AN EXAMINATION OF THE ECONOMIC BENEFITS OF ISO 9000 AND THE BALDRIGE AWARD TO MANUFACTURING FIRMS

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This Thesis examines the financial data of manufacturing companies who are ISO 9000 certified and the winners in the manufacturing category of the Malcolm Baldrige National Quality Award to determine whether the benefit of receiving certification or winning the award is economically attractive. A literature review is completed to show the limited number of quantitative analyses that have been conducted on this subject and to provide the sources of raw data that were used in the thesis. An analysis of the costs and benefits associated with registration is performed for ISO 9000, while stock performance is examined for the Baldrige Award winners.

Results show that the economic success reported by companies that received ISO 9000 certification or the Baldrige award may be exaggerated and certainly that this success cannot be guaranteed. Recommendations for further study and a simple program design for a summative evaluation of the Baldrige award winning companies is also suggested for future research.

DESCRIPTORS

Hypothesis Testing

Malcolm Baldrige National Quality Award

Summative Evaluation

ISO 9000

Quality

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PREFACE

Many thanks must go first to my graduate committee. Dr. Kim Needy for all of her guidance and continual motivating presence. Also, Dr. Norman and Dr. Wolfe for their comments and their time. I also would like to acknowledge Mary Ann Walsh for her contributions to the Baldrige Section of this research and her contributions to the editing process. Lastly, I would like to thank my wife for allowing me to work on my thesis while she went to work everyday.

1.0 INTRODUCTION

Internationally, there are nearly 60 awards and programs that reward companies for improving quality. Some of these awards are listed in Table 1. The most notable of these awards are the Malcolm Baldrige National Quality Award (U.S. Only), the Deming Prize, Six Sigma (Troy 1992), and the ISO 9000 programs. The Malcolm Baldrige Award and the ISO 9000 programs are the focus of this research. Because of their popularity each of these programs has well documented qualitative benefits that include improving competitiveness and increasing customer awareness; however, very little has been published on the quantitative benefits of these programs. This is particularly interesting in light of the current economic situation in the United States, where companies are looking for the best cost saving programs. It would seem then, that most of these organizations would want to know if the financial benefits associated with ISO 9000 registration and winning the Baldrige award outweigh the costs associated with obtaining the recognition. Thus a critical question is: Does the investment in ISO and Baldrige lead to a significant financial return?

This thesis has three main purposes. The first purpose is to expand the knowledge base on the topic of the financial impact of ISO 9000 and the Baldrige award by completing new analyses on past data. Current sources conclude that the financial benefits outweigh the costs, but a different methodology might provide more insight. The second purpose of this thesis is to show the shortcomings in some of the ways the financial benefits of these programs are calculated. This will mainly be done for the

Table 1. Awards and Programs for Improving Quality

The President's Quality Award
Deming Award for Quality
The European Quality Award
The Shingo Prize for Excellence in Manufacturing
Malcolm Baldrige National Quality Award
Secretary of Defense Quality Management Office Awards
Six Sigma
ISO 9000 Series
The Canada Awards for Excellence
45 Quality awards given by individual states in the United States

Baldrige Award and will be completed by reexamining the results of past studies. The final purpose of this thesis is to recommend future areas of study. All quality programs should lead to some financial improvement either directly or indirectly and the future areas for study will recommend ways to better collect this kind of data.

This thesis begins with a brief section that covers the motivation for the research and continues with a review of the ISO 9000 and Baldrige Award literature, followed by a review of the literature on how to complete a proper program design for evaluating the overall success or failure of implementing the Baldrige Award.

The ISO 9000 literature includes two surveys completed by information service companies and one previous piece of research completed by a group from the University of California, Los Angeles (UCLA). The surveys provide detailed cost and

benefit data associated with registration. The research completed by the UCLA group shows a method of determining if ISO 9000 registration is beneficial that differs from this thesis. This method is an empirical Return on Asset analysis.

The Baldrige literature review covers the award's criteria and shows that no scientific study currently exists to evaluate the program's true benefits to manufacturing organizations. The Baldrige literature review also introduces the Standard & Poors (S&P) 500 stock study that is used by the National Institute of Standards (NIST) for justifying the success of the award program. The program design literature review, which is the basis for recommendations on future Baldrige analysis, covers the basics of how to properly evaluate complex programs.

After the literature review, Section 4.1 covers the approach and methodology used to determine if ISO 9000 registration is financially beneficial for manufacturing companies. This includes tables of data gathered from two ISO 9000 studies and the testing completed on that data. In Section 4.2, the approach and methodology is defined for the Malcolm Baldrige National Quality Award (MBNQA) analysis. Because manufacturers are the primary organizations that apply for ISO 9000 registration, the Baldrige portion of the analysis focuses on the manufacturing company winners of the MBNQA only. The research examines factors such as company size and the amount of time that quality programs were in place at organizations prior to their winning the MBNQA. It also examines the current NIST method of showing the financial success of MBNQA winning manufacturing companies by comparing their stock performance to the

financial performance of the manufacturing companies that make up the Standard and Poors 500 Index.

After the approach and methodology sections, the results are presented in Section 5. This section details the new data generated by this thesis and what that new data implies. After discussing the quantitative ISO 9000 and MBNQA results, a methodology for developing a proper summative evaluation for the Baldrige Award is offered. This is included with the discussion of the results section of the thesis because it is one possible tool that NIST could use for future studies.

Finally, conclusions are discussed and areas where future research could be conducted are offered.

1.1 Background on ISO 9000

ISO 9000 is a set of quality assurance standards that was published by the International Organization of Standardization (ISO) in 1987. ISO was founded in Geneva, Switzerland in 1946 to develop international industrial standards. The United States representative to this organization is the American Standards Institute. The ISO 9000 standard is codified, verifiable, and easily adaptable. In fact, it is so adaptable that updates and changes have been made approximately every three years since its inception, with the last large update in 2000.

Firms seek to become ISO 9000 registered because of the internal improvements and strategic benefits associated with the quality program. The internal improvements include requiring that all business activities related to a product be conducted in a three-part continuous cycle of planning, control, and documentation. In more simple terms, the cycle would be described as say what you do, do what you say, and document what you are doing. This cycle, along with a necessary quality conformance system that maintains regular calibration of measuring and testing equipment are some of the immediate improvements. ISO 9000 also prevents shipment of product that does not meet the quality standard, thereby reducing the number of returns from the buyer. The strategic benefits include gaining access to companies who only purchase products from ISO certified suppliers. These companies wish to maintain high quality levels while keeping costs low. One way of doing this is to have their suppliers examine quality first. By doing so, the buyer may reduce the number of inspections of incoming materials.

The objective of working on this topic is to see if the monetary costs associated with obtaining ISO 9000 certification is justified based solely on the monetary benefits that are realized when certification is obtained.

1.2 Background on Malcolm Baldrige National Quality Award

In 1987, the United States Congress established the Malcolm Baldrige National Quality Award (MBNQA) and in 1988, the first awards were presented. The award recognizes organizations in the United States for their achievements in quality and

performance and raises awareness about the importance of quality and performance excellence as a competitive edge. The annual awards were initially given in three categories: manufacturing, service, and small business; in 1999, two additional awards were added in the areas of education and health care. The award is named after Malcolm Baldrige, the former Secretary of Commerce who held the post from 1981 until his death in 1987. Baldrige was an active supporter of quality management as a key to the prosperity and long-term strength of United States' companies in the world marketplace. He actually helped draft one of the early versions of the award. Any organization falling into the above categories that is headquartered in the United States or its territories may apply for the award, including United States divisions of foreign companies.

The United States Commerce Department's National Institute of Standards and Technology (NIST) manages the Baldrige National Quality Program in close cooperation with the American Society for Quality (ASQ) and the private sector. An independent Board of Examiners that is primarily composed of private-sector experts in quality and business evaluates applications for the award. Examiners look for achievements and improvement in each of the seven categories of the award. Finally, the President of the United States presents the award to the recipients.

Powell (1995) and the National Institute of Standards and Technology (2003) list the seven categories that are the focus of the award criteria. They are Leadership, Strategic Planning, Customer and Market Focus, Information and Analysis, Human

Resource Focus, Process Management, and Business Results. Summarized descriptions of these criteria follow.

Leadership – Examines how senior executives guide the organization and how the organization addresses its responsibilities to the public and practices good citizenship. Leadership must include top executive involvement in creating and building quality values beginning with the humility to openly accept honest appraisals from employees, suppliers, and customers about what is wrong – as well as what is right – with the organization.

Strategic Planning – Examines how the organization sets strategic directions and how it determines key action plans. The company's strategic planning process and plan must integrate the quality requirements into the overall business plan. The company must have short and long-term plans that include how quality performance requirements are implemented and met.

Customer and Market Focus – Examines how the organization determines requirements and expectations of customers and markets. It examines the company's relationship with customers and its knowledge of customer requirements and the key quality factors that determine marketplace competitiveness. Customer satisfaction is a measure of this category.

Information and Analysis – Requires the use of data and information to measure and drive quality excellence and to improve competitive performance. The company must have adequate systems to collect, validate, analyze, disseminate, and monitor quality. The system must support the collection and analysis of data to drive quality excellence and improve competitive performance along with improving the company's customer focus, products, services, and internal operations. Quality management is marked by a move from defect detection to defect prevention.

Human Resource Focus – Examines how the organization enables its workforce to develop to its full potential and how well the workforce is aligned with the organization's objectives. Along with management commitment, employee commitment is also essential to the success of total quality. The company must build and maintain an environment conducive to full participation and personal growth of all employees. Training programs play a major role in ensuring that an employee can develop to his/her full potential. Communication and listening are essential components.

Process Management – Examines aspects of how key production/delivery and support processes are designed, managed, and improved. Qualitative research by Powell (1995) has shown that world-class companies were able to compete effectively because of higher levels of process improvement in quality and customer service-related areas.

Business Results – Examines the organization's performance and improvement in its key business areas: customer satisfaction, financial and marketplace performance, human resources, supplier and partner performance, and operations performance. This category also examines how the organization performs relative to competitors. Companies also use this to look for opportunities for growth in future products and markets.

These criteria are designed to help organizations enhance their competitiveness by focusing on delivering ever improving value to customers and improving overall organizational performance. Unlike the ISO process, the Baldrige criteria are not specific to only the product or products of a company; they apply to the entire organization.

The objective of working on this topic is to see if the current tool that is used to show the financial success of Baldrige Award winning companies provides correct and useful information.

