12-2004

Modeling the Strategic Impact of Management Accounting Methods on the Implementation of Lean Manufacturing

David Joseph Meade
Western Michigan University

MODELING THE STRATEGIC IMPACT OF MANAGEMENT ACCOUNTING METHODS ON THE IMPLEMENTATION OF LEAN MANUFACTURING

by

David Joseph Meade

A Dissertation
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
Degree of Doctor of Philosophy
Department of Industrial and Manufacturing Engineering

ADVISOR: DR. BOB E. WHITE

Western Michigan University
Kalamazoo, Michigan
December 2004

ACKNOWLEDGMENTS

It has been a long journey to this milestone of achieving a Ph.D., one that started before many of my colleagues in graduate school were born. This trip has taken me on a path that I would not change, one that has been rich with friendships and reward. It would be impossible to adequately acknowledge everyone that has contributed to this effort but I will do my humble best to thank those who were most instrumental.

Firstly, I would like to thank God for granting me the wisdom to navigate through this process and for providing me the financial resources, excellent advisors, and encouragement to succeed. I would like to thank Dr. Bob White and Dr. Sameer Kumar for enabling me to pursue this work, for their constant encouragement and for their efforts as members of my committee. I would like to thank Dr. Houshyar and Dr. Butt for their excellent advising in regard to this research and for the time spent to review the manuscript. Their efforts have greatly improved the quality of this document. I would also like to thank my colleague Mr. Kevin Kinsinger for his contributions to this research.

The last group I would like to thank is my family. Thank you Mom and Dad for your efforts in editing this manuscript and for your never-ending encouragement. Thanks also to my children, Sarah, Amy, Daniel, and Hannah, who have given up much to support their dad in achieving his dream. Finally, thanks most of all to my beautiful wife Shelly, without whom this would not have been possible.

David Joseph Meade

TABLE OF CONTENTS

Table of Contents—continued

LIST OF TABLES

List of Tables—continued

LIST OF FIGURES

List of Figures—continued

CHAPTER I

INTRODUCTION

Historical Background of the Problem

The accounting function within the manufacturing environment came under attack in the 1980's when H. Thomas Johnson and Robert S. Kaplan published their book, *Relevance Lost: The Rise and Fall of Managerial Accounting* (1991). This book chronicled the history of the development of modern day accounting practices as they pertain to manufacturing. The two areas of accounting in this category are namely Managerial Accounting and Financial Accounting. The second is primarily concerned with the processing of data and information for external reporting, that is reporting to investors and the government. Managerial Accounting is concerned with the management of the internal operations of the business. External reporting is governed by law and therefore must be supported on an ongoing basis. Non-compliance is not an option. However, support of the manufacturing operations with financial information in addition to that required for external reporting is not governed by external forces. Companies must decide if they are willing to support a financial reporting system in addition to that required by law to provide information relevant to operations for decision support. Per Johnson & Kaplan (1991), many companies have opted to rely on Financial Accounting information prepared for external reporting for managerial decision support. In effect, Managerial Accounting has become subservient to Financial Accounting. The unfortunate result of this development is that the financial information required for external reporting lacks the accuracy required for internal decision support. Lacking appropriate information for

decision support the operations management team has attempted to interpret where profit is being lost using the available financial reports. These reports often provide a misleading picture of what the current dynamics are in terms of the financial performance of the firm. This is due to several factors; cost allocation schemes and timing for the recognition of operational expenditures are two issues among these factors. As a result, Lean Manufacturing programs are being viewed as failures due to the effect they are having on the profit and loss statements in the early months of implementation (Womack and Jones, 2003; Cunningham and Fiume, 2003; Soloman, 2003). In fact, the more successful the lean manufacturing program the more damaging it can be on the financial statements. However, this phenomenon is only temporary and has no relevance to the true current operational performance. The length of time it will take the traditional financial reports to reflect the improvements is dependent on how poorly the operation was doing initially in terms of inventory management, prior to the initiation of the lean effort. It is hypothesized that through the application of simulation modeling, the dynamics of this phenomenon can be better understood. The results of this study will lead to a superior ability to predict the effects on the financial statements resulting form the initiation of a lean program. In turn, this knowledge will lead to the avoidance of surprises that impede progress with the implementation of lean strategies.

The problems that are created by traditional financial accounting practices are several. First, due to the need to account for indirect costs, costs that cannot be directly attributed to the product such as direct labor or direct materials, allocation schemes must be used. These schemes attach a portion of the overhead costs to the final product in an effort to "recognize" these costs in the reporting of financial

results. Sales price targets can then be calculated by using the derived cost information. However, in reality the market usually determines the sales price that must be met in order to compete. The problem with allocation schemes are that they are, at best, estimates. The basis for application of a dollar amount is based on direct labor hours required to produce the product in 68 to 73% of manufacturing operations (Drury and Tayles, 1997). This assumes that all indirect costs necessary to support the production of a particular product are proportional to the amount of direct labor required to produce that product. Many scenarios can be envisioned where this is clearly not sound logic. For instance, a part that has been in production for years may have a lower level of automated operations leading to a higher content of direct labor. A new part in the same operation, with a high level of automation, would have a lower direct labor content. The new part requires new capital equipment with a higher depreciation value then the old part. In addition, it is very typical that in the early months or years of manufacture, a product requires much more support from departments other than production than does a product that has been manufactured for years. In a costing system that relies on allocations, the old part would be carrying a greater portion of the indirect burden than the new product, in essence carrying some of the overhead costs of the new product. Using product cost information such as this to identify profitable products from those that are unprofitable can lead to incorrect conclusions. When these cost accounting practices were developed direct labor in the United States constituted about 60% of the total product cost. Today direct labor in the U.S. accounts for about 10% of the total product cost (Cunningham & Fiume, 2003). This transition has only exacerbated the inaccuracies inherent to this method of determining product cost.

A second issue created by traditional accounting practices comes from the concept of Cost Attachment and the handling of these "attached" costs. This is the primary issue causing the misrepresentation of performance improvements from lean manufacturing programs. In accounting terms, the cost attachment process has the effect of deferring the efforts (expenses) of producing a product until the accomplishment (revenue) is recognized. In other words, what attachment does is postpone the recognition of an expense until a later date. For instance, material and labor plus overhead required to produce a product are actually shown on the profit and loss statement in the period when the product is sold or otherwise removed from finished goods inventory. This means that labor and materials that were expended and paid during the current month may possibly not show up on the income statement this month and perhaps not for several months to come. Once the material has been converted into finished goods the cost is transferred to the Balance Sheet as an asset. When the item is sold, the expenses are recognized on the income statement as a Cost of Goods Sold. Therefore, if a lean program results in the lowering of finished goods inventories, which should be the case, the costs from prior production periods will begin to show up on the income statement without the corresponding transaction to the Balance Sheet that previously postponed the recognition of current period labor, material and overhead expenses. Without a corresponding offsetting transaction, a reduction in period indirect labor or salaries for instance, the income statement results move in a less favorable direction, i.e. lower gross and net profits. This will continue to occur until the finished goods inventories stabilize. In some operations, this could continue for a considerable length of time. As mentioned, a reduction in period costs would offset the effect of liberating the attached costs, however, this is a difficult option to manage. It is true that production will likely decrease for a time while

inventories are being depleted. However, these reductions will most likely be across all product lines making it difficult to remove a specific group of production workers and supporting staff. In addition, once the inventories have been lowered to the desired level, production will return to the pre-lean level, presumably requiring all or most of the production workers that were part of the operation at the onset of the lean program. The labor pool most affected by lean initiatives is indirect labor; those activities associated with moving material while in process or after completion. When material is eliminated from the operation, the indirect activities associated with its movement are also eliminated. These savings begin to build over time in terms of their contribution to the income statement but do not occur during a time frame sufficient to offset the initial negative impact from inventory reduction.

Research Objectives

The primary focus of this research is to study the impact on key external operational financial measures, as reported by various financial accounting methods, which result from the implementation of lean manufacturing practices. The analysis is conducted under several cost accounting environments. The traditional method of full absorption costing is used as a baseline and is important to this study as it is the method with the longest history and is the method most often used in industry (Drury and Tayles, 1997). It is also the method accepted by the IRS and SEC for calculation of externally reported financial results. Other known methods evaluated include direct costing, activity based costing and throughput costing. These methods have arisen out of a desire to develop a cost accounting method that removes or diminishes some of the negative aspects of cost accounting systems described earlier. A fifth method is introduced that has not yet been discussed in published research. This method is the

Meade-Kinsinger costing method and is based on the premise that overhead costs are not volume related but rather are the result of transactional activity that products cause in a manufacturing operation. The intent is to better understand how the external reported figures are affected under the various systems.

Previous research has chosen to focus in the area of evaluating which combination of manufacturing environment and management accounting system results in superior firm performance (Lea, 1998, Boyd, 1999). The research study documented here is not concerned with the evaluation of manufacturing methods, such as MRP, Throughput, or JIT, in an effort to determine the one best method. It is extremely difficult to identify the best manufacturing environment in terms of short or long term profit. MRP or batch may be superior to JIT in ship building for instance, while TPC or theory of constraints may be superior to JIT and MRP in industries with very high capital equipment costs. Lean strategies, on the other hand, can be defended in nearly any manufacturing environment. It is true that lean strategies would be most closely aligned with a JIT method of manufacturing, but aspects of lean, documented in Table 1 of Chapter II, could be applied to any manufacturing environment. If the strategies implemented had the effect of reducing on-hand inventories, then the impact on the income statement as previously discussed would be present. A base assumption of this research assumes that the benefits to a firm, which will come as the result of the adaptation of lean strategies, are evident and that lean has been accepted as the improvement strategy of choice. Additionally, this study accepts the fact that financial accounting methods required for the external reporting of operation performance will not soon change and therefore the problem of ineffective reporting will continue into the foreseeable future.

Research Questions

Since the various cost accounting methods differ in their handling of the recognition of the various components of cost, which lead to variations between gross and net profit the research questions are divided as follows:

Q1: Within a given cost accounting method, does rate of inventory reduction have an effect on reported gross profit?

Q2: Within a given cost accounting method, does rate of inventory reduction have an effect on reported net profit?

