0             | 1                                | 2 | 3 | 4                    | 5 | 6 | 7                               |

*Thank you very much. Please return the questionnaire in the enclosed envelope.*

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