2.0 MOTIVATION FOR RESEARCH

During time spent on Co-op, the author was exposed to both ISO 9000 and the Malcolm Baldrige National Quality Award. The experience was both educational and frustrating at the same time. It was educational from the standpoint of seeing how a state run organization approaches a quality program. An example of this would be instead of just looking at one specific quality measure, i.e. customer satisfaction, an organization looks at what made the customer satisfied and the planning that goes into maintaining customer satisfaction. It was frustrating, because it seemed that a large amount of money was spent with very little economic benefit being realized. Expensive consultants were brought in to teach the meaning of the criteria and train employees to write Baldrige applications, but no training was given on how to respond or interpret Baldrige inspector feedback. This raised the question: Do all organizations see such little return on such a large investment?

3.0 LITERATURE REVIEW

A large number of publications devoted to ISO registration were found during this literature review, but only two surveys were found that contained raw data on costs and benefits. For the Baldrige Award there were many publications on how winning companies successfully applied and met the criteria for the award, but unlike the ISO surveys, these sources did not include quantifiable data on the costs and benefits of winning the award. This made it important to research the methods used to show the success of the Baldrige award program and learn how to create a proper summative program design to gather meaningful financial data.

3.1 ISO 9000

A large number of books and papers exist on the topic of ISO 9000 and its related programs. For example, Clements (1993), Johnson (1993, 2000), MacLean (1993), and Zuckerman (1995) have written books that are considered to be “road maps” to registration. These books provide step-by-step guidance on how to standardize procedures and documents. They also show what must be done to complete the entire registration process. Papers associated with ISO 9000 focus mainly on the qualitative benefits associated with certification, such as increases in communication and in understanding of how the company works. There is little published documentation on the quantitative benefits; however, an article by Corbett, et al. (2002), the ISO 9000 Survey: 1996, and the ISO 9000 Survey: 1999 were found.

In the Corbett (2002) article, the authors used Worldpreferred.com to obtain lists that identify all of the ISO 9000 certified companies in the United States. They also used the Compustat Database to obtain financial information such as market value of equity, liquidating value of outstanding stock, and debt for each of these ISO 9000 certified companies. This database summarizes information from the Security and Exchange Commission for all publicly traded companies in the United States. Corbett, et al. (2002) were able to show, quantitatively, that ISO certification does lead to improved financial performance against competitors, but they also showed that certification does not lead to significant internal financial improvements. This study looked at Return on Assets (ROA) to support these conclusions. The ROA is calculated by looking at each company's operating income before depreciation and then dividing that number by the total assets of the company. It is considered better to have a high ROA Ratio. To increase the validity of their study and make the ROA ratio more meaningful, the authors of this paper created "performance-matched control groups". They did this so that they could track whether or not pre-certification performance had any impact on post-certification performance. The findings of this study showed that overall company performance increased when organizations went through the ISO 9000 registration process, but that these increases were mainly due to qualitative gains rather than direct monetary savings (Corbett, et al., 2002).

In contrast, the approach described in this research looks at the statistical significance of the differences between the costs and benefits associated with obtaining

ISO 9000 registration. Data for the study was obtained from the ISO 9000 Survey: 1996 and the ISO 9000 Survey: 1999. More recent surveys could not be found.

Dun&Bradstreet Information Services conducted the 1996 survey and it contains actual cost and benefit data as reported by almost 1,900 ISO 9000 registered companies. This number represents a 26.9 percent response rate from the 6,981 ISO 9000 registered companies that were initially sent a survey. The survey consisted of 39 focused questions that asked about topics ranging from “What are the most important reasons your company initiated the ISO 9000 registration process?” to “How many equivalent full-time employees are dedicated or required to maintain the registration?” Responses to these questions were then divided based on annual sales and the results were reported in 63 total tables. From these tables the Dun&Bradstreet authors then drew conclusions about the total costs and benefits associated with ISO 9000 registration. Even though they admit the numbers they gathered vary greatly, the Dun&Bradstreet authors conclude that the benefits of registration outweigh the costs in almost all cases. A major shortcoming of these conclusions is that they were not tests for statistical significance but rather comparisons of simple averages. One final note on this source is that the authors of the survey assume that the companies that responded did so truthfully and reported their numbers correctly. This assumption is also held while conducting the research for this thesis.

The ISO 9000 Survey: 1999 was sponsored by Quality Systems Update and published by McGraw-Hill. At the time of its completion the number of ISO 9000

registered companies was approximately 33,000. This means there was an increase of over 24,000 registered companies from the time of the 1996 survey. The response rate to this survey was 11 percent, lower than rate of the 1996 survey, but the amount of data gathered actually increased due to the larger number of registered companies. The questions in the survey covered all of the same topics that the 1996 survey covered with expanded coverage based on industry type and culture. The depth of the survey is very impressive and the calculations, along with the findings, are also well presented. One issue, however, is that the authors of the survey use a ratio to show that the benefits of ISO 9000 registration outweigh the costs. This method tries to address the very issue that is at the heart of this thesis, but it once again falls short. It assumes that the distributions of the numbers that were reported are actually significantly different from each other even though a majority of the ratios were very close to 1:1. The authors actually admit to having data that has a very wide variance, but do not address how they took that into consideration. No focus on statistical significance is presented. Also, similar to the previous survey from 1996 the responses to the survey were assumed to be truthful and correct. Once again this assumption is maintained for the thesis.

3.2 Malcolm Baldrige National Quality Award

Similar to the literature on ISO 9000, the literature focusing on the Baldrige Award contains numerous books and articles on total quality, in general, and more specifically

on how to interpret the award criteria. A large amount of emphasis is also placed on how to win the award.

The National Institute of Standards and Technology website (NIST, 2003-2004) provides a large amount of information on the MBNQA and the winning companies. Mainly, it focuses on the history of the award, the process associated with starting a "quality journey," and what goes into applying for the award. This includes descriptions of the updates that have been made to the criteria and a list of all the companies that have won the Baldrige award. There is also a list of links to the winning companies who are expected to share their knowledge and experience with others.

Independent of the National Institute of Standards and Technology, Brennan (1994), Troy (1992), Martino (1997), and Powell (1995) discuss some of the challenges faced by the recipient companies and the lessons they learned while applying for the award. Information on the MBNQA and the winning companies was obtained from these references and from the NIST website.

As shown in Table 2, twenty-three awards have been presented in the manufacturing group to twenty-one different companies. This includes two awards each for Motorola and Solectron. The data presented, shows the size of each company and the time it took for each of the companies to win the MBNQA. This illustrates, on a Macro level, the resources and the commitment needed to win the award.

Table 2. Statistics on the MBNQA winning Manufacturing Companies: Years Quality Programs and Number of Employees

Manufacturing Company, Division	Year of Award	Year Started Quality	Years Until Win	Average Number of Employees
Motorola, Government and Industrial Solutions Sector	2002	~1987	15	14,000
Clarke American Checks, Inc.	2001	1986	15	3,300
Dana Corporation - Spicer Driveshaft (now Torque Technologies)	2000	1995	5	3,300
KARLEE Company, Inc.	2000	N/A	N/A	550
STMicroelectronics Inc., Region Americas	1999	1993	6	3,200
Boeing, Airlift and Tanker Programs	1998	1993	5	8,700
Solar Turbines Inc.	1998	1992	6	6,200
3M, Dental Products	1997	1990	7	700
Solectron Corporation	1997, 1991	1987	4	18,000
ADAC Laboratories	1996	1990	6	710
Armstrong World Industries, Inc., Building Products	1995	1990	5	2,400
Corning Inc., Telecommunications	1995	1983	12	1,400
Eastman Chemical Comp	1993	1982	11	17,750
AT&T, Network SYS Group Transmission (now Lucent Tech., Optical Networking)	1992	1989	3	7,500
Texas Instruments Defense Sys. & Electronics	1992	1980	12	15,000
Zytec Corp. (now part of Artesyn Tech.)	1991	1984	7	748
General Motors, Cadillac Motor Car Company	1990	1985	5	10,000
IBM Rochester	1990	1983	7	8,100
Milliken & Company	1989	1981	8	14,300
Xerox Corp., Bus Pro & Sys.	1989	1984	5	50,200
Westinghouse, Commercial Nuclear Fuel Div.	1988	1984	4	2,000
Motorola Inc.	1988	1981	7	99,000
N/A = data not found	Average Years prior to Award and Average Size of Organization		6.8	13,500

The size of the companies in Table 2 varies from as few as 550 employees at the KARLEE Company, Inc. in 2000 to the 99,000 employees at Motorola in 1988. In the early years of the award, mainly large publicly traded corporations or a subdivision werewinning the award for manufacturing, companies such as Motorola with 99,000 employees, Westinghouse Nuclear Fuel with 2,000 employees (a division of Westinghouse Corporation), Xerox Business Products with 50,200 employees, General Motors Cadillac with 10,000 employees, and IBM Rochester with 8,100. The exception was Milliken in 1989. In business for over 100 years, Milliken remains a privately held manufacturer of textiles and chemicals. While the company is privately held, it does

have 14,300 employees, which, with respect to size, puts it in the same ballpark as the other winning corporations. During this same time period only two small business awards were given, and one service award. Since 1990, the manufacturing winners have all had below 20,000 employees and since 1994, all but two of the twelve winners have below 10,000 employees. One possible explanation is that in the early years of quality techniques, only large companies had the resources to develop quality programs. Then, as total quality became more widespread and more external resources became available, such as NIST and ASQ, the smaller companies became involved and small divisions of large companies developed total quality programs within their division. Another possibility for Baldrige winners having less than 10,000 employees is the continuing reduction in size of traditionally large manufacturing companies.

Developing a quality program also takes time and resources. The award winning companies began their programs an average of nearly seven years prior to winning the MBNQA. External competition and customer demands; internal desire for improvement, to be the “best”, and cost savings are the main reasons given for starting a quality program (NIST 2003-2004). The NIST web site (2003-2004) provides examples of what motivated award winning companies to develop quality programs but does not provide an example of their quality systems. Some of the companies’ motivations are discussed next.

- In 1981, Motorola launched an ambitious drive for a tenfold improvement in the quality for its products and services. Their quality goal was “zero defects in everything we do” and their corporate objective was “total customer satisfaction.”

- In the early 1980’s, Westinghouse’s Commercial Nuclear Fuel Division was motivated by stiff competition and demanding customer requirements to build a culture of quality culture that asked employees to “do the right things right the first time.”

- In 1984, Xerox launched an ambitious quality improvement program to arrest its decline in the world market, a market that it had originally created, but was losing ground due to new competition. They were able to halt the loss of market share, and even reverse it to regain their position.

- In 1981, senior management set in motion Milliken’s “Pursuit of Excellence” as a commitment to customer satisfaction; that commitment pervades all company levels at all locations.

- By benchmarking other companies’ practices and synthesizing them into quality philosophies that would work well at Kodak, Eastman Chemicals developed their “Quality Leadership Process.”

- As early as 1979, 3M Dental Products Division (DPD) was involving the customer in their product design. Since the early 1990's, DPD strongly emphasized team-based approaches to problem solving and continuous improvement, enabling them to double sales over the next seven years without increasing the size of the workforce.