Q3: Within a given inventory reduction policy, does the cost accounting method have an effect on reported gross profit?

Q4: Within a given inventory reduction policy, does the cost accounting method have an effect on reported net profit?

Q5: For a given inventory reduction policy, does the cost accounting method used have an effect on reported gross profit?

Q6: For a given inventory reduction policy, does the cost accounting method used have an effect on reported net profit?

Q7: How does the rate of inventory reduction affect the customer service level, measured by stock-outages, under the production and market environment modeled in this study?

Q8: How does forecast accuracy affect gross and net profit under the production and market environment modeled in this study?

Q9: How does forecast accuracy affect the customer service level, measured in terms of stock-outages, under the production and market environment modeled in this study?

Importance of This Research

Hofer (1994) presents four reasons for conducting research:

1. The issue or topic has not been studied before.
2. The frequency with which the issue is observed in the real world is increasing.
3. Theory on the topic is non-existent, incomplete, internally inconsistent, and/or inconsistent with empirical observations.
4. The issue is very important to successful management practices.

In reference to this research the above points can be answered thus:

1. Past literature on this subject includes accounting text's, journal articles, popular books on operations management, and research dissertations. These publications have identified the negative effect on gross and net profit that occurs when inventory is "moved" from the balance sheet to the income statement. What has been lacking in the literature is a longer-term perspective of the problem. What needs to be better understood is how significant the impact is and how long it lasts? This research attempts to expand the level of understanding of this problem in regard to these questions.

2. The movement toward the acceptance and application of lean manufacturing strategies has been gaining speed for the past twenty or more years. Large manufacturers were the early adapters, industries like automotive and appliance. However, much of American manufacturing is still in the early stages of implementation of these strategies. As more and more publicly held or heavily

financed companies begin to embrace the philosophies of lean manufacturing, the issues identified in this research will lead to an increasing number of failed implementations.

3. In regard to theory on this topic, the level of understanding of the impact on the financial measures is high within the accounting community. This understanding has given rise to some of the other methods of cost accounting previously identified. However, the level of understanding of the problems researched in this study diminishes rapidly outside of the accounting circle. The weight given to the reported results for gross and net profit by stakeholders external to a corporation can have a devastating impact on the firm. It is in this community that the issue is not understood and where the expectation for positive operational results is quarter by quarter. This research will show that a short-term perspective of this nature will have a stifling effect on the implementation of lean strategies.

4. The economic environment has also been changing significantly over the past twenty of so years. The sophistication level of investors and their access to within the hour information regarding the performance of corporations has contributed to a culture that has an extremely short-term perspective in regard to firm performance. As a result, managers are under pressure to focus on the short-term implications of any program that impacts operational performance. Since the negative impact experienced in the reported financial measures resulting from a lean program will surely span several quarters, the incentive for managers is to avoid the implementation of lean manufacturing practices or take a very cautious stance and not move rapidly or aggressively. For firms in financial difficulties this may be a formula for bankruptcy.

Organization of This Document

This dissertation is organized as follows:

Chapter I - Introduction, the current chapter. A brief review of the issues surrounding this research.

Chapter II – Literature Review. An extensive review of the existing literature reviewing (1) the origin and intended purpose of management accounting, (2) the transition in the focus of financial reporting from internal to the business to external, (3) the difficulties presented to operations management, in regard to making operational improvements, by the current forms of financial reporting, and (4) literature defining the concepts and attributes of Just-in-Time (JIT) and lean manufacturing.

Chapter III – Research Design. A description of the tools, methods, and assumptions used in the development of a simulated repetitive manufacturing environment used to conduct this research.

Chapter IV – Results. Analysis of the data set created using the modeling tools is reviewed and discussed.

Chapter V – Conclusions. In this chapter the results of the statistical analysis of Chapter IV are interpreted in terms of the application to real world manufacturing operations.

CHAPTER II

LITERATURE REVIEW

Literature pertinent to this research is that which describes (1) the origin and intended purpose of management accounting, (2) the transition in the focus of financial reporting from internal to the business to external, (3) the difficulties presented to operations management, in regard to making operational improvements, by the current forms of financial reporting, and (4) literature defining the concepts and attributes of Just-in-Time (JIT) and lean manufacturing. Also pertinent to this research is a review of recent research activities in the area of the interactions of various management accounting systems with the dominant production planning systems.

Management Accounting

Scott (1931) identified that prior to the Industrial Revolution accounting was primarily record keeping of external transactions between businesses. During the period prior to the Industrial Revolution manufacturing was essentially a system of artisans exchanging their output, or product, on an open market. It was not until the advent of the factory, where several manufacturing processes became linked, that measurement systems were developed to monitor exchange between units of an enterprise. According to Scott, management accounting grew out of the need of large, integrated, enterprises to track financial data between business units for purposes of administrative control. Johnson & Kaplan (1991) use the examples of the textile, steel, and railroad industries to further identify the evolution of managerial accounting practices. During the period of the Industrial Revolution manufacturing management

transitioned from a system of buying goods on the open market, to one that employed internal contractors to supply manufacturing labor, to employing the laborers directly. The driving force behind this transition was the belief, of the owners of these single-activity enterprises, that greater profits could be realized through integration of processes. This transition brought about many new challenges in regard to monitoring performance of the organization. The key issue was that of tracking worker performance, i.e. efficiency. In the market based piece-rate system, prices for intermediate output were unambiguous. In the integrated system, the cost for the intermediate output was now dependent on labor content and therefore not as evident as in the market-based system. In order to assure increased profits owners created entirely new managerial accounting procedures to monitor and evaluate the performance of internally managed processes.

The earliest record of the systems developed to support the integrated manufacturing processes were in the textile industry. Detailed records were kept of the efficiency of the use of cotton, labor, and general overhead. This information was used for the determination of the cost of intermediate output and ultimately the finished product cost. Product cost information was used to evaluate the performance of workers. Worker performance was evaluated between employees in the same period and on the same process, as well as across several periods for the same worker on the same process. It is important to note that the cost information provided by these systems was intended to focus managers' attention inwardly on the operations of the business, not outwardly on performance in the market (Johnson et al., 1991).

The steel industries cost management systems developed in a similar way to

that of the textile industry. What was unique to the steel industry was the introduction of the "voucher" system to job tracking (Chandler, 1977). The voucher system was a system of tracking that had been in use in the railroad industry but had not been widely seen in factories. The voucher system is analogous to "job-cost" systems of today whereby the direct manufacturing related costs to complete a specific job, labor and direct materials, are recorded on a cost sheet or "voucher," one per job. Utilizing historical records of cost sheets steel manufacturers could evaluate performance on a job-by-job basis. These cost sheets were the primary control mechanism for the administration and oversight of managers, foremen, and workers. In addition, the information in the cost sheets was used for quality checks for mix of raw materials, to direct process and product improvements and for decision making pertaining to the development of by-products. Again, in the steel industry, as in textile, the focus of the information was internal for the purposes of bringing about improvement.

Johnson & Kaplan (1991) further explain the origin and evolution of management accounting with a discussion on "scientific management." Between 1880 and 1910, engineer-managers in American metal working firms developed systems used to evaluate task productivity and to analyze profit by product in the more complex manufacturing segments. These segments included the manufacture of reapers, sewing machines, locks, firearms, pumps, typewriters, and the machines used to produce these products. Tracking performance of the processes utilized in the manufacture of these goods was no longer enough for the owners and managers of these businesses for adequate management as they attempted to increase profits. As a result, targets for productivity were established using engineering standards developed through the application of scientific management techniques. The practitioners of this

science were engineers. Their focus was on identifying the "one best way" to use labor and material resources. Again, the focus was on internal process and product improvements. Martin-Vega (2001) credits industrial engineering pioneers such as Fredrick Taylor and the husband and wife team of Frank and Lillian Gilbreth with the development of the early systems and tools applied to manufacturing for human performance measurement for the purposes of efficiency improvement.

An important point that Johnson and Kaplan (1991) make, is that during the time frame previously discussed, inventory valuation was not viewed as an important aspect of an accounting system. At times when inventory value was reported, in audited or un-audited financial reports, market price was frequently used for valuation purposes. Additionally, capital management was not a component of the accounting process. Depreciation was not tracked in any form and therefore was not included in the product costing process. These are both important components of a 20th and 21st century cost accounting system.

Garrison and Noreen (1994) describe management accounting as that which is concerned with providing information to managers inside the organization. Specifically, this means those who are charged with directing and controlling the operation. They contrast this with financial accounting, which is concerned with external reporting to stockholders, creditors, and others such as the SEC and the government. They also identify eight major differences between management accounting and financial accounting. Management accounting (1) focuses on providing data for internal uses by the manager, (2) places more emphasis on the future, (3) emphasizes the relevance and flexibility of the data, (4) places less

emphasis on precision and more emphasis on the non-monetary data, (5) emphasizes the segments of a corporation rather than just looking at the organization as a whole, (6) draws heavily from other disciplines, (7) is not governed by generally accepted accounting principles (GAAP), and (8) is not mandatory. In contrast to the previous authors, Heartley (1983) chooses not to distinguish between the two functions stating that the two areas do not have clear territorial boundaries. He does however note that those who view management accounting differently from financial accounting make their distinction in the target users of the information; internal to the operation vs. external, respectively. Horngren (1995) identifies that management accounting has two simultaneous missions: (1) transmission of information to help reach wise economic decisions, and (2) motivation of users toward organizational goals. Again, the target of the information is internal to the corporation. He further states that management accounting systems must meet the cost-benefit criteria. Elaborate systems are a large expense in both money to purchase and time to support. Therefore, decisions to implement these systems must be weighed carefully with the potential benefits.