- KARLEE Company's employees, called "team members," are a very diverse group with 47 percent Hispanic, 8 percent African American, and 10 percent Asian.

- Clarke American started their TQM program - "First in Service" around 1986. In 2001, their "actions- results" program resulted in more than 20,000 improvement ideas and saved the company approximately $10 million.

- In 1993, Boeing's Airlift and Tanker (A&T) Programs began to work with its customers and to use a Customer Performance Assessment Report (CPAR) rating as valuable feedback to identify areas for improvement.

- Following its six "strategies to win," Solar Turbines Inc. has increased its share of the worldwide market for new turbine equipment to a position of strong global leadership since 1992.

Based on the dates that these quality programs were begun, the numbers of years until each manufacturing company received the MBNQA was calculated. Table 2 shows this time ranges from a minimum of three years to a maximum of 15 years, with an average of 6.8 years and a median of 6 years. Thus, developing a well-established quality program that leads to winning the MBNQA takes a lot of time in comparison to the one to two years that it takes to become ISO certified. This reinforces the need for a study that shows if significant financial gain will arise from winning the MBNQA. So, how does one decide if the costs and time to implement and sustain a quality program, such as the Baldrige, are worthwhile in comparison to the gains one can achieve by adopting the program? Evans and Jack (2003) addressed cause and effect linkages or correlations among performance measures and total quality companies. This study of 307 companies supported the long-standing beliefs that improving internal management practices leads to improvements in external results. The study did not, however, look specifically at which tools were used to improve internal management. There may be many different tools that provide the same benefits but require much less of a significant monetary investment than the MBNQA.

The best known and the only financial studies that focus specifically on MBNQA winning companies are the NIST stock performance studies. These studies compare a hypothetical investment in the MBNQA winning companies (the “Baldrige Index”) with a hypothetical investment in the Standard and Poors 500 (S&P 500) stock index. Harry Hertz, the director of the National Institute of Standards and Technology, justifies the use of this study because it has, “…shown that businesses that excel in everything they

do can achieve success in many areas, including the bottom line." No other reason for looking at sock price was provided.

NIST issued the first annual study in 1995 and it has continued through the present. For the study, NIST invests a hypothetical $1,000 in each of the publicly traded whole company winners of the Malcolm Baldrige National Quality Award. For a division or subsidiary of a company, the sum invested is $1,000 times the percent of the whole company's employee base that the subunit represents. The same dollar amount is also invested in the S&P 500 Index for the same time period. The ratio of the total closing value of all of the MBNQA winners to the closing value of the S&P 500 is calculated. The studies, the time period, and the results are summarized in Table 3. With the exception of the most recent period, ending December 2, 2002, the MBNQA companies have always outperformed the S&P 500 by a ratio of at least 2.4 to 1. In other words, this study has consistently shown that the Baldrige Award winning companies have outperformed the S&P 500. This conclusion will be shown to be an exaggerated.

3.3 Program Design and Evaluation

The purpose of program design and evaluation is to create an organized study that can validate conclusions. The evaluation does this by ensuring that the gathered data is placed in the proper context. By doing so, the researcher is able to predict what would have occurred if the program being examined had never existed (Fitz-Gibbon, 1987).

Table 3. Hypothetical "Baldrige Index" Studies

No.	Beginning Time	Closing Date	Whole Company Ratio of MBNQA to S&P 500	All Companies Ratio of MBNQA to S&P 500
1	April of the year the award was won or the year the company went public.	October 3, 1994	6.5 to 1	3 to 1
2		August 1, 1995	5 to 1	4 to 1
3		December 2, 1996	3.5 to 1	3 to 1
4	First business day of the month following the announcement of the award recipients or the date they began public trading.	December 1, 1997	2.7 to 1	2.4 to 1
5		December 1, 1998	2.6 to 1	2.5 to 1
6		December 1, 1999	4.8 to 1	3.8 to 1
7	10-year study 1990-1999. First business day of the month following the announcement of the award recipients or the date they began public trading.	December 1, 2000	4.4 to 1	4.2 to 1
8	10-year study 1991-2000.	December 3, 2001	4.4 to 1	2.9 to 1
9	10-year study 1992-2001.	December 2, 2002	-0.71 to 1	-0.53 to 1

http:www.nist.gov/public_affairs/releases/n95-05.htm
http:www.nist.gov/Second_Stock_Study.htm
http:www.nist.gov/public_affairs/releases/n97-04.htm
http:www.nist.gov/public_affairs/releases/n98-07.htm
http:www.nist.gov/public_affairs/stockstudy.htm
http:www.nist.gov/public_affairs/releases/g00-26.htm
http:www.nist.gov/public_affairs/releases/stockstudy.htm
http:www.nist.gov/public_affairs/factsheet/stockstudy.htm
http:www.nist.gov/public_affairs/factsheet/stockstudy9201.htm

There are two main types of evaluation, formative and summative. A formative evaluation looks at the development of programs and how they are implemented. This type of evaluation is ongoing during a program and the measures are formulated before the program begins. Control groups are established in advance and the data is gathered in real time, often through observation. A summative evaluation, in general, generates a report that summarizes the accomplishments or failures of a program. This type of evaluation occurs during the life of a program or when the program is complete. Control groups that have not been subjected to the program are identified and

compared against groups that have been part of the program. The comparisons are made after measurements are taken through surveys or other kinds of tests (Fitz-Gibbon, 1987).

The lack of proper evaluation design can cause results to be questioned and doubted, but proper design can strengthen a researchers defense against attacks from skeptics (Fitz-Gibbon, 1987). Proper summative evaluation design consists of six phases. Each phase and the major elements that make up the phases are listed in Table 4 (Rosander, 1977).

Table 4. Six Phases of Sample Study and Summative Evaluation Design

Phase	Major Elements
1. Planning	Identify goals, etc.
2. Technical and Non-Technical Design	Create data collection plans
3. Implementation	Organize data collection process
4. Processing	Complete computations
5. Interpretation	Present findings and conclusions through reports
6. Appraisal	Determine how well each step in the process worked

By following the six phases, a researcher can properly test a conclusion or make a “before and after” summative comparison. This kind of comparison is required when examining changes in organizational practices and policies.

One tool that can be used for summative comparisons is a survey. A survey samples a population and it must include all the questions that are necessary to address the hypotheses being investigated. A survey, however, may not be appropriate for evaluating all programs. To determine if a survey will work for a program, Sapsford (1999) identifies five questions that must be answered in the affirmative.

- "Is research feasible at all in these circumstances?"
- "Is survey research the right way to approach the problem, to obtain the kind of answers that are required?"
- "Is a survey feasible here – would it yield a valid conclusion?"
- "Is it ethically appropriate to use survey methods here rather than some other approach?"
- "Is it ethically and politically appropriate to carry out any form of research, given the research question and social context?"

All aspects of program design and evaluation must be considered when determining the future work needed for ISO 9000 and the Baldrige Award with a particular emphasis being placed on the type of evaluation necessary. By doing this, it is hoped that the framework will be formed for more conclusive studies on the financial aspects of the programs.

4.0 METHODOLOGY

4.1 Approach and Methodology: ISO 9000

As mentioned, very little financial data specific to the costs and benefits of implementing an ISO 9000 program has been published. Much of the ISO 9000 literature discusses the qualitative benefits of successful ISO 9000 programs without presenting data on the money companies spend or the quantitative results that companies achieve. This is changing somewhat as companies are looking more critically at their quality programs, but it is occurring very slowly. The author believes it is possible to add to the body of knowledge that has been published and help increase the amount of material available on the financial aspects of ISO 9000. This involves looking at the non-recurring costs and benefits, and the recurring costs and benefits associated with ISO 9000 registration. By examining the statistical significance of the actual costs and benefits associated with registration that have been reported by ISO 9000 organizations, the author hopes to expand on the conclusions that Corbett, et al. (2002) and the ISO 9000 survey authors (both the 1996 and the 1999 surveys) have already made about the financial benefits. It is believed that if the financial benefits of achieving ISO 9000 registration outweigh the financial costs, then there should be a statistically significant difference between the means of the costs and the benefits. The data on the registration cost, recurring costs, one-time benefits and recurring benefits for ISO 9000 registered companies was taken from the ISO 9000 Survey: 1996 and the ISO 9000 Survey: 1999.

4.1.1 ISO 9000 Survey: 1996

The data in the ISO 9000 Survey: 1996 was organized categorically based on annual sales volume, which ranged from less than $11 million in sales to over $1 billion in sales. There were a total of eight different annual sales ranges. Within these sale ranges, companies reported their recurring and non-recurring costs and benefits. The samples that were then taken from this data showed a tendency for normality when extreme outliers were removed and together the collection of normal sample distributions produced an overall normal distribution for each sales volume range.

The statistical analysis methods applied to the data are found in Devore (1995). The elements of statistical theory used in the thesis included the Central Limit Theorem, outlier identification, and hypothesis testing. Descriptions of how to do these analyses and how they were used follow.

In each annual sales category a random number of data points was pulled to form each sample. Initially these samples appeared to follow a distribution that was not normal, but after further examination, one or two points consistently skewed the samples. To identify these outliers, SPSS (SPSS, Version 11.5) was used to construct box plots. These plots are shown in Appendix A. The box plots showed the mean, spread, symmetry, and outliers of each distribution. After identifying the outliers, they were removed from the data allowing for a more accurate representation of samples.

At this point, the samples were representative and could be used to create the final distribution for each range. In all cases, sample sizes used for calculating the sample means were greater than 30, thus the final distribution of the sample means could be considered normal based upon the Central Limit Theorem (CLT). This theorem states that if the sample size is large enough the distribution of the sample means is approximately normal. A sample size of 30 means is generally accepted as being large enough. The standard deviations were also assumed to be similar in this situation.

After organizing the data into single distributions for each annual sales category the next step was to check the differences between those distributions. The differences checked were between the non-recurring costs and benefits, and the recurring costs and benefits. This involved completing a hypothesis-testing problem, in this case a two-sample z-test having a large sample size. A paired t-test would have been more ideal for this type of analysis, but the lack of identification on the responses made this type of test infeasible. The paired t-test would also have helped in the case of the standard deviations, since they can be different for this type of test.

A hypothesis-testing problem is formulated so that one claim is initially favored. This is called the null-hypothesis. In the current situation the null-hypothesis is: $\mu_1 - \mu_2 = \Delta_0 = 0$. Where μ_1 = the true mean of the benefits and μ_2 = the true mean of the costs. In other words, this states that there is no difference between the means of the cost distribution and the benefit distribution.

To check the null hypothesis an alternative hypothesis is created. In this case the alternative hypothesis is: $\mu_1 - \mu_2 \neq \Delta_0 \neq 0$. This means that some difference exists between the means of the distributions.

Once the test had been created, confirming that the null hypothesis should be accepted or rejected involved computing the rejection region for a level α test and comparing it to the test statistic value '*z*'. Each sample size, *m* and *n* for each respective sample, must be known along with each sample's true variance, σ_1^2 and σ_2^2. The null-hypothesis, alternative-hypothesis, rejection region, and test statistic are shown below in Figure (1).

$$H_0 = \mu_1 - \mu_2 = \Delta_0$$

$$H_a = \mu_1 - \mu_2 \neq \Delta_0$$

$$\text{Rejection Region: } Z \geq Z_{\alpha/2} \text{ or } Z \leq -Z_{\alpha/2}$$

$$Z = \frac{\overline{X} - \overline{Y} - \Delta_0}{\sqrt{\frac{\sigma_1^2}{m} - \frac{\sigma_2^2}{n}}}$$

H_0 = Null Hypothesis

H_a = Alternative Hypothesis

μ_1 = True Mean of Population 1

μ_2 = True Mean of Population 2

Δ_0 = Difference Between the Two Population Means

Z = Test Statistic

α = Significance Level

$\overline{X}$ = Sample Mean of Population 1

$\overline{Y}$ = Sample Mean of Population 2

σ_1 = True Variance of Population 1

σ_2 = True Variance of Population 2

m = Size of Population 1

n = Size of Population 2

Figure 1. Hypothesis Testing, Known Variance

Normally the *z*-value for this kind of test involves only known variances (σ^2), but because the sample sizes are greater than 30 those variances can be estimated with sample variances (s^2). This change to the test is as shown in Figure (2):

$$H_0 = \mu_1 - \mu_2 = \Delta_0$$

$$H_a = \mu_1 - \mu_2 \neq \Delta_0$$

$$\text{RejectionRegion: } Z \geq Z_{\alpha/2} \text{ or } Z \leq -Z_{\alpha/2}$$

$$Z = \frac{\overline{X} - \overline{Y} - \Delta_0}{\sqrt{\frac{S_1^2}{m} - \frac{S_2^2}{n}}}$$

H_0 = Null Hypothesis

H_a = Alternative Hypothesis

μ_1 = True Mean of Population 1

μ_2 = True Mean of Population 2

Δ_0 = Difference Between the Two Population Means

Z = Test Statistic

α = Significance Level

$\overline{X}$ = Sample Mean of Population 1

$\overline{Y}$ = Sample Mean of Population 2

S_1 = Sample Variance of Population 1

S_2 = Sample Variance of Population 2

m = Size of Population 1

n = Size of Population 2

Figure 2. Hypothesis Testing, Sample Variance

When the test statistic value '*z*' falls within the rejection region, the null-hypothesis is rejected and the alternative-hypothesis is accepted. The hypothesis testing was completed for all of the sales volume ranges. The testing results are shown in the results section of the thesis.

4.1.2 ISO 9000 Survey: 1999

The data in the ISO 9000 Survey: 1999 was organized similar to the data in the ISO 9000 Survey: 1996. The numbers were arranged based on annual sales volume. The annual sales volumes were divided into three ranges. These ranges were 0-25 million dollars, 25-200 million dollars and all annual sales greater than 200 million dollars. Thus there are fewer divisions by annual sales in this survey than in the 1996 survey, but comparisons between the two can still be made because the divisions align with each other. An example of this would be in the range of 0 to 25 million dollars. In the 1996 survey this range was divided into two categories instead of one. Within each range in the 1999 survey there were frequency distributions for the recurring and non-recurring costs and benefits. The statistical analysis methods applied to the data are found in Devore (1995). As with the 1996 survey, the elements of statistical theory used in this part of the thesis included the Central Limit Theorem, outlier identification, and hypothesis testing. In the annual sales categories the sample sizes for each mean frequency distribution were greater than 30, and like the 1996 survey they were large enough to be considered normal based upon the Central Limit Theorem.

Unlike the 1996 survey, the 1999 survey contains cost and benefit data for different manufacturing sectors. These sectors are listed in Table 5 and they allow for a test of significance to be completed for different types of manufacturing. It must be mentioned, however, that responses in the Agriculture, Forestry, and Mining and the Services, Trades, and Construction Sectors were less than 30. This means that, unfortunately,

these sectors could not be analyzed using the test of significance. For all other instances, a test of significance similar to the one completed for the 1996 survey was also completed for the 1999 ISO 9000 survey.

Table 5. Manufacturing Sectors in the ISO 9000 Survey 1999

Agriculture, Forestry and Mining
Services, Trades, and Construction
Food, Tobacco, Textile and Wood Products
Petrochemicals and Plastics
Manufacturing, Metals and Machinery
Electronics and Instruments

4.2 Approach and Methodology: MBNQA

A simple evaluation was completed using the numbers provided in the NIST stock market studies. Looking at the numbers provided would suggest, as the National Institute of Standards would want, that companies who receive the Baldrige Award show an increase in stock performance over their competitors. The many factors that contribute to stock performance, however, make findings based solely on this one number questionable. To see if this question is indeed valid, however, the stock performance of each manufacturing company that appeared in both the 1998 and 2000

stock market studies were examined individually to see how each contributed to the average performance of the MBNQA companies.

The NIST studies included all of the MBNQA winning companies but, because of the focus of this thesis, the manufacturing organizations were extracted and examined as a separate group in the surveys ending in December 1998 and in December 2000. These two particular surveys were chosen for two important reasons.

The first reason is that, starting in 1998, all of the stock performance studies began looking at ten-year intervals of performance. Prior to 1998, the performance was calculated from the time the first award was given in 1988 until the year of the study. This means that all studies before 1998 covered the same companies with the new winners being added each year. This thesis only compares companies that appeared in both of the two ten-year studies examined. This excludes companies like Motorola who won in 1988 (not included in 2000 study) and Dana Corporation who won in 2000 (not included in 1998 study), thus allowing for the same organizations to be compared.

The second reason for choosing the studies involves mainly the study ending December 2000. It was chosen because it was the last study not affected by the major stock market downturn of 2001.

After the data was organized, it was analyzed further by removing the outstanding performers and recalculating the ratios. The ratio of the company representing the median of performance was also compared to the S&P 500 to show if that number might be more representative of central tendency than the average.

5.0 RESULTS

5.1 ISO 9000 Results

The results of the hypothesis test for the 1996 ISO 9000 survey are shown in Tables 6a and 6b. For the non-recurring costs and benefits, the results show that there is no significant difference between the means for a majority of the distributions, and where there was a significant difference, the costs were identified as being greater than the benefits.

For the recurring or annual costs and benefits, the hypothesis test showed that in general, for companies with a high volume of annual sales, the annual benefits are statistically significantly larger than the annual costs. Companies with low levels of annual sales, showed no significant difference between annual benefits and annual costs at a confidence level of 95 percent.

The data from the 1996 survey provides several significant insights and one major question. The first insight is that companies with annual sales below $100 million will either break even or lose money on their ISO investment when considering quantitative benefits alone. In fact, for organizations in the $26 million to $50 million range, both sets of costs, non-recurring and recurring, were significantly greater than both sets of benefits. The second and more questionable insight is that companies with large levels of annual sales (above $100 million) will make money on their investment, but only due

to long-term annual cost savings. This insight is questionable because the data that it is drawn from shows some strange behavior. Overall, a majority of the data shows that an increase in annual sales correlates to an increase in costs and benefits associated with registration. The $201 million to $500 million range, however, is a major exception to that trend. It is an exception because the recurring benefits for this range drop well below the recurring benefits experienced by the previous range of companies and it actually shows that the costs are greater than the benefits. Other than the smaller sample size (all other ranges had more data points), possible explanations for this large drop are difficult to identify. The sample size may have allowed the outlier to have more of an effect on the average and cause it to drop to such a low point. To reinforce this point, the original tables did show that the data followed a generally increasing pattern when the outliers were included. The original trend, combined with the results from the other ranges shows that the second insight, while questionable, is generally correct.

The numbers from the 1999 ISO 9000 survey were examined and tested in the same way as the 1996 survey and the results are shown in Tables 7a and 7b. In all cases, the data from the 1999 survey followed the expected patterns and provided more consistent data than the 1996 survey. The results of the hypothesis test for the non-recurring or one-time costs and benefits in the1999 ISO 9000 survey shows that there is no significant difference between the means for companies with annual sales over $200 million. For companies that have annual sales below $200 million, the distributions are significantly different with the costs outweighing the benefits.

Table 6a. *Z*-Test for Non-Recurring Costs and Benefits – ISO Survey 1996

Non-Recurring Costs

	Annual Sales Volume ($)							
	< 11M	11M to 25M	26M to 50M	51M to 100M	101M to 200M	201M to 500M	501M to 1B	> 1B
Responses	178	249	287	252	187	165	94	183
Average $ Spent	43006	58845	84625	83611	120963	145727	120878	211776
Standard Dev.	42669	55136	83067	84837	108350	146075	120680	243922

Non-Recurring Benefits

	Annual Sales Volume ($)							
	< 11M	11M to 25M	26M to 50M	51M to 100M	101M to 200M	201M to 500M	501M to 1B	> 1B
Responses	132	202	209	207	147	130	76	128
Average $ Benefit	13845	45050	43678	67645	102194	118385	139276	164453
Standard Dev.	22252	139096	124120	159890	283331	285197	463358	436039
z=	7.80	1.33	4.14	1.29	0.76	0.99	-0.34	1.11
α value	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
P value	.0004	.1836	.0004	.197	.4532	.3222	.7414	.267
rejection region	>1.96, <-1.96	>1.96, <-1.96	>1.96, <-1.96	>1.96, <-1.96	>1.96, <-1.96	>1.96, <-1.96	>1.96, <-1.96	>1.96, <-1.96
Accept, Reject?	Reject	Accept	Reject	Accept	Accept	Accept	Accept	Accept

Table 6b. *Z*-Test for Recurring Costs and Benefits – ISO Survey 1996

Recurring Costs

	Annual Sales Volume ($)							
	< 11M	11M to 25M	26M to 50M	51M to 100M	101M to 200M	201M to 500M	501M to 1B	> 1B
Responses	179	249	285	257	196	183	105	197
Average $ Spent	10810	13394	16342	16693	19503	22568	19357	22119
Standard Dev.	6918	7628	7803	7812	12316	15892	12024	16559

Recurring Benefits

	Annual Sales Volume ($)							
	< 11M	11M to 25M	26M to 50M	51M to 100M	101M to 200M	201M to 500M	501M to 1B	> 1B
Responses	127	161	144	122	125	63	76	118
Average $ Benefit	12165	15373	13724	14836	47620	13056	151612	118369
Standard Dev.	11462	12979	11510	12677	55410	12317	263195	184386
z=	-1.18	-1.74	2.45	1.48	-5.58	4.88	-4.37	-5.65
α value	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
P value	.238	.0802	.0138	.1362	.0004	.0004	.0004	.0004
rejection region	>1.96, <-1.96	>1.96, <-1.96	>1.96, <-1.96	>1.96, <-1.96	>1.96, <-1.96	>1.96, <-1.96	>1.96, <-1.96	>1.96, <-1.96
Accept, Reject?	Accept	Accept	Reject	Accept	Reject	Reject	Reject	Reject

For the recurring or annual costs and benefits, the hypothesis test showed that in cases where companies have annual sales of less than $200 million the distributions were significantly different, with the benefits outweighing the costs by an average of 4:1. For companies with sales of more than $200 million, the distributions were not significantly different.