Transition in Focus From Internal to External

Johnson and Kaplan (1991) explain how, until the 1920s, managers invariably relied on information about the underlying processes, transactions, and events that produced financial numbers. By the 1960s and 1970s, however, managers relied commonly on the financial numbers alone. They explain this transition as being the result of two forces. First, as companies transitioned from single purpose operations whose focus was economy of scale, to vertically integrated operations whose focus was economy of scope, performance tracking became more complex. In the vertically

integrated environment, tracking the consumption of indirect resources at the unit level became too cumbersome. It was felt that the benefit received was not worth the expense necessary to collect the data required to adequately cost product at the unit level for a diverse product line. This was somewhat due to the labor intensiveness of the tracking systems available at that time. Secondly, after 1900 new requirements were placed on corporate enterprises by capital markets, regulatory bodies, and the federal government for external reporting. Included in these demands was the need for externally audited financial reports by independent public accountants. This requirement led to the development of well-defined standard procedures for corporate financial reporting. Among these procedures was a process for valuing inventories, both finished and in-process. In order to value inventories, auditors needed to add to the available material and labor information a portion of the overhead costs of the operation. For their purposes the costing methods developed by engineers after 1880 were too cumbersome and confusing. They instead developed a simple system of distributing the overhead cost by utilizing a common base, such as direct labor hours or direct labor cost. This was adequate for external reporting purposes as the inaccuracies inherent to the system were offsetting. In aggregate, the financial reports were accurate and acceptable. Differences in accuracy between the engineers product cost system and the auditors inventory cost system ensued. The engineering system, not having the necessary support from the accountants or regulatory entities, was replaced by the auditors system. There is general agreement in the literature that the unit product costs information resulting from allocation methods is inappropriate for managerial purposes, i.e. internal decision support of product pricing, product profitability determination, and/or process change decisions (Cooper et al., 1988, Johnson et al., 1991, Kaplan, 1994, Noreen, 1994, Drury et al., 1997, Lere, 2001,

Nachtmann et al., 2003).

Two of Noreen's (1994) points in reference to management accounting, (7) is not governed by generally accepted accounting principles (GAAP), and (8) is not mandatory, identify an important issue that impacts the level of interest to support a management accounting system. External reporting is required by the IRS and the SCC, among others, and requires a financial accounting system. Unfortunately, most companies are unwilling to support dual systems (Johnson et al. 1991). Drury and Tayles (1997) substantiated Johnson's claim with survey results that indicated that 79% of respondents "often/always" use product costs derived from stock valuations for decision-making and only 9% claiming that they "never/rarely" did so. Systems to address the issue of inaccurate product costs, due to inaccurate allocation of overhead costs, have been developed and introduced over time. Three of these systems are direct costing, activity based costing, and throughput costing. External financial reporting regulations require that stocks be valued at "full production cost" to include the indirect costs of running the operation (Drury and Tayles, 1997). Since direct costing and throughput costing do not allocate indirect costs for product valuation, neither system is acceptable for external reporting purposes. Therefore, if either of these improved management accounting systems was to be used it would necessarily need to be in addition to a system that provided full product costs, including the allocated costs, again leading to dual systems.

Drury and Tayles (1997) conducted a survey with the purpose of investigating the claims of Johnson and Kaplan that management accounting has become subservient to financial accounting. They found that 73% of the non-automated and

68% of the automated manufacturers used labor hours/cost as the base for allocations, even though other systems, with claims of better accuracy exist. Only 4% of the surveyed companies had implemented ABC costing with another 9% indicating that they had intentions to do so. Their conclusion is that simplistic methods are being widely used for decision-making. These are methods that have been primarily designed for meeting financial accounting requirements. Their survey findings indicated that many companies use the same information for both internal and external purposes, even when conventional wisdom suggests that they should not. They concluded that Johnson's and Kaplan's claims that management accounting had become subservient to financial accounting could not be disputed. Elnicki (1971) found that since the 1950s corporate management has "managed by the numbers," using data compiled for external financial reporting.

Difficulties Presented by the Current Forms of Financial Reporting

Lere (2001) identifies several issues with the use of product costs derived using a common allocation base for market decisions. The inaccuracies introduced by the allocation process can lead to product costs that are over or under actual costs. This can (1) lead to sales focusing on sales efforts of the wrong products while forgoing efforts to sell the right products, (2) cause sales to enter and exit the wrong markets, and (3) set prices that are too high or too low. He references a hydraulic valve manufacturing company that, through a change in accounting systems, identified that they were losing money on 75% of their product line. One specific example was a valve that reportedly had a gross margin of 47% when in fact its gross margin was –258%. In his survey of 500 U.S. companies, the most common allocation base identified was direct labor (either hours or cost). Lere states that the

drawback in using a direct labor measure as the overhead rate denominator assumes that the use of manufacturing capacity is proportionate to direct labor consumption. He further states that in labor-intensive manufacturing environments that may be the case but in other manufacturing environments it may not.

Traditional cost accounting practices tend to influence overproduction (Womack and Jones, 2003). The need to absorb overhead allocations cause managers to maximize the standard labor hours or machine hours over which the overhead needs to be spread. Through experience, managers learn that by increasing run quantities and minimizing down time from start-up or set-up activities this is more easily accomplished. Womack and Jones (2003) believe that in order to influence managers to do the right things, standard cost and variance analysis systems need to be abandoned.

Cunningham and Fiume (2003) suggest that as companies begin the transition from batch to lean, trouble will ensue with the product costing system. These authors suggest that the roll of the cost accountant must change to cost management. Attempting to identify costs precisely at the item level, results in irrelevant information due to necessary inaccuracies. Instead, managing financial matters at the aggregate level should be their concern. These authors advocate "plain English" management financial statements be developed by the accounting function to replace the standard P/L statements used for external reporting. The information conveyed by the new financial statements will allow the reader to easily evaluate the results of changes that are being made because of a Lean manufacturing program.

The practice of cost attachment, whereby labor and overhead costs become "attached" to the finished product, is identified repeatedly in the literature as problematic for management accounting decision support [Hartley (1983), Drury, et al. (1997), Cunningham, et al. (2003)]. The issue here is that overproduction, resulting in an increase in finished goods, becomes stored on the balance sheet as a capital asset. The costs resulting from the production of these items are not recognized on the income statement until the items are sold, which could be some time into the future. Therefore, overproduction will result in an increase in the capital assets of the company, capitalizing labor and overhead costs in the process. Gross profit will increase for the current period because of these capitalized costs, including labor and overhead, being moved to the balance sheet where they are not recognized as a period cost. When the reverse occurs, more product is sold than produced resulting in an inventory reduction, the result is a lowering of the gross profit as these stored costs are liberated. During the implementation of JIT or lean manufacturing, inventory reduction is certain to occur. The mechanics of this issue is best explained with an income statement from before and during a lean/JIT program, see Figure 1.

Just-in-Time (JIT) and Lean Manufacturing Practices

There is formidable consensus in the literature as to the origin of just-in-time (JIT) manufacturing and lean manufacturing practices. These formal systems were clearly developed by Japanese manufacturers with aspects of these disciplines having been birthed in the US (Pine, 1993, Womack et al., 2003, Schonberger, 1982). Wantuck (1989) uses the example of the Ford Automobile plant in Dearborn, MI,

	Before Lean	During Lean
Net Sales	100,000	100,000
Cost of Sales		
Purchases	35,000	23,000
Inventory material:(+) -	(6,000)	6,000
Total Material Cost	29,000	29,000
Processing Cost		
Factory Wages	11,000	11,000
Factory Salary	2,000	2,000
Factory Benefits	5,000	5,000
Services & Supp.	2,500	2,500
Depreciation	2,000	2,000
Scrap	2,000	2,000
Total Processing Cost	24,500	24,500
Occupancy Cost		
Building Dep.	200	200
Building Svrc.	2,000	2,000
Total Occupancy Cost	2,200	2,200
Total Manufacturing Cost	55,700	55,700
Inventory-Labor, Overhead (inc) dec	(4,000)	4,000
Cost of Sales	51,700	59,700
Gross Profit	48,300	40,300
Gross Profit %	48.3%	40.3%

Figure 1: Impact on Gross Profit Due to Cost Attachment
(Womack & Jones, 2003)

where iron ore was unloaded from a ship and converted into a complete automobile within 48 hours prior to 1926. This process was documented in a book, authored by Henry Ford, entitled Today and Tomorrow published in 1926. Strangely, the book

was not sold in America. It was however converted to Japanese and still available to purchase in Tokyo until the mid 1980's.

Shah and Ward (2002), identify just-in-time (JIT) manufacturing techniques as a subset of lean manufacturing. It is described as a "bundle" of interrelated practices, one of four bundles that encompass the aspects of lean manufacturing. The remaining three are total quality management (TQM), total preventive maintenance (TPM), and human resource management (HRM). JIT is described as a manufacturing program with the primary goal of continuously reducing and ultimately eliminating all waste (Sugimori et al., 1977). Work-in-process (WIP) inventories and delays are cited as two of the major forms of waste that JIT focuses on eliminating. The tools and techniques used to accomplish the improvement are (1) lot size reduction, (2) cycle time reduction, (3) quick changeover techniques, (4) cellular process layout, (5) reengineering production processes, and (6) bottleneck removal. In contrast, lean is described as a multi-dimensional approach that encompasses a variety of management practices including JIT, quality systems, teams, and supplier management working together in an integrated system. The core objective of lean is to create a streamlined, high quality system that produces product at a pace equal to the demands of the customer. Lean practices cited most frequently in the literature are identified in Table 1.

Not evident in the list of lean practices, but certainly implied, is the benefit of reduced inventories. Schonberger (1982) in an article exposing the beneficial impact of JIT on inventory reduction indicated that, although the focus of the article was mainly on work-in-process inventories, the concepts also applied to finished goods

inventories and their flow from manufacturing to distribution. He states that by extending JIT forward, pressure is exerted on the factory to match daily output to daily sales. Listed as the benefits of reductions in inventory are a lowering of inventory carrying costs, scrap/quality improvement, and productivity increases.

Fullerton and McWaters (2001) have identified that the implementation rates of JIT in US firms has been relatively slow despite awareness of its purported benefits. The reasons identified for the resistance of firms to adopt these practices were; resistance to change, lack of understanding of JIT methods, incompatible workforce and workplace environment, non-supportive suppliers, and inadequate performance measurement and incentive systems. Their survey examined the benefits resulting from the implementation of JIT in six operational measures, (1) quality benefits, (2) time-based benefits, (3) employee flexibility, (4) accounting simplification, (5) firm profitability, and (6) changes in inventory. Most notable in their findings were that time-based benefits, the reduction of non-value added activities and the shortening of manufacturing cycle time, were significantly improved by JIT implementation. Additionally, reductions in work-in-process and raw material inventories were substantial. However, the results indicated little difference in finished good inventories following the implementation of JIT practices. Noted also in the study was that several studies have examined the production benefits resulting from JIT, but there is limited and conflicting evidence on the effect on financial performance measures resulting from the implementation of JIT.

Table 1: Lean Practices and Their Appearance in Key References
(Adapted From McLachlin, 1997)

		Sources															
	Lean Practice	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Bottle neck removal																
2	Cellular mfg.									*			*	*	*		*
3	Competitive benchmarking																
4	Continuous improvement		*				*	*	*	*		*	*	*	*	*	*
5	Cross-functional workforce	*		*		*	*			*		*	*	*	*	*	*
6	Cycle-time reductions									*			*	*		*	*
7	Focused factory production									*		*	*	*	*	*	*
8	JIT/continuous flow production	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9	Lot size reductions	*	*		*	*	*	*	*	*	*	*	*	*		*	*
10	Maintenance optimization																
11	New process equipment/technologies									*			*			*	
12	Planning and scheduling strategies																
13	Preventative Maintenance			*			*		*	*	*	*	*	*	*	*	*
14	Process capability measurements									*			*	*	*	*	
15	Pull systems/kanban	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
16	Quality mgnt. Programs		*														
17	Quick changeover techniques	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
18	Reengineered production process																
19	Safety improvement programs									*			*			*	
20	Self-directed work teams		*					*	*	*	*	*	*	*	*	*	
21	Total quality mgnt.		*				*	*	*	*		*	*	*	*	*	*

(1) Sigimori et at. (1977); Monden (1981); Pegels (1984), (2) Wantuck (1983); (3) Lee and Ebrahimpour (1984); (4) Suzaki (1985); (5) Finch and Cox (1986); (6) Voss and Robinson (1987); (7) Hay (1988); (8) Bicheno (1989); (9) Chan et al. (1990); (10) Piper and McLachlin (1990); (11) White (1993); (12) Shingo Prize Guidelines (1996); (13) Sakakibara et al. (1997); (14) Koufterous et al. (1998); (15) Flynn et al. (1999); (16)White et al. (1999). (Source: Shah and Ward 2003)

Their study did show a significant correlation between the perceived increases in financial performance of the respondents and those reported externally by the firms.

Related Research and Missing Elements

Recent research in this area has focused on the identification of the most profitable combination of accounting method and production planning systems (Lea 1998, Boyd 1999). These studies couple various cost accounting systems with several manufacturing environments and test the performance of all combinations by comparing income and total income, i.e. the sum over some period. Both authors take the stance that in order to maximize profit a firm must select a managerial accounting method that is well aligned with the manufacturing environment that exists. A baseline premise in both studies is that demand exceeds production capacity. A further assumption ingrained in the two studies is that the firm is at liberty to choose which products they will manufacture. This criterion creates a simulated manufacturing environment where product mix is used to maximize profits. Profit by product varies under the various management accounting methods due to the differences in the way overhead is calculated and distributed. In these two studies, the researchers used the profit by product information as calculated by a variety of cost accounting methods for a number of products to determine what to produce based on profit maximization. Simulation was used to simulate manufacturing environments for a number of differing methods of manufacturing in order to determine when to produce the various products. Running the simulation allowed these researchers to determine what would actually be produced. By following this procedure with all combinations of cost accounting method and manufacturing operation they were able to identify which combination produced the maximum return, short and long term,

based on the other assumptions built into their models. The studies produced differing results, which is an indication that they were operating under differing assumptions. This also gives an indication of the difficulty that exists in attempting to prove the theory that profit maximization can be achieved as the result of the correct selection of cost accounting method and production system.

In Boyd's (1999) study, the accounting methods chosen were traditional (full absorption), throughput (TPC), activity based costing (ABC), and direct costing. The production philosophies studied were Reorder Point, MRP, JIT and Theory of Constraints (TOC). Boyd's conclusion was that the TPC / theory of constraints combination performed as well, if not better, than all other combinations tested. However, the TPC method of accounting is not approved by regulatory agencies for inventory costing and therefore would not provide a single system of accounting that has been pursued to satisfy managerial as well as financial accounting issues.

Lee (1998) chose full absorption, throughput (TPC), and activity based costing (ABC) for cost accounting methods under MRP, throughput, and JIT manufacturing environments. Her conclusion was that the ABC method was superior as well as being more sensitive in the presence of environmental uncertainty. She noted however, that given an appropriate allocation rate, traditional costing methods preformed nearly as well. Many authors have identified ABC methods as another method of determining allocations (Kaplan, 1994; Womack et al., 2003; Drury et al., 1997). Therefore, as the allocation method of the traditional system is modified to more closely align with that of an ABC system the reported results would logically merge.

The researchers for the studies just described did not include operational improvement in the focus of their analysis. The studies were limited to evaluating firm performance under a number of predetermined operational conditions and management accounting methods. The studies did not identify or attempt to quantify the short or long term effects on reported net profit or total net profit that would result from an operational improvement effort that led to a lowering in on-hand inventories, labor reductions, facility space savings, etc. A second issue with these studies is that the evaluation of performance of the various combinations of accounting method and manufacturing environment were quantified by using profit figures derived from product standards. The standard costs that were used were developed using machine hours as the allocation base for the distribution of overhead costs. As has been previously stated, the need to allocate indirect costs is at the root of the issue with accounting reports providing irrelevant data for the purpose of profit determination [Johnson and Kaplan (1984), Kaplan (1994), Drury and Tayles (1997), Womack and Jones (2003), Cunningham and Fume (2003), Soloman (2003)]. Therefore, according to substantial agreement in the literature, the assessment of which combination of accounting method and manufacturing environment demonstrated superior performance was based on flawed data.

It has been identified, in previous sections of this chapter, that a common belief in manufacturing is that JIT offers numerous operational improvements to manufacturers with the most noted benefits being reduced cycle time, leading to better customer service levels, and inventory reductions in the area of raw and work-in-process inventories. Many authors have also identified that finished goods inventories should be significantly reduced through the implementation of lean methods;

however, survey results do not indicate that this is always the case (Fullerton and Mc Waters, 2001). Also identified, by this review of literature, is that the dominant accounting practices in use today in the US and UK, specifically full-absorption costing and the concept of cost attachment, are suspect in their ability to provide meaningful information for decision support in terms of operational decisions. Further, these practices are known to confound decisions when accurate product cost information is required or when manufacturing inventories, raw material, work-in-process, and finished goods are changed significantly between reporting periods. An additional complication of cost attachment is the effect this practice has on the value of capital assets of a company as reported on the balance sheet.

Problems With Previous Research

1. The simulation models tested have presumed, as a base assumption, that demand for product is unlimited and that a firm is at liberty to choose to produce only the products they choose. This unfortunately is often not the situation on a sustained basis. Even in a situation where sales have outstripped manufacturing capacity for a product, manufacturers are often required to produce complementary products to support the sales volume.

2. From an external reporting standpoint, an approved accounting system must be in use at a manufacturing operation in order to satisfy compliance issues. Any planning method that does not utilize either full absorption or ABC costing would have to be in addition to one of these, implying a need to support a dual system of accounting.

3. None of the work so far has addressed the phenomenon of falling gross or net profit as a company becomes more "lean" with any level of actual research and

analysis.

Contributions of This Research

In this research, simulation has been used to model the dynamics of the phenomenon identified in point three above. The model was designed to accomplish the following:

1. Identify the duration of the reduction in the reported gross profit based on the starting inventory positions and the rate of reduction of inventories.

2. Predict the magnitude of the impact on the reported gross profit based on the starting inventory positions and the rate of reduction of inventories.

This research expands the current body of knowledge in the area of lean manufacturing. The understandings gained from the output of this study allow inferences to be made in regard to the above points. Such inferences include the ability to predict outcomes of a lean effort, with sufficient accuracy, to provide credibility for lean implementation efforts. Pre-selling of a lean program to management and investors could include the recognition of this phenomenon as well as predictions as to the impact, short-term and long term, on gross and net profit. Achievement of such predictions would provide encouragement to stake holders rather than being a cause for alarm.

CHAPTER III

RESEARCH DESIGN

This chapter describes the methods and tools employed in the development of a model manufacturing operation used to answer the research questions presented in chapter 1:

(1) What are the effects on operational performance, as determined by standard financial reports, resulting from the implementation of a lean manufacturing program?

(2) How do varying accounting systems differ in their reporting of the identified effects?

(3) What is the trend of operational performance over a twelve-month period based on the inventory reduction policy chosen?

The simulated factory models a build-to-stock, repetitive manufacturing environment. ProModel simulation software from ProModel Corporation, Orem, Utah, was used for the development and operation of the simulation model. Excel from Microsoft Corporation was used for production planning and financial reporting functions and Visual Basic for Applications was used to automate the execution process and provide a user interface and prompting during execution.

Experimental Design, Statistical Hypothesis, and Data Analysis

Experimental Design

The experimental design used to address the research questions includes three experimental factors. They are three levels of inventory policy, five levels of management accounting system, and three levels of sales volume per replication. The experimental design is a 3 x 5 x 3 full factorial experiment in a randomized block design and 35 replications. This is accomplished by fixing a unit sales level for one complete data generation cycle of thirty-six iterations which provides one year of data for each of the three inventory policies. Inventory policy is fixed for one twelve month cycle, completing one year of profit and loss data for one inventory policy. This is repeated for all inventory policies prior to the next replication, requiring a change of sales volume data. The five management accounting systems then use the resulting data to determine gross and net profit levels and percentages. The preceding process is followed for 35 replications under each of three sales volume stochasity scenarios. Sales volume data is randomly changed within a range following a normal distribution based on a forecast value for each of the thirty parts to be produced prior to each replicated run. The values used for standard deviation for the three sales levels are 10%, 25%, and 40% of the mean value.