The results of the hypothesis testing completed on each manufacturing sector in the 1999 survey are shown in Table 8a through 8d. They show that there is no significant difference between the distributions of total costs and benefits for any sector. This means that companies in each manufacturing sector will break even when they register for ISO 9000.

Comparing the hypothesis tests completed for the two surveys shows more differences than similarities. For example, the recurring cost and benefit distributions for companies with annual sales of less than 25 million dollars were shown to be significantly different in the 1999 survey with the benefits outweighing the costs, but were not significantly different in the 1996 survey. This shows that instead of breaking even, as in 1996, smaller organizations were seeing annual benefits in 1999. In fact, all organizations were seeing annual benefits greater than or equal to annual costs in 1999, a major difference from 1996. A possible explanation is that if organizations are willing to wait for a return on their investment they will receive one.

Table 7a. Z-Test for Non-Recurring Costs and Benefits – ISO Survey 1999

Non-Recurring Costs Across All Industries

	Annual Sales Volume ($)		
	< 25M	25M to 200M	> 200M
Responses	495	266	116
Average $ Spent	72502	106890	299765
Standard Dev.	156481	146394	665292

Non-Recurring Benefits Across All Industries

	Annual Sales Volume ($)		
	< 25M	25M to 200M	> 200M
Responses	284	176	71
Average $ Benefit	27968	73312	174471
Standard Dev.	73766	189350	524914

z=	5.37	1.99	1.43
alpha value	0.05	0.05	0.05
P value	.0004	.0466	.1528
rejection region	>1.96, <-1.96	>1.96, <-1.96	>1.96, <-1.96
Accept, Reject?	Reject	Reject	Accept

Table 7b. Z-Test for Recurring Costs and Benefits – ISO Survey 1999

Recurring Costs Across All Industries

	Annual Sales Volume ($)		
	< 25M	25M to 200M	> 200M
Responses	508	286	127
Average $ Spent	29595	42014	93104
Standard Dev.	34256	45604	160731

Recurring Benefits Across All Industries

	Annual Sales Volume ($)		
	< 25M	25M to 200M	> 200M
Responses	291	174	72
Average $ Benefit	53895	109890	443701
Standard Dev.	152739	199120	1642116

z=	-2.67	-4.42	-1.80
alpha value	0.05	0.05	0.05
P value	.0076	.0004	.0718
rejection region	>1.96, <-1.96	>1.96, <-1.96	>1.96, <-1.96
Accept, Reject?	Reject	Reject	Accept

Table 8. Z-Test for Costs and Benefits by Industry Sector – ISO Survey 1999

Food, Tobacco, Textiles, and Wood Products	
One-Time Costs	Mean of the Sector
Responses	42
Average $ Spent	150221
Standard Dev.	152920
One-Time Benefit	Mean of the Sector
Responses	26
Average $ Benefit	159250
Standard Dev.	255705
z=	-0.16
alpha value	0.05
P value	0.8728
rejection region	>1.96, <-1.96
Accept, Reject?	Accept

Petrochemicals and Plastics	
One-Time Costs	Mean of the Sector
Responses	109
Average $ Spent	200942
Standard Dev.	617032
One-Time Benefit	Mean of the Sector
Responses	63
Average $ Benefit	122736
Standard Dev.	215516
z=	1.20
alpha value	0.05
P value	0.2302
rejection region	>1.96, <-1.96
Accept, Reject?	Accept

Manufacturing, Metals, and Machinery	
One-Time Costs	Mean of the Sector
Responses	325
Average $ Spent	161285
Standard Dev.	335973
One-Time Benefit	Mean of the Sector
Responses	193
Average $ Benefit	262243
Standard Dev.	1277274
z=	-1.08
alpha value	0.05
P value	0.2808
rejection region	>1.96, <-1.96
Accept, Reject?	Accept

Electronics and Instruments	
One-Time Costs	Mean of the Sector
Responses	137
Average $ Spent	129307
Standard Dev.	149328
One-Time Benefit	Mean of the Sector
Responses	83
Average $ Benefit	209674
Standard Dev.	447732
z=	-1.58
alpha value	0.05
P value	0.1142
rejection region	>1.96, <-1.96
Accept, Reject?	Accept

The other major difference between the 1996 survey and the 1999 survey is the hypothesis test on the non-recurring costs and benefits for companies with mid-level annual sales (25 to 200 million dollars). In 1996, the hypothesis tests showed that companies in this range of annual sales were generally breaking even on non-recurring costs and benefits. In 1999, companies in this same range were shown to be spending significantly more on non-recurring costs than the amounts they were receiving from non-recurring benefits. This means that mid-level annual sales companies in 1999 were

required to overcome a larger initial monetary deficit than their counterparts did in 1996. One reason for this increase might be higher consultant fees, an increase in the demands of registration (shifting from ISO 9000 to ISO 9000:2000) or some other fee increase in an area necessary for registration.

The major insight from the two surveys is that, in most cases, organizations that attempt ISO 9000 registration either break even or see significant financial benefits. The payback always comes from recurring benefits because no group of organizations in either survey saw non-recurring benefits that were larger than the non-recurring costs. Finally, industry sector has a very minimal effect on whether an organization will see financial benefits.

5.2 MBNQA Results

As mentioned in Section 4.2, Approach and Methodology: MBNQA, two stock performance studies completed by NIST were used for this thesis. For the 10-year stock performance comparison study ending December 1998, the initial investment in the MBNQA winning manufacturing companies and the S&P 500 was $5,479. The award recipients' value at the close of December 1998 was $30,273 for a 452% return compared to the S&P 500 Index closing value of $19,915 for a 263% gain. Thus, the "Baldrige Index" for the manufacturing companies outperformed the S&P 500 by a ratio of 1.5:1 (not as well as all companies at 2.5:1). This result is shown in Table 9 and the data, with calculations, can be found in Appendix B.

In 2000, the initial investment in the MBNQA winning manufacturing companies and the S&P 500 was the same as the 1998 study, $5,479. The award recipients' value at the close of December 1, 2000 was $50,629 for an 825% return compared to the S&P 500 Index value at $16,592 for a 202% gain. Thus, the "Baldrige Index" outperformed the S&P 500 by a ratio of 3:1 (not quite as well as all companies at 4.2:1). Again, these results are summarized in Table 9.

The numbers in the previous paragraphs show the outstanding gains realized in the stock market by the Baldrige award winning manufacturing companies as a group. It does not show, however, the performance of individual companies. This means the study is actually misleading because, as will be shown, the average performance of the manufacturing MBNQA companies is skewed by large gains in the stock price of two companies. Removing these stocks causes major changes in the performance of the group as a whole.

Since 1988, Solectron has had the highest gains in stock performance of the 18 manufacturing companies in the study (1,778% gain by 1998, 3,185% gain by 2000). This means that in the study ending December 1998, if Solectron is removed the percent return for the remaining 11 manufacturing companies decreases from 452% to 154%. Assuming the S&P 500 return remains at 263%, Table 9 shows the ratio of the "Baldrige Index" to the S&P 500 decreases and is now .7:1. In the 10-year study ending December 2000, the percent return for the remaining 11 companies decreases from

825% to 298%. Assuming the S&P 500 return remains at 202%, Table 9 shows the ratio has decreased to 1.3:1. This data shows that by removing one company the S&P actually outperformed the Baldrige Index in 1998 and was very close to doing so in 2000.

The company with the second highest gains in stock performance since 1988 is Zytec (477% gain by 1998, 1,113% gain by 2000). Zytec is chosen because it was present in both studies. In the 1998 study, if both Solectron and Zytec are removed, the percent return for the remaining 10 manufacturing companies decreases from 452% to 61%. Assuming the S&P 500 return remains at 263%, the remaining companies drop to a ratio .59:1 against the S&P 500. In the 10-year study ending in 2000, the percent return for the remaining 10 manufacturing companies decreases from 825% to only 64%. Assuming the S&P 500 return remains at 202%, the remaining MBNQA companies continue to show poor performance against the S&P 500 with a ratio of 0.6:1. Thus, as Table 9 illustrates, removing the star performers can have a great effect on the comparison with the S&P 500 as the remaining MBNQA winners had a poorer performance than the S&P in the 10-year study concluded in 2000.

One additional element to this analysis is the comparison of the median return of the Baldrige winners to the S&P 500 return. The median for the 1998 survey falls between two companies and is a return 89.3%. Compared to the 263% return of the S&P 500 this is a ratio of .33:1. The median for the 2000 survey is a return of 111%. Compared to the 202% return of the S&P 500 this ratio is .54:1. What these numbers show is that

Table 9. Analysis of the "Baldrige Index" to the S&P 500 Index Ratios

Companies used in Baldrige Index	Ratio for Study ending Dec. 1998	Ratio for Study ending Dec. 2000
All MBNQA Companies Included in Both Studies	2.5 to 1	4.2 to 1
MBNQA Manufacturing Companies included in both studies	1.5 to 1	3 to 1
Remove One Company: Solectron	0.7 to 1	1.5 to 1
Remove Two Companies: Solectron and Zytec	0.59 to 1	0.62 to 1
Comparison of the Medians for Companies in Both Studies	0.33 to 1	0.54 to 1

a majority of the manufacturing companies that were in both the 1998 and 2000 studies had returns well below that of the S&P 500. In fact, in 2000, three of the 12 manufacturing companies actually had negative stock performance. Overall, this element of the analysis does show the central tendency better than the overall average and it agrees with the other findings. It also reinforces that the outstanding performers have a major impact on the results of the NIST study.