The mathematical model for this experiment is:

$$
\begin{aligned}
Y_{ijkm} = \mu + S_i + IP_j + MA_k & \quad \text{(main effect)} \\
+ SIP_{ij} + SMA_{ik} + IPMA_{jk} & \quad \text{(two-way interactions)} \\
+ SIPMA_{ijk} & \quad \text{(three-way interactions)}
\end{aligned}
$$

$$+ \varepsilon_{m(ijk)}$$

Where:

Y_{ijk} = gross and net profit

μ = the true mean of the population

S_i = the sales volume effect where i =3

IP_j = the inventory policy effect where j = 1, 2, or 3

MA_k = the management accounting system effect where k = 1, 2, 3, 4, or 5

$\varepsilon_{m(ijk)}$ = the random error in the experiment where m = 1 through 35

Statistical Hypothesis

H_1: Within a given management accounting method, does rate of inventory reduction have an effect on reported gross profit?

$H_{1,0}$: $Policy_i = 0$, for gross profit

H_2: Within a given management accounting method, does rate of inventory reduction have an effect on reported net profit?

$H_{2,0}$: $Policy_i = 0$, for net profit

H_3: Within a given inventory reduction policy, does the management accounting method have an effect on reported gross profit?

$H_{3,0}$: $Acct_j = 0$, for gross profit

H_4: Within a given inventory reduction policy, does the management accounting method have an effect on reported net profit?

$H_{4,0}$: $Acct_j = 0$, for net profit

H_5: For a given inventory reduction policy, does the management accounting method used have an effect on reported gross profit?

$H_{5,0}$: $Policy_i * Acct_j = 0$, for gross profit

H_6: For a given inventory reduction policy, does the management accounting method used have an effect on reported net profit?

$H_{6,0}$: $Policy_i * Acct_j = 0$, for net profit

H_7: Does inventory reduction policy have and affect on the customer service level, measured by stock-out's, under the production and market environment modeled in this study?

$H_{7,0}$: $Policy_i = 0$

H_8: Does volatility in the sales demand have an effect on reported gross and net profit under the production and market environment modeled in this study?

$H_{8,0}$: $Sales_i = 0$

H_9: Does volatility in the sales demand have an effect on the customer service level, measured by stock-out's, under the production and market environment modeled in this study?

$H_{9,0}$: $Sales_i = 0$

Data Analysis

The study described above combines fixed effect and random effect factors. Inventory policy is limited to three levels. Management accounting system is limited to five levels. Unit sales level has three factor levels that impact the stochasity of the value used by the model. This model parameter is allowed to take on any value, with such values following a normal distribution with the mean equal to the forecast and the standard deviation equal to 10%, 25% or 40% of the forecast based on the factor level being modeled. The hypotheses will be tested using analysis of variance (ANOVA) for all factors and interactions.

Methods Diagrams

Figure 2 graphically represents the data generation process through the use of a flow chart. From this diagram, it can be seen that the process follows that of a real-world manufacturing operation where a schedule is established based on a forecast and current inventory position. The plant attempts to satisfy the schedule, at times falling short. At the conclusion of the month, profit and loss statements are produced based on the results of the period including actual sales. Then the cycle starts again with the creation of next month's production schedule, again based on a forecast and current inventory position.

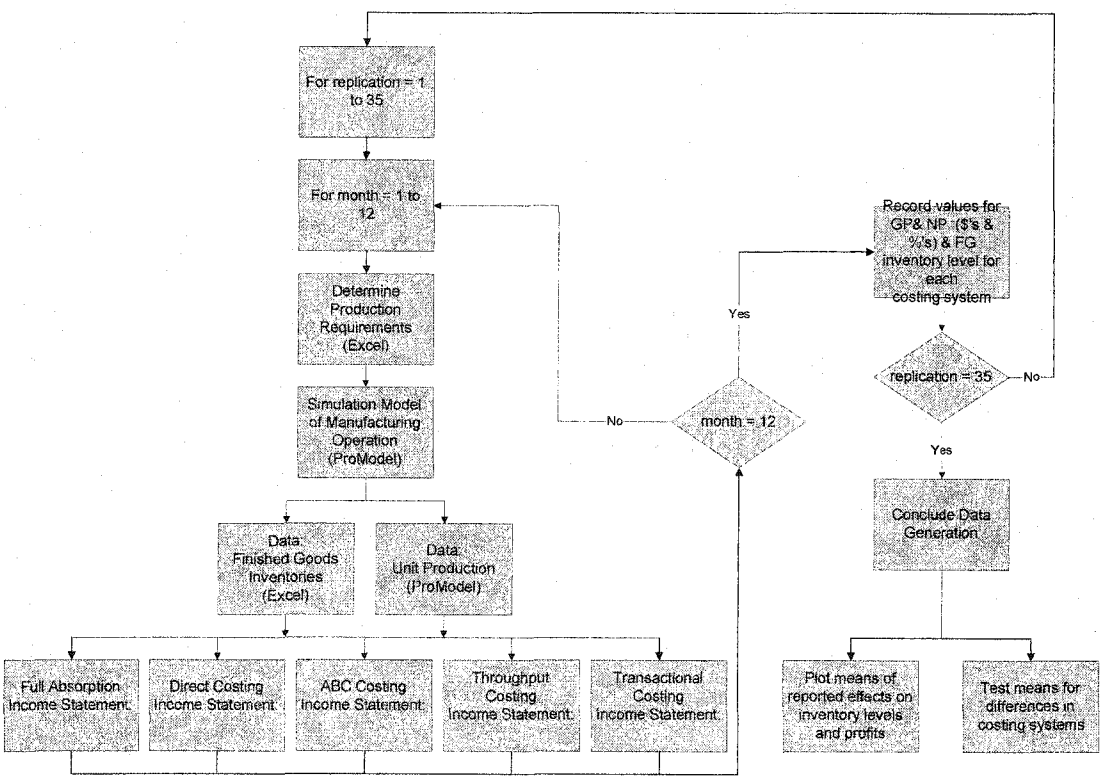

Figure 2: Data Generation Flow Chart

The mechanics of the data generation process is depicted in Figure 3. This diagram details the interfaces between the software packages employed in this research. Visual Basic for Applications was utilized to aid in the replication process by automating many of the steps required for spreadsheet data update, data transfer between software packages and data archiving between replications.

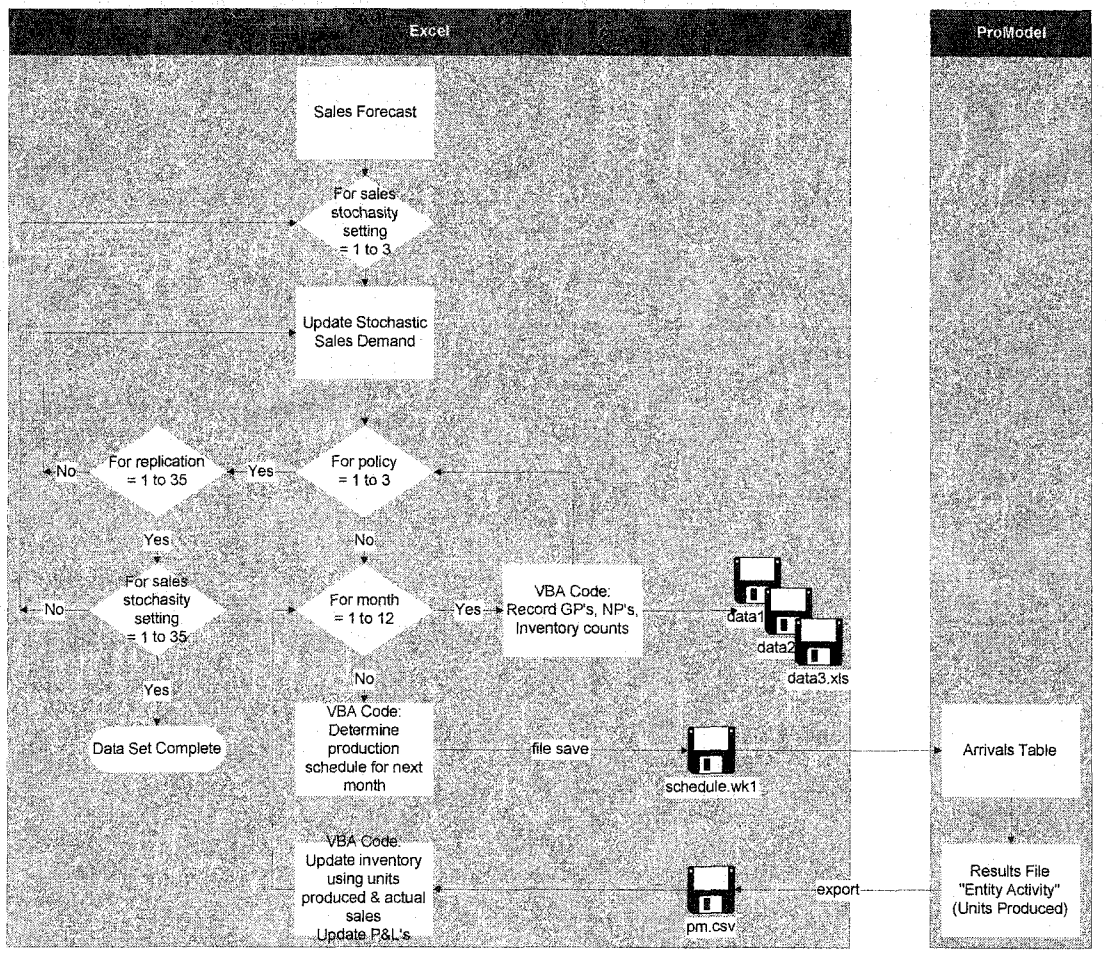

Figure 3: Interfaces Between Systems

Experimental Factors

The following sections describe how sales volume, inventory policy, and management accounting method are made operational for this study.

Generation of a Random Sales Demand

The entry of a sales forecast by part and by month for the period to be modeled is provided through a series of cells in an excel spreadsheet. The modeled period was twelve months for this study. Forecast values are arbitrary based on the designed capacity of the model plant. In order to emulate the effects of forecast error (the difference between actual demand and forecasted demand), simulated sales values were computed using the following procedure. Actual sales volumes by part and by month were generated through the utilization of a formula adopted from Hillier and Lieberman (2001) that provided a random number, approximately normally distributed, with a mean value equal to the forecasted value and a standard deviation of 10%, 25%, or 40% of the forecasted value. This procedure provides for three levels of stochasity in the sales demand of the model. In the case of the 25% setting the actual demand used in the simulation becomes a number between +/- 25% of the forecast value 68.3% of the time, 25 – 50% below or above the forecast value 27.1% of the time, 50 – 75% below or above the forecast 4.3% of the time and greater than 75% above or below the forecast 0.3% of the time. The formula used to accomplish this was:

$$=(RAND()+RAND()+RAND()+RAND()+RAND()+RAND()+RAND()+RAND()+RAND()+RAND()+RAND()+RAND())*control\_sheet_{d9}*forecast!_{ij}$$

$+forecast!_{ij}-6*control\_sheet_{d9}*forecast!_{ij}$

Where $forecast!_{ij}$ is the cell reference to the appropriate cell on the forecast sheet that corresponds to the part for which sales data is being calculated and $control\_sheet_{d9}$ is the reference to the cell containing the current setting for sales stochasity. This formula is contained in the various cells on the sales_simulation sheet that provide for the calculation of 12 months of sales demand by part. Recalculation of new sales figures is accomplished by initiating a re-calculation on the sales_simulation sheet. Once calculated, the numbers are rounded to whole units and copied to the sales sheet using the copy values command. This step stores the values in a state that will not change during further model execution. The values are in a sense frozen so that they can be used by the scheduling logic throughout the 12-month simulation cycle. Visual Basic for Applications was employed to automate the process of updating the sales values following the completion of the 36th iteration of the production update sequence between Excel and ProModel.

Inventory Policy

Inventory policy is defined in this study as the reduction targets for finished goods over a stated period of months. The three scenarios examined in the study are (1) no reduction over the twelve month simulated period (baseline), (2) 50% reduction in on hand inventory over the twelve month period, and (3) 50% reduction in the first six months of the twelve month period and no further reduction in the remaining six months.

The rate of reduction of inventory has a significant effect on the reported financial results of the firm. This is primarily due to the movement, on paper, of assets. Using the concept of cost attachment a business essentially stores the manufacturing costs of finished goods inventory produced in excess of what is needed in the current period. The labor, material, and factory overhead costs are virtually moved to the balance sheet where they are recognized as an asset. Physically the product is stored in a warehouse facility until disposed of. These costs are not included in the current periods income statement, instead they are recognized in a future period when they are removed from inventory, either as a result of a sale or as a result of being scrapped as obsolete or otherwise unacceptable inventory. The chosen levels of inventory policy will allow the effect of these accounting practices to be measured and compared.

Management Accounting Method

Financial reports using five different management accounting methods are used to compare the differences in reported results between systems. The five systems are (1) full absorption, (2) direct, (3) ABC, (4) throughput and (5) M-K (transactional).

Full Absorption

This method of accounting is the most accepted and most widely used method of cost accounting (Cooper and Kaplan, 1988; Govindarajan and Anthony, 1983) and is used in more than 60% of industries surveyed by Hendricks(1992). This method is

characterized by the use of an allocation base to apply overhead costs to products. Some common bases include direct labor, direct materials and, machine time among others with the most common base being direct labor (Drury and Tayles, 1997). This method of product costing is characterized by the inclusion of all variable and fixed manufacturing costs being "attached" to the product in inventory. When production is greater than sales in a given period, these costs are capitalized on the balance sheet.

The profit and loss statement for the full absorption method in this study utilizes standard labor as the allocation base. Standard labor and materials plus the allocated costs are used in the calculation of gross profit.

Direct (Variable)

In the direct method of product costing allocations of overhead costs are not made at the product level. Instead these fixed costs are quantified for the given reporting periods and are included or assigned to the profit and loss for that period regardless of the sales volume. This prevents the storage and later recognition of these costs as products are taken from inventory to satisfy the current period's sales.

The profit and loss statement for direct costing in this study utilize standards for labor and material to determine product cost, which are then used in the determination of gross profit. Allocated costs are distributed evenly across the 12-month period and included in the calculation for monthly net profit.

ABC (Activity Based Costing)

The ABC method of product costing arose, similar to direct costing, out of a desire to create a more accurate method for assigning allocated costs. Many authors agree on the issues related to the inaccuracies introduced in product costing by the use of allocation bases such as direct labor, machine time, plant square footage, etc. (Kaplan & Johnson, Drury & Tayles, 1997, Horngren, 1995). These bases may have little or no relationship to the proportion of allocated resources consumed by a particular item of production. ABC attempts to correct the inequitable distribution of these costs by identifying what cost generating activities, referred to as cost drivers, are caused by a particular family or group of products. Using this information the pool of costs can be distributed in a fashion that relates more closely to the real world.

This method of costing is simulated in this study by allowing the assignment of allocated costs to vary based on product family. The three families are A, B, and C. The model allows allocated costs to be adjusted independently for each family in the "costs_ABC" spreadsheet, thus simulating the effects of ABC costing and the resulting impact on gross and net profit.

Throughput

Throughput costing is an outgrowth of a method of plant performance improvement called "the theory of constraints" popularized by Eli Goldratt in his book The Goal (Goldratt, 1992). In this method of product costing the only relevant cost is the material cost. Therefore, all other costs, including labor, are considered fixed period costs and are expensed at the end of each period. Using this method,

gross profit is determined using material costs only. Material costs are taken from standard.

M-K Method

The M-K method of cost accounting is currently being researched as an alternative method to others previously discussed. The M-K method uses a new approach to address the issue of an appropriate allocation base. As mentioned earlier, the traditional approach of full absorption costing uses direct labor, direct materials, machine time, or plant square footage, among other bases to apportion overhead costs. The full absorption method of costing has been under attack in the literature for many years. ABC attempts to improve on this method by identifying cost drivers by product family for the equitable distribution of costs. The ABC method is an improvement over full absorption but still has two primary drawbacks;

1. The system is costly to maintain as the drivers and apportionment are determined through interviews and will change over time requiring continued follow-up interviews to make adjustments, and
2. For purposes of efficiency, products are grouped into families and overhead costs factors are then applied by family. Not all products within a family will necessarily consume activities in the same apportionment as others in the family.

The M-K method addresses the issue of cost allocation based on unit production volumes. The types of costs that are being distributed through allocations have among them engineering, purchasing, accounting, maintenance, shipping and

receiving, and others, many of which are influenced by transactions. This is to say that many of the allocated costs are equal for an order of one or one thousand products. When direct labor is used as the base, the total direct labor for the order is factored to identify the allocated portion. When the order is for one vs. one thousand then the allocated amount is $1/1000^{th}$ of the order for one thousand, although the support from engineering, purchasing, accounting, shipping, and receiving will often be the same for either case. In this situation the high volume product is penalized disproportionately. The M-K method attempts to correct this by setting allocations based on transactions. One measure for transactions is number of sales orders. This is a simple number to retrieve from a sales order entry system, eliminating the high maintenance costs of ABC. The factoring for allocation is based on the following equations:

$$transaction\_per\_product = \frac{\sum_{month=1}^{12} sales\_orders\_by\_product}{\sum_{month=1}^{12} units\_produced\_by\_product}$$

$$transaction\_cost = \frac{annual\_budgeted\_fixed\_costs}{\sum_{all\_products} annual\_sales\_orders}$$

$$product\_cost = direct\_labor + direct\_material + (transaction\_per\_product * transaction\_cost)$$

Using this method for applying the allocated costs produces a product cost that presumably is closer to reality.

Detailed Description of Data Generation Process

The following section steps through the data generation process, as briefly as possible, in an effort to allow future readers to replicate the tools for further research purposes. The following example of the data generation process will reference Figure 1 extensively. References to actions such as re-calculation of sheets, cutting and pasting of data, and opening and closing of computer files throughout this description are actions preformed by the Visual Basic data bridge unless otherwise noted.

The data generation process begins with the establishment of a forecast to be used for the duration of the 35-year replication process; process (1) in Figure 4. Table 1 shows an excerpt from the "forecast" sheet from the "P&L PP&C VB.xls" (Excel) production planning and control simulation tool. The monthly forecast quantities for January through June are shown in the top three rows. These are family forecast quantities with each family consisting of ten individual products. The values used for this study were near the capacity of the ProModel simulation model and were established using a trial and error process to seek out the demonstrated capacity of the system. The fourth row contains the factors used to convert the family forecast quantities to individual unit quantities; only the first six factors are shown. The bottom rows of Table 2 show the unit forecast quantities which are the result of multiplying the pareto factor by the family forecast quantity. Therefore, unit quantities will automatically be updated when family forecast quantities are changed.

With the forecast set, the process continues by establishing the random sales values that will be used throughout the first year of simulated operation. Process (2) in Figure 4. Table 3 shows the "sales_simulation" page of the Excel tool. The unit

values shown in Table 3 reflect the effect of the application of the equation described earlier under random sales demand. These cells in this sheet reference the values in the "forecast" sheet, again allowing automatic updating when the forecast values are updated. The values in the "sales_simulation" sheet are rounded to whole numbers and saved as values, not formulas, in the "sales" sheet of the Excel tool where the numbers are prevented from changing as the model execution progresses through the twelve-month process. In this way, the random sales values for all twelve months are established prior to initiation of the replication process.