Since the 2000 study, the stock in the MBNQA companies has decreased in value by 23.7 percent, while the S&P 500 index has increased by 45 percent. Of the MBNQA manufacturing companies only Raytheon and 3M, two out of thirteen, showed an increase in stock price. As listed in the literature review, Table 3, the latest 10-year study, closing date of December 2002, showed that all of the MBNQA winning

companies under performed the S&P 500 by a ratio of -0.53:1. This most up to date ratio, combined with the evidence of inflated ratios in 1998 and 2000, contributes to the evidence that the performance of Baldrige award winners may not be primarily based on winning the award, but on how strong the stock market is as a whole when they win the award.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Overall, the data does show that financial gains can be made through the implementation of quality programs like ISO 9000 and the Malcolm Baldrige National Quality Award. These financial gains, however, come from long-term organizational improvement instead of from immediate monetary benefits. For most organizations the immediate gains are only qualitative in nature, and the financial gains arise after a period of improved performance. For ISO 9000, the findings of this thesis agree with the previous research of Corbett et al., but differ from the two ISO 9000 surveys that only compared the simple averages of each distribution. For the Baldrige award, the findings of this thesis contradict the stock market study that has been so widely used to demonstrate the financial impact of the award.

The evaluation of the statistical significance between the costs and benefits of ISO 9000 registration showed that annual sales volume (company size) does have some impact on financial returns, but that overall the recurring benefits will eventually outweigh the non-recurring and recurring costs. The analysis of the 1996 and 1999 ISO surveys showed that companies with higher annual sales (above $200 million) break even on non-recurring costs and benefits. Also, in almost all cases, these “larger” companies’ recurring benefits were higher and significantly different than the annual costs associated with maintaining registration. This means that these organizations, once they are registered, should see a financial improvement in a relatively short period of time.

Unlike their larger counterparts, companies that had low levels of annual sales (below $200 million) experienced one-time costs were either similar to or significantly larger than the one-time benefits. This means, even with evidence of significantly higher annual benefits, that the financial impact will not be as immediate for these smaller organizations.

These findings can mean a number of things for companies who are determining if they want to become ISO 9000 registered. First, the management teams for companies with smaller levels of annual sales (below $200 million) must decide if the qualitative benefits associated with ISO 9000 registration are enough to offset the one-time expenditures that are necessary. Second, for all companies (regardless of sales volume) management must determine if the company can wait an extended period of time for a positive return on their ISO investment. Third, and finally, one factor may outweigh any decision based on financial return. If an organization's customers start to require registration, the process may be forced upon management. At this point then, the decision of whether to become ISO certified has been made for management and the fact that some additional financial gain will be likely is just a bonus.

Specifically for the MBNQA, the S&P 500 stock studies have been around for over ten years, but it has been shown in this thesis that they may be misleading. An examination of the data showed that the numbers and type of indices chosen to show the success of the Baldrige Award program are skewed. There are many reasons for this. First, the ever-changing value of the stock market makes it very difficult to make

comparisons. At one point in time, a group of selected stocks may perform well above any other group of selected stocks, but at another time this same group may lose more money. Second, stock performance itself can be affected by many factors that have nothing to do with winning the Baldrige Award. An increase in stock performance can arise when a company introduces new products, merges with another company, or produces a higher than expected profit. Third and finally, the data in this thesis demonstrated that one or two outstanding performers have the ability to lift a group from mediocre performance to outstanding performance. This means that, in most cases, being successful as organization means more to stock performance than just winning the Baldrige Award. For all of these reasons, the data used by NIST is skewed for the manufacturing sector and the conclusions made by the agency about increases in financial performance for winners are suspect based on this one measure.

The MBNQA's reliance on the stock market study and the positive spin that it has given for the award appears to have prevented any new official studies from being conducted. This lack of a true study into the financial effects of the MBNQA can lead to improper decisions by management who may base a decision to implement this quality program on the assumed benefit of increased stock performance. By definition, a "before and after" summative evaluation is a tool that would provide a quantitative report on the successes and failures of the Baldrige program. The data for the report would be gathered using a survey similar to the ISO 9000 surveys cited in this Thesis. A survey would be an appropriate research tool because this type of study meets the criteria set by Sapsford (1999). The research would be feasible. The kind of answers required

(economic data) can be gathered using survey questions. Valid conclusions can be made from the data. Ethics are not a concern in this situation, and politics should not be factor. The assumption associated with the last criteria is, of course, a large one. A program with the history and notoriety of the Baldrige Award may have individuals associated with it that have an interest in maintaining that the program is a success. The current stock study generally shows that the program is a success because two companies had outstanding gains. A survey and summative evaluation may show this to not be the case. Even with this possibility, an unbiased evaluation would determine if the Baldrige award really is a viable quality tool for organizational improvement.

General recommendations include continuing to track the costs and benefits associated with ISO 9000 registration. The two surveys published so far did a great job of summarizing important and useful data, but are becoming dated. Also, unlike the past ISO surveys, any data gathered in the future needs to have some type of company identification included. This will allow for paired tests and proper grouping as demonstrated in Corbett, et al.

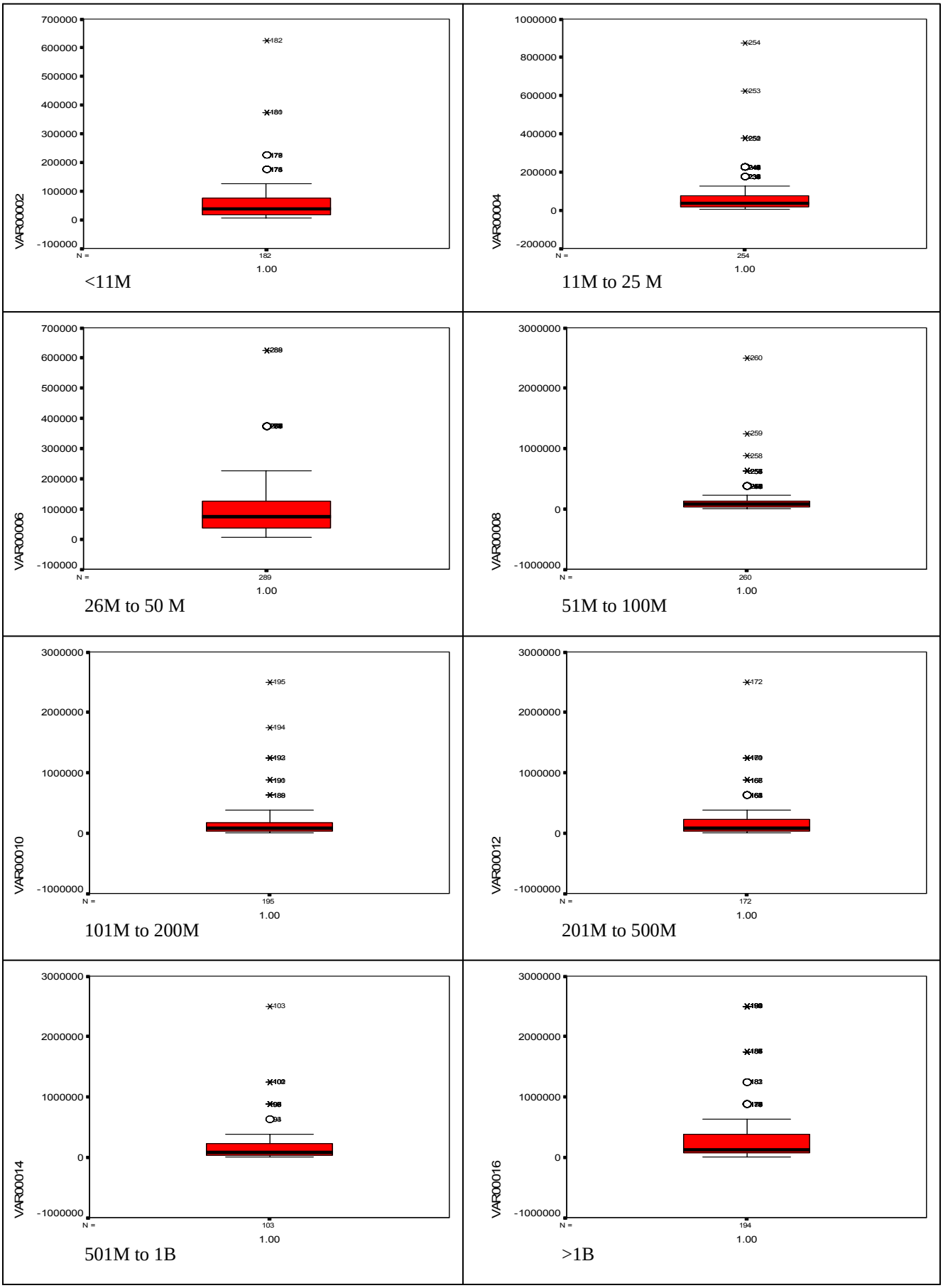
One recommendation for future work to better quantify the benefits of the MBNQA is to complete a summative evaluation of the award winning companies. This survey would request data on the costs incurred to implement the Baldrige Criteria and to apply for the award, as well as, the savings realized due to the improvements brought about as a result of implementing the quality award criteria. Also, NIST would have to support this development of a well-designed program evaluation that looks at the financial

performance of each new award applicant before and after they win the Baldrige Award. This would help to measure the award winners' and show the true financial benefits of the program.

APPENDIX A

ISO 9000 Box Plots

One Time Costs



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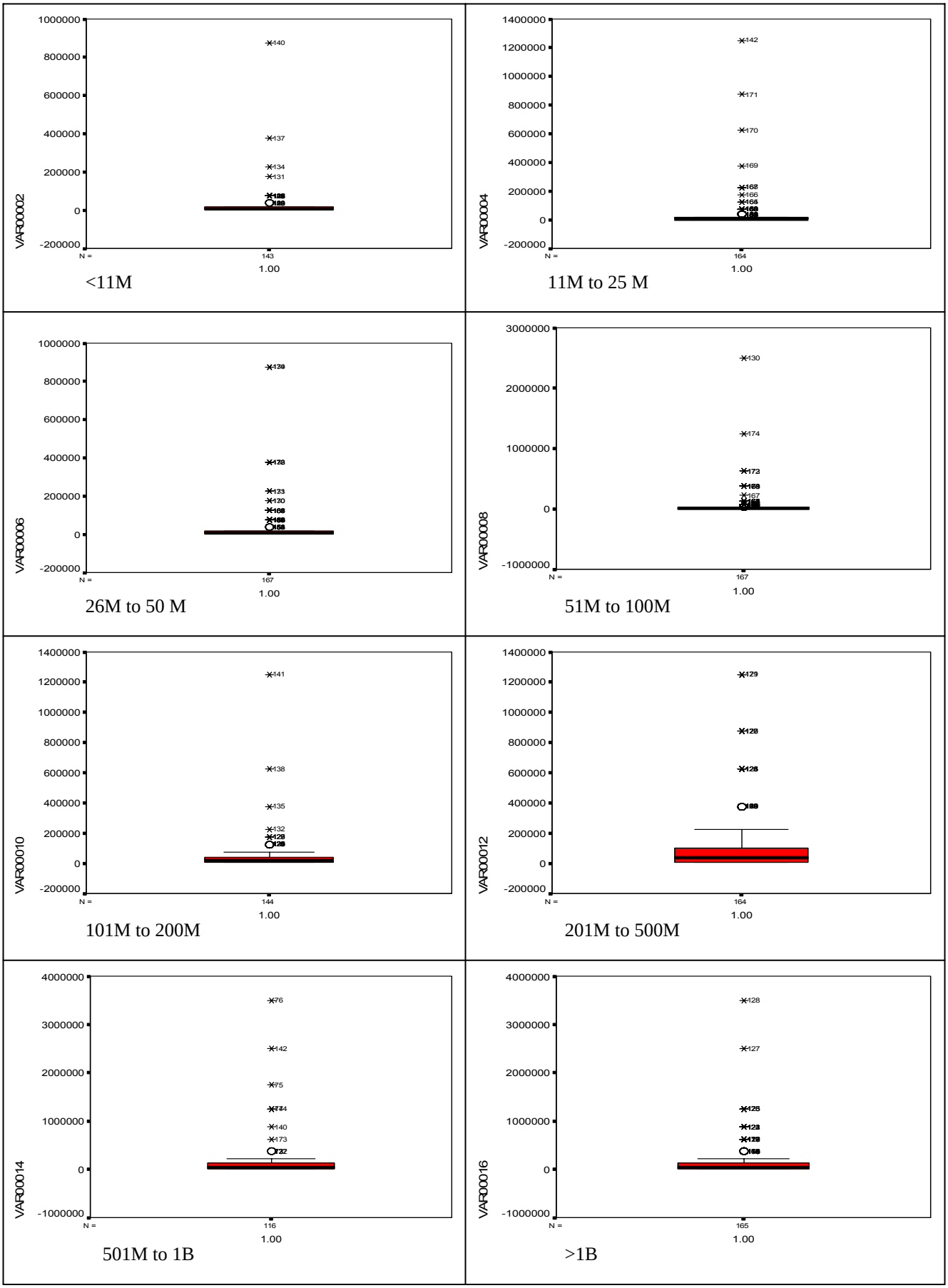

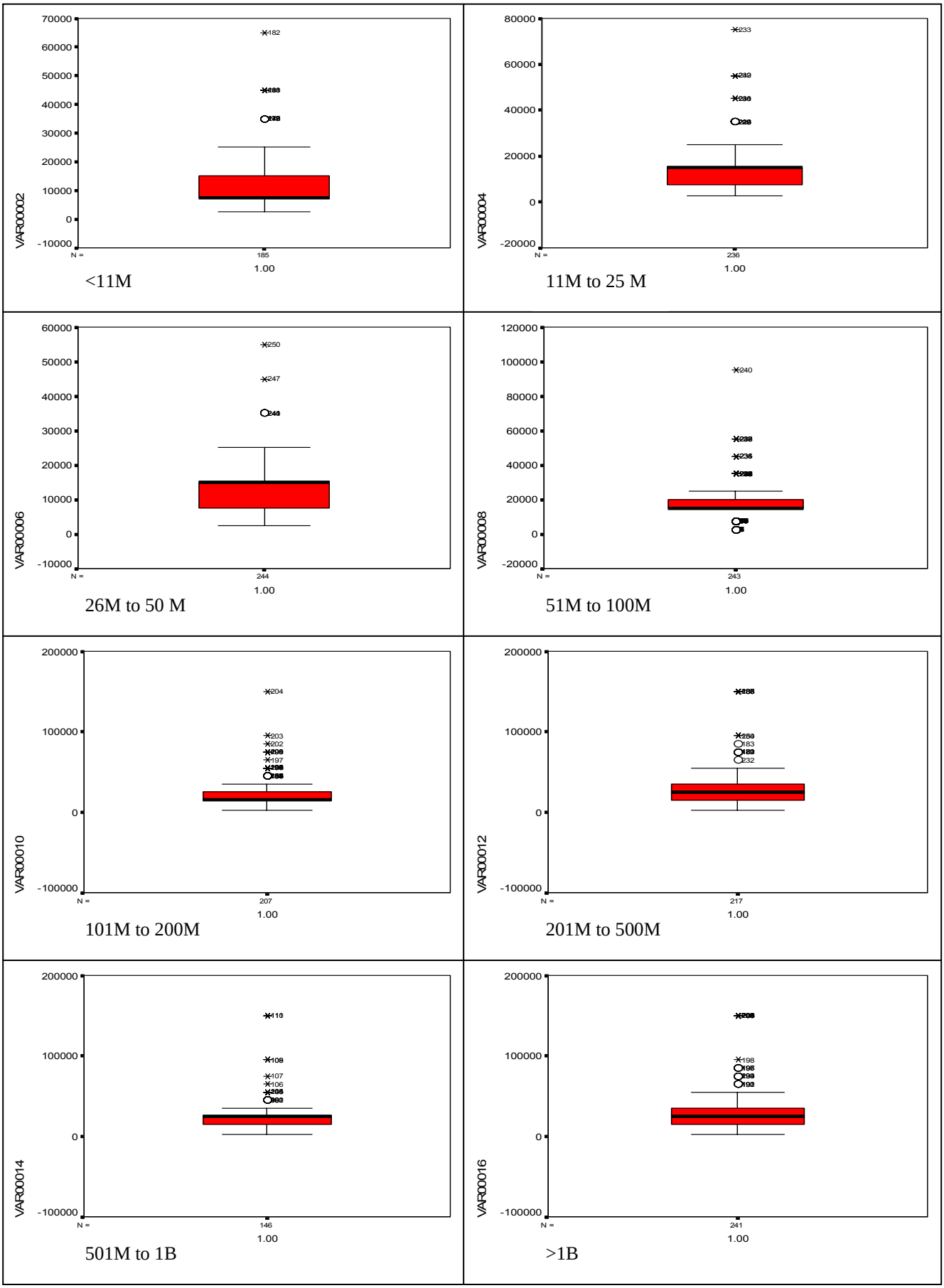
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60000
40000
20000
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233
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236
1.00
11M to 25 M
VAR00006
60000
50000
40000
30000
20000
10000
0
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250
247
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26M to 50 M
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120000
100000
80000
60000
40000
20000
0
-20000
240
N =
243
1.00
51M to 100M
VAR00010
200000
100000
0
-100000
204
203
202
197
N =
207
1.00
101M to 200M
VAR00012
200000
100000
0
-100000
183
232
N =
217
1.00
201M to 500M
VAR00014
200000
100000
0
-100000
110
109
107
106
N =
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501M to 1B
VAR00016
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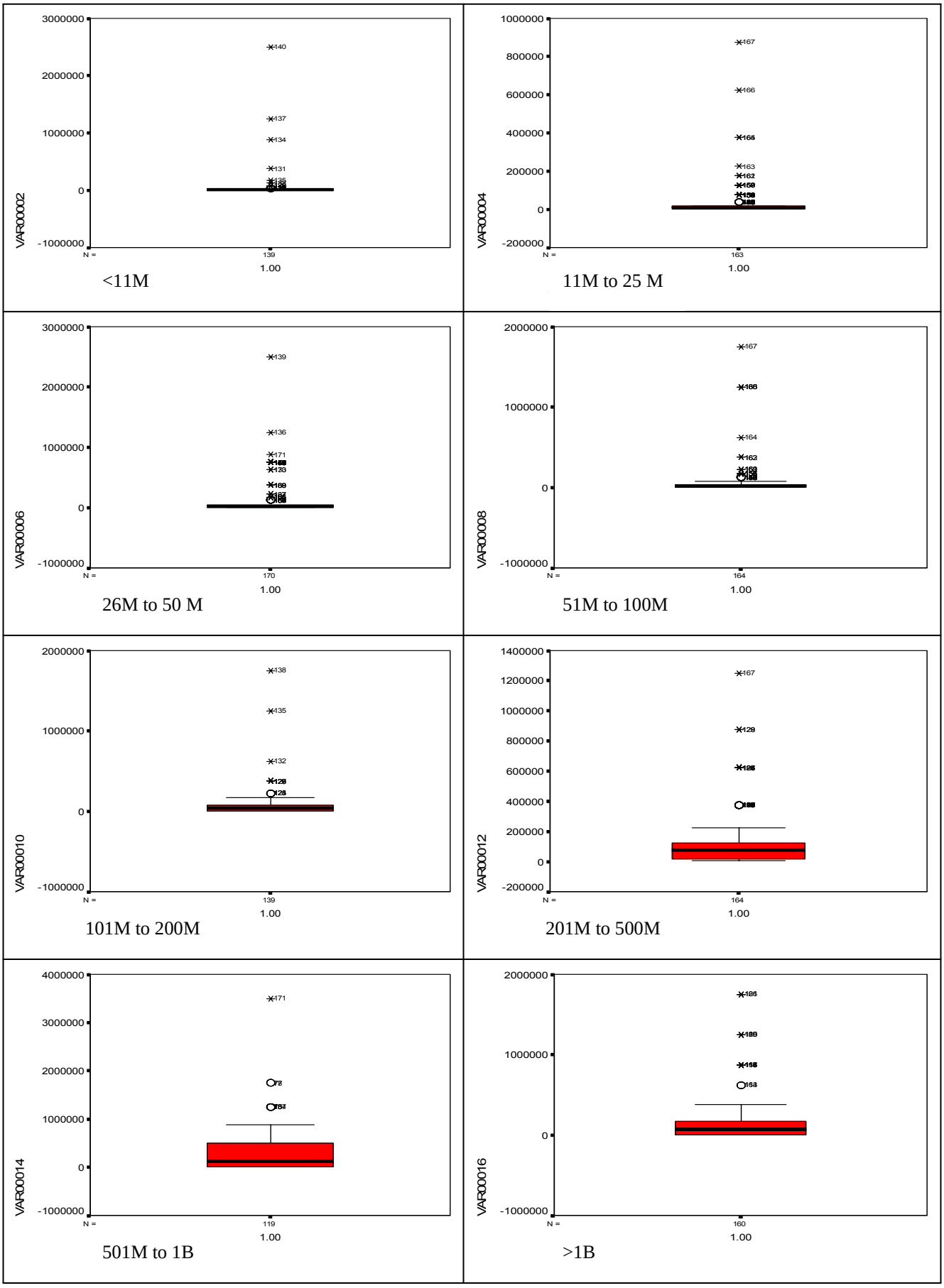
0
-100000
198
N =
241
1.00
>1B