Table 2: "Forecast" Sheet of Excel Production Planning Simulation Tool

		Jan	Feb	Mar	Apr	May	Jun
Sales Forecast	Family A	5885	5885	5885	5885	5885	5885
	Family B	1422	1422	1422	1422	1422	1422
	Family C	2091	2091	2091	2091	2091	2091
Family distribution (Pareto) factors		0.5	0.36	0.04	0.03	0.02	0.015

Units (part)	Month	Jan	Feb	Mar	Apr	May	Jun
A1		2943	2943	2943	2943	2943	2943
A2		2119	2119	2119	2119	2119	2119
A3		236	236	236	236	236	236
A4		177	177	177	177	177	177
A5		118	118	118	118	118	118
A6		89	89	89	89	89	89
A7		74	74	74	74	74	74
A8		59	59	59	59	59	59
A9		45	45	45	45	45	45
A10		30	30	30	30	30	30

With the actual sales volumes established the simulation process is set to begin. The inventory reduction policy is selected based on the current cycle through a for/next loop. The loop starts with policy 1 and ends with policy 3. The cycle starts by calculating the schedule for the coming month; process (3) in Figure 4. ProModel will use this schedule to emulate the operation of a manufacturing process. The production

schedule is calculated by subtracting the forecast demand and the safety stock target level from the current inventory quantity. Table 4 shows an excerpt from the "production_schedule" sheet in the Excel tool. The values in the various cells of Table 4 show the result of this calculation. Inventory levels were equal to safety stock target level as part of the initial conditions of the model. In the top row of Table 4, the factors used to control inventory reduction policy can be seen. Factors for only the first six months are shown here. These factors are referenced in the cell equations andused to factor the safety stock target level. The safety stock target level is multiplied by the factor in the cell above the month for which the schedule is being calculated. In Table 4, the factors for inventory reduction policy 3 are shown. In this policy, the safety stock target level is reduced to 50% of the initial target value within a six-month period. In this example, the schedule value for part A1 in June would be calculated by the following equation:

*Schedule = Current inventory level for A1 – [5886 (safety stock target) * 0.5 (reduction factor)] – 2943 (forecast for June)*

Inventory reduction factors are stored in the "inventory_policy" sheet of the Excel tool. These factors are automatically updated in the "production_schedule" sheet to coincide with the current inventory reduction policy being modeled.

Unit quantity data in the "production_schedule" sheet is then re-formatted by the "to_ProModel" sheet, in preparation for transfer to ProModel. Re-formatting is required in order to provide the level of detail required by the simulation model. The simulation model requires the arrival of several sub components to create a completed part. The "schedule.wk1" file is opened and the column in the "to_ProModel" sheet corresponding to the coming months production requirements is copied to the

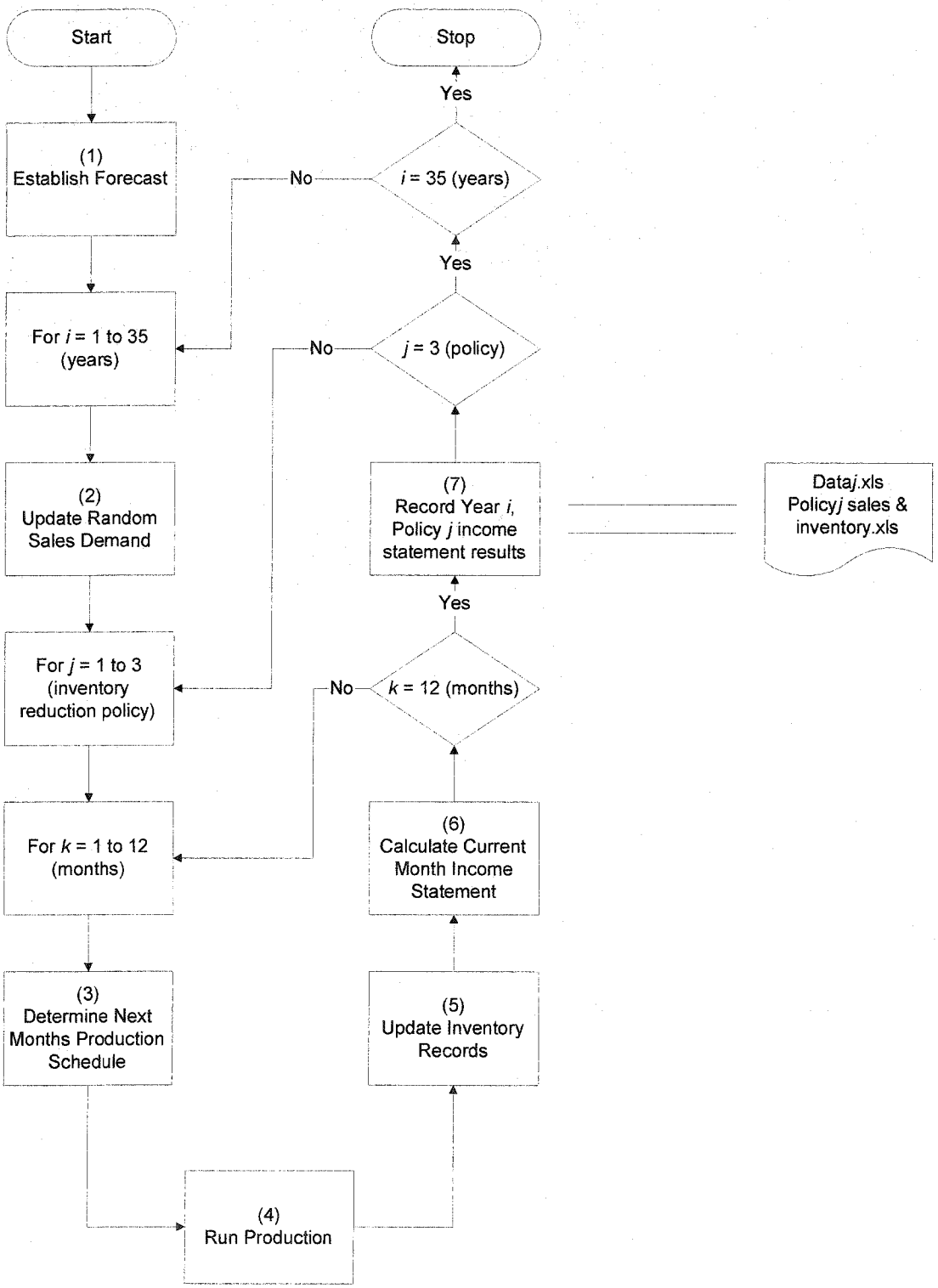

Figure 4: Execution Process

Table 3: "Sales_Simulation" Sheet of Excel Production Planning Simulation Tool

Sales Actual (stochastic calculation)						
	Jan	Feb	Mar	Apr	May	Jun
Part #						
A1	2042.82	2729.32	2937.66	2354.57	1050.76	3210.29
A2	1488.18	2157.40	2189.51	2229.23	1662.00	2141.65
A3	207.05	231.09	268.75	254.35	110.07	272.57
A4	201.84	166.22	147.06	190.96	160.45	164.76
A5	101.01	63.47	120.86	133.39	177.19	127.34
A6	123.42	60.16	103.98	53.66	90.77	109.28
A7	82.32	65.26	53.51	77.38	91.76	81.12
A8	60.52	75.21	86.18	104.36	42.73	60.41
A9	49.76	44.46	62.52	21.44	27.85	45.50
A10	40.11	16.91	35.49	33.29	20.84	28.39
total	**4397.02**	**5609.49**	**6005.51**	**5452.63**	**3434.43**	**6241.31**
B1	960.04	558.51	556.82	349.02	902.59	493.46
B2	403.45	760.24	470.89	639.49	764.04	486.75
B3	53.24	63.42	79.80	68.67	57.71	45.02
B4	53.56	47.82	58.75	24.54	44.91	49.73
B5	28.35	48.00	32.95	23.46	24.10	25.36

appropriate column in the "schedule.wk1" file, and the file is closed. At this point, the user is prompted by a pop-up user window to "Run the simulation model, export the entity activity report to pm.csv, then click OK"; process 4 in Figure 4. At this point, manual intervention is required to start the simulation model execution. The model will open the "schedule.wk1" file and copy the schedule information into the "arrivals" table in ProModel. The model runs to termination and the user is prompted by a pop-up user window that asks, "Do you want to see the results?" Selecting "Yes" opens the report module within ProModel. The user selects the tab for "Entity Activity," and under the "File" pull down menu selects "Export." The Excel tool requires that the exported information be found in a file named "pm.csv." Using this file name, the user answers yes to two additional pop-up windows. At this point, production results have been stored in a location accessible by the Excel tool.

Table 4: "Production_Schedule" Sheet of Excel Production Planning Simulation Tool

Schedule (minimum orders)

Inventory reduction factors		0.917	0.833	0.750	0.667	0.583	0.500
		Jan	Feb	Mar	Apr	May	Jun
Part	safety stock						
A1	5886	2453.0	1364.0	2045.0	2724.0	3286.0	1248.0
A2	4238	1766.0	2905.0	1739.0	1977.0	861.0	2462.0
A3	472	197.0	147.0	215.0	206.0	179.0	269.0
A4	354	148.0	118.0	226.0	152.0	120.0	107.0
A5	236	98.0	66.0	54.0	73.0	158.0	93.0
A6	356	59.0	48.0	67.0	54.0	60.0	44.0
A7	296	49.0	64.0	17.0	45.0	12.0	62.0
A8	236	39.0	52.0	47.0	44.0	34.0	34.0
A9	180	30.0	46.0	25.0	19.0	33.0	14.0
A10	120	20.0	26.0	4.0	10.0	37.0	24.0
B1	1422	593.0	786.0	792.0	404.0	233.0	676.0
B2	1024	427.0	620.0	442.0	497.0	150.0	472.0
B3	114	48.0	48.0	20.0	30.0	53.0	46.0
B4	86	36.0	41.0	40.0	24.0	40.0	27.0
B5	58	24.0	20.0	31.0	15.0	23.0	23.0

The user then selects "OK" in the window that initiated the manual activity. This starts an update cycle that opens the "pm.csv" file, copies the column corresponding to last months production counts, pastes the values in the appropriate month column in the "from_ProModel" sheet in the Excel tool and closes the "pm.csv" file; process 5 in Figure 4. The new data is formatted for use elsewhere within the Excel tool by the "production" sheet in the tool. This sheet strips off information pertaining to sub component activity and reports only unit production. Inventory records are updated in the "inventory" sheet of the Excel tool through the use of a formula in the cells that track ending inventory levels; Table 5. The equation adds the new production from the "production" sheet to the ending inventory level from the previous month then subtracts the unit quantity sold from the "sales" sheet.

If this calculation results in a negative number, then zero is entered in the ending balance cell indicating a stock-out situation. The unit sales information is adjusted in the "revenue" sheet to reflect the lost sales due to the stock-out situation.