Annual Benefits



APPENDIX B

Baldrige Index vs. S&P 500 Index Calculations

S&P 500 vs. All Manufacturing Winners Included in 1998 and 2000 studies											
						December 1, 1998 Close*			December 1, 2000 Close*		
Date of Investment	Whole Co or Parent of Division	Stock Price	Percent of 1000	Amount invested	Number of shares	Stock Price	$ Value	% Change	Stock Price	$ Value	% Change
11/1/1990	General Motors	36.875	1.34%	$ 13.39	0.36	71.75	26.05376	94.58%	50.31	18.2685	36.43%
	Cadillac										
11/1/1990	IBM	107.25	1.76%	$ 17.62	0.16	169.88	55.8172	216.78%	95.63	62.84385	256.66%
	Rochester					2x split				4x split since 1990	
11/1/1991	Solectron	28.25	100.00%	$ 1,000.00	35.40	66.688	18884.96	1788.50%	29	32,849.56	3184.96%
						8x split				32x split since 1991	
11/2/1992	AT&T	44.125	3.75%	$ 37.54	0.85	88.5	220.6076	487.66%	15.69	78.16882	108.23%
	Systems Bus Unit					2.93x split				5.855x split since 1992	
	(now part of Lucent, Optical Networking)										
11/2/1992	Texas Instruments	49.375	24.66%	$ 246.61	4.99	56.375	1004.65	307.38%	29.81	531.2395	115.42%
	DSEG					3.568x split				3.568x split	
	(now Raytheon)										
11/11/1992	Zytec	10.5	100.00%	$ 1,000.00	126.67	17	5770.933	477.09%	35.75	12135.93	1113.59%
	(now Artesyn, 1 share Zytec=1.33 Artesyn					2.68x split				2.68x split since 1992	
11/3/1994	Eastman Chemical	45.125	100.00%	$ 1,000.00	22.16	57.938	1283.934	28.39%	44.38	983.4903	-1.65%
11/1/1995	Armstrong Wrld	58.875	11.83%	$ 118.25	2.01	66.375	133.3137	12.74%	1	2.008493	-98.30%
	Buildng Products										
11/1/1995	Corning TPD	25.75	3.64%	$ 36.41	1.41	40.5	67.00147	84.02%	60.94	301.5879	728.31%
						1.17x split				3.5 split since 1995	
11/1/1996	ADAC Lab	20.875	100.00%	$ 1,000.00	47.90	24.75	1185.629	18.56%	18.38	880.479	-11.95%
	(now part of Philips)										
11/3/1997	3M	92.188	0.99%	$ 9.90	0.11	81.375	8.738847	-11.73%	99.63	10.69925	8.07%
	Dental Pro Div										
11/3/1997	Solectron	40.875	100.00%	$ 1,000.00	24.46	66.69	1631.56	63.16%	29	2837.92	183.79%
	ORGINAL	SUM (1998 study)		$ 5,479.72							
	ORGINAL	SUM (2000study)		$ 5,479.72		SUM =	30,273.19		SUM =	50,692.20	
						ORGINAL SUM=		5,479.72	ORGINAL SUM=		5,479.72
						PERCENT CHANGE=		452%	PERCENT CHANGE=		825%
						RATIO		5.524588	RATIO		9.250874
						Dec 1, 1998 CLOSE =			Dec 1, 2000 CLOSE =		
	S&P 500						19914.77			16591.6	
						ORGINAL SUM=		5,479.72	ORGINAL SUM=		5,479.72
						PERCENT CHANGE=		263.4%	PERCENT CHANGE=		202.8%
						RATIO		3.634268	RATIO		3.027819
					RATIO MBNQA : S&P 500			1.52			3.06
*Reference: http://www.nist.gov/public_affairs/stockstudy.htm, through Dec 1998											
*Reference: http://www.nist.gov/public_affairs/releases/stockstudy.htm, 10-year comparison											

S&P 500 vs. All Manufacturing Winners (1998 and 2000) without highest performer											
						December 1, 1998 Close*			December 1, 2000 Close*		
Date of Investment	Whole Co or Parent of Division	Stock Price	Percent of 1000	Amount invested	Number of shares	Stock Price	$ Value	% Change	Stock Price	$ Value	% Change
11/1/1990	General Motors	36.875	1.34%	$ 13.39	0.36	71.75	26.05376	94.58%	50.31	18.2685	36.43%
	Cadillac										
11/1/1990	IBM	107.25	1.76%	$ 17.62	0.16	169.88	55.8172	216.78%	95.63	62.84385	256.66%
	Rochester					2x split				4x split since 1990	
11/1/1991	**Solectron**	28.25	100.00%	**$1,000.00**	35.40		0		0	0.00	0.00%
						8x split				32x split since 1991	
11/2/1992	AT&T	44.125	3.75%	$ 37.54	0.85	88.5	220.6076	487.66%	15.69	78.16882	108.23%
	Systems Bus Unit					2.93x split				5.85x split since 1992	
	(now part of Lucent, Optical Networking)										
11/2/1992	Texas Instruments	49.375	24.66%	$ 246.61	4.99	56.375	1004.65	307.38%	29.81	531.2395	115.42%
	DSEG					3.568x split				3.568x split	
	(now Raytheon)										
11/11/1992	Zytec	10.5	100.00%	$1,000.00	126.67	17	5770.933	477.09%	35.75	12135.93	1113.59%
	(now Artesyn, 1 share Zytec=1.33 Artesyn					2.68x split				2.68x split since 1992	
11/3/1994	Eastman Chemical	45.125	100.00%	$1,000.00	22.16	57.938	1283.934	28.39%	44.38	983.4903	-1.65%
11/1/1995	Armstrong Wrld	58.875	11.83%	$ 118.25	2.01	66.375	133.3137	12.74%	1	2.008493	-98.30%
	Buildng Products										
11/1/1995	Corning TPD	25.75	3.64%	$ 36.41	1.41	40.5	67.00147	84.02%	60.94	301.5879	728.31%
						1.17x split				3.5 split since 1995	
11/1/1996	ADAC Lab	20.875	100.00%	$1,000.00	47.90	24.75	1185.629	18.56%	18.38	880.479	-11.95%
	(now part of Philips)										
11/3/1997	3M	92.188	0.99%	$ 9.90	0.11	81.375	8.738847	-11.73%	99.63	10.69925	8.07%
	Dental Pro Div										
11/3/1997	Solectron	40.875	100.00%	$1,000.00	24.46	66.69	1631.56	63.16%	29	2837.92	183.79%
	-1	SUM (1998 study)		$4,479.72							
	-1	SUM (2000 study)		$4,479.72		SUM =	11,388.24		SUM =	17,842.64	
						ORGINAL SUM=		4,479.72	ORGINAL SUM=		4,479.72
						PERCENT CHANGE=		154%	PERCENT CHANGE=		298%
						RATIO		2.542176	RATIO		3.982981
						Dec 1, 1998 CLOSE =			Dec 1, 2000 CLOSE =		
	S&P 500						16,280.50			13,563.78	
						ORGINAL SUM=		4,479.72	ORGINAL SUM=		4,479.72
						PERCENT CHANGE=		263.4%	PERCENT CHANGE=		202.8%
						RATIO		3.634268	RATIO		3.027819
					RATIO MBNQA : S&P 500			0.70			1.32
*Reference: http://www.nist.gov/public_affairs/stockstudy.htm, through Dec 1998											
*Reference: http://www.nist.gov/public_affairs/releases/stockstudy.htm, 10-year comparison											

S&P 500 vs. All Manufacturing Winners (1998 and 2000) without two highest performers											
						December 1, 1998 Close*			December 1, 2000 Close*		
Date of Investment	Whole Co or Parent of Division	Stock Price	Percent of 1000	Amount invested	Number of shares	Stock Price	$ Value	% Change	Stock Price	$ Value	% Change
11/1/1990	General Motors	36.875	1.34%	$ 13.39	0.36	71.75	26.05376	94.58%	50.31	18.2685	36.43%
	Cadillac										
11/1/1990	IBM	107.25	1.76%	$ 17.62	0.16	169.88	55.8172	216.78%	95.63	62.84385	256.66%
	Rochester					2x split				4x split since 1990	
11/1/1991	**Solectron**	28.25	100.00%	**$1,000.00**	35.40		0		0	0.00	0.00%
						8x split				32x split since 1991	
11/2/1992	AT&T	44.125	3.75%	$ 37.54	0.85	88.5	220.6076	487.66%	15.69	78.16882	108.23%
	Systems Bus Unit					2.93x split				5.855x split since 1992	
	(now part of Lucent, Optical Networking)										
11/2/1992	Texas Instruments	49.375	24.66%	$ 246.61	4.99	56.375	1004.65	307.38%	29.81	531.2395	115.42%
	DSEG					3.568x split				3.568x split	
	(now Raytheon)										
11/11/1992	**Zytec**	10.5	100.00%	**$1,000.00**	126.67		0			0	
	(now Artesyn, 1 share Zytec=1.33 Artesyn					2.68x split				2.68x split since 1992	
11/3/1994	Eastman Chemical	45.125	100.00%	$1,000.00	22.16	57.938	1283.934	28.39%	44.38	983.4903	-1.65%
11/1/1995	Armstrong Wrld	58.875	11.83%	$ 118.25	2.01	66.375	133.3137	12.74%	1	2.008493	-98.30%
	Buildng Products										
11/1/1995	Corning TPD	25.75	3.64%	$ 36.41	1.41	40.5	67.00147	84.02%	60.94	301.5879	728.31%
						1.17x split				3.5 split since 1995	
11/1/1996	ADAC Lab	20.875	100.00%	$1,000.00	47.90	24.75	1185.629	18.56%	18.38	880.479	-11.95%
	(now part of Philips)										
11/3/1997	3M	92.188	0.99%	$ 9.90	0.11	81.375	8.738847	-11.73%	99.63	10.69925	8.07%
	Dental Pro Div										
11/3/1997	Solectron	40.875	100.00%	$1,000.00	24.46	66.69	1631.56	63.16%	29	2837.92	183.79%
	-2	SUM (1998 study)		$3,479.72							
	-2	SUM (2000 study)		$3,479.72		SUM =	5,617.30		SUM =	5,706.71	
						ORGINAL SUM=		3,479.72	ORGINAL SUM=		3,479.72
						PERCENT CHANGE=		61%	PERCENT CHANGE=		64%
						RATIO		1.614298	RATIO		1.63999
						Dec 1, 1998 CLOSE =			Dec 1, 2000 CLOSE =		
	S&P 500						12,646.23			10,535.96	
						ORGINAL SUM=		3,479.72	ORGINAL SUM=		3,479.72
						PERCENT CHANGE=		263.4%	PERCENT CHANGE=		202.8%
						RATIO		3.634268	RATIO		3.027819
					RATIO MBNQA : S&P 500			0.44			0.54
*Reference: http://www.nist.gov/public_affairs/stockstudy.htm, through Dec 1998											
*Reference: http://www.nist.gov/public_affairs/releases/stockstudy.htm, 10-year comparison											

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