Table 5: "Inventory" Sheet of Excel Production Planning Simulation Tool

Inventory (FG)

		Init.	Jan	Feb	Mar	Apr	May	Jun
Part								
A1	beg.		5886	6484	5313	4143	3091	4638
	end	5886	6484	5313	4143	3091	4638	3718
A2	beg.		4238	2746	3559	2967	3730	1776
	end	4238	2746	3559	2967	3730	1776	2950
A3	beg.		472	482	375	345	332	203
	end	472	482	375	345	332	203	231
A4	beg.		354	354	217	261	264	247
	end	354	354	217	261	264	247	73
A5	beg.		236	249	241	202	98	143
	end	236	249	241	202	98	143	165
A6	beg.		356	338	289	272	237	223
	end	356	338	289	272	237	223	200
A7	beg.		296	257	279	226	235	160
	end	296	257	279	226	235	160	126
A8	beg.		236	204	189	172	163	143
	end	236	204	189	172	163	143	115
A9	beg.		180	149	155	146	117	121
	end	180	149	155	146	117	121	74
A10	beg.		120	104	116	100	63	66
	end	120	104	116	100	63	66	72

Process 6 in Figure 4 compiles information from a number of sheets to calculate the month end profit or loss. Table 6 shows an excerpt from the income statement for the full absorption costing method. COGM refers to the cost of goods manufactured. The value in the cells for each month come from the "costs_*method*" sheets where *method* refers to the accounting method, full absorption in this example. An excerpt from the "costs_FA&D" sheet is shown in Table 7. The components of COGM can be seen to include direct labor, direct material and, manufacturing

overhead. The next component in the income statement is COGS, which refers to cost of goods sold. This is the key area that drives the confusion with the recognition of operational improvements, resulting from a lean effort, that lead to inventory reduction. The cost of goods sold is the COGM minus the increase in finished goods inventory. If inventory decreases then the COGS is the COGM plus the inventory decrease. The income statement shown in Table 6 shows what happens during a period of rapid finished goods inventory reduction. This income statement displays the results from inventory reduction policy 3. As can be seen, the change in finished goods inventory is negative each month indicating a steadily decreasing inventory level. The cells in the sales row reference values calculated in the "revenue" sheet. An excerpt of the "revenue" sheet is shown in Table 8. Sales values are the result of multiplying the sales quantity times the selling price. The remainder of the income statement is subtracting COGS from sales to calculate gross profit and subtracting inventory carrying costs from gross profit to calculate net profit. This is a greatly simplified income statement; it includes only the cost and revenue components of interest to this study. The items that are not included are considered constant under all inventory reduction scenarios. The remaining four income statements, representing results of the four other accounting methods, are updated simultaneously using the same methods and working from the same production data.

The process just described continues for a period of twelve months, as shown in Figure 4. When the twelfth month is completed, the information from the five income statements is logged; process 7 in Figure 4. The information of interest for later analysis is gross profit dollars and percent, net profit dollars and percent as well as inventory states by month and sales volumes by month. This information is saved

in a series of Excel files: data1.xls, data2.xls. data3.xls, policy1 sales & inventory, policy 2 sales & inventory and, policy3 sales and inventory. The digit on the file indicates what inventory reduction policy the data pertains to. With the data logging complete the cycle reverts to the initial month using the next inventory reduction policy. When all three inventory policies have been completed using the current sales volume demand data, the program re-calculates the sales volume demand data and begins the process again with inventory reduction policy 1. This continues until 35 years of data have been created and logged.

Table 6: "P&L FA" Sheet of Excel Production Planning Simulation Tool, Income Statement for Full Absorption Costing Method

Income Statement (full absorption)	Jan	Feb	Mar	Apr	May	Jun
COGM						
Total cogm	521374	598934	536497	443451	549242	541923
COGS						
Finished goods +/-	-120467	-68915	-11298	-45831	-100653	-47206
Total cogs	641841	667848	547795	489282	649894	589129
Sales	649487	680155	593852	526295	613620	591213
less COGS	641841	667848	547795	489282	649894	589129
GP	7646	12307	46058	37013	-36275	2085
GP%	0.0118	0.0181	0.0776	0.0703	-0.0591	0.0035
Interest Expense	14000	12337	12061	11536	9192	8159
Net Profit	-6354	-31	33997	25477	-45467	-6074
NP%	-0.00978	-0.00004	0.05725	0.04841	-0.07410	-0.01027

Simulation Model Design

The following discussion describes the logic and execution process for the simulation tool, which was developed to address the previously stated research questions.

Table 7: "P&L FA" Sheet of Excel Production Planning Simulation Tool, Cost of Goods Manufactured Calculations for Full Absorption Costing Method

Manufacturing Costs - Full Absorption

full absorption oh rate = 200%

Part	Cost component	Amount	Jan	Feb	Mar	Apr	May	Jun
A1	direct lab	3.7167	6894.417	9421.75	11949.08	14034.13	6463.283	8057.733
	direct mat	25.0000	46375	63375	80375	94400	43475	54200
	OH	7.4333	13788.83	18843.5	23898.17	28068.27	12926.57	16115.47
	Total	**36.1500**	67058.25	91640.25	116222.3	136502.4	62864.85	78373.2
A2	direct lab	3.7167	12108.9	7775.267	8663.55	4512.033	10462.42	4787.067
	direct mat	25.0000	81450	52300	58275	30350	70375	32200
	OH	7.4333	24217.8	15550.53	17327.1	9024.067	20924.83	9574.133
	Total	**36.1500**	117776.7	75625.8	84265.65	43886.1	101762.3	46561.2
A3	direct lab	3.3000	617.1	838.2	808.5	722.7	1016.4	795.3
	direct mat	15.0000	2805	3810	3675	3285	4620	3615
	OH	6.6000	1234.2	1676.4	1617	1445.4	2032.8	1590.6
	Total	**24.9000**	4656.3	6324.6	6100.5	5453.1	7669.2	6000.9
A4	direct lab	3.3000	488.4	841.5	600.6	491.7	452.1	927.3
	direct mat	15.0000	2220	3825	2730	2235	2055	4215
	OH	6.6000	976.8	1683	1201.2	983.4	904.2	1854.6
	Total	**24.9000**	3685.2	6349.5	4531.8	3710.1	3411.3	6996.9
A5	direct lab	3.3000	280.5	244.2	306.9	584.1	372.9	234.3
	direct mat	15.0000	1275	1110	1395	2655	1695	1065
	OH	6.6000	561	488.4	613.8	1168.2	745.8	468.6
	Total	**24.9000**	2116.5	1842.6	2315.7	4407.3	2813.7	1767.9
Labor			65583	78218	68191	55760	71354	71821
Material			324625	364280	331925	276170	335180	326460
OH			131166	156436	136381	111521	142708	143642
OH variance			0	0	0	0	0	0
Total (FA)			521374	598934	536497	443451	549242	541923

Simulated Factory Parameters

In an effort to be consistent with previous studies, Lea (1998), Ramasceh (1990), and Krawjewski, King, Ritzman, and Wong (1987), the following list of assumptions were used for model design:

1. No pre-emption of orders: orders ran to completion or terminated due to lack of available production time
2. No alternative routings
3. No back orders: demand that is not filled is lost
4. The first operation was never starved for work if there were remaining orders in the schedule

Table 8: "Revenue" Sheet of Excel Production Planning Simulation Tool

Revenue

		Jan	Feb	Mar	Apr	May	Jun
	Selling Price						
A1	45.19	83823	114550	145278	170628	78581	97967
A2	45.19	147221	94532	105332	54858	127203	58202
A3	31.13	5820	7906	7626	6816	9587	7501
A4	31.13	4607	7937	5665	4638	4264	8746
A5	31.13	2646	2303	2895	5509	3517	2210
A6	45.19	3479	4383	3796	4022	3344	3028
A7	45.19	3977	1898	3163	1627	3931	4338
A8	61.94	4398	4150	3964	3283	3345	3840
A9	61.94	3778	2478	2106	2973	1796	3778
A10	61.94	2230	867	1239	2911	2106	1115
B1	92.71	83901	84365	48486	32541	73703	68233
B2	92.71	65452	48857	53956	21879	51639	61002
B3	69.17	4012	2006	2767	4288	3873	3528
B4	69.17	3320	3251	2213	3251	2352	2421
B5	69.17	1729	2421	1383	1937	1937	1522
Mo. Total		**649487**	**680155**	**593852**	**526295**	**613620**	**591213**

Model: Manufacturing Operation

The model factory employs three repetitive manufacturing cells configured as in-line flow cells. Each cell is designed to accommodate the fabrication and assembly of a given family of product. The families are designated A, B, and C. Between fabrication and assembly is a shared painting operation that all three cells utilize. The product families are comprised of ten unique products per family. Ten products allowed a relatively simple application of the pareto principle for production volume distribution within the given family. This distribution, whereby 20% of the part numbers contribute to 80% of the unit sales, is a pattern that is prevalent across many industries (Kinsinger, 2004). Each part within a family has an identical routing to other parts within the family but different processing times. Standard times are used in the model as mean processing times in each operation with the actual modeled cycle time being a normally distributed random number with mean equal to the engineered standard and a standard deviation of 10 to 20% depending on the operation. The standards are displayed in table 9, 10, & 11.

The model operates as a collection of repetitive manufacturing cells. This is characterized by a flow of material through each cell as the various operations take place. One-piece flow, first-come first-served, is utilized throughout the model including the paint process. Several queues are utilized in operations where the simulated operation would require the parts to stage for a given period in order to cure prior to being consumed by the next process. Raw material enters the system in batches at the beginning of each line. The arrival process is not sequenced by time; instead, the arrival file contains all orders for the period to be simulated in a sequence arranged from the highest priority to lowest priority product by family. ProModel

executes these orders in the order of arrangement. Since raw material and its operational characteristics are not the subject of this study it was determined that, the batch arrival process employed was of no significance to the outcome of the study.

Table 9: Standard Operation Times for Family "A" (Time in Seconds)

Item	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Category	med	med	sm	sm	sm	med	med	large	large	large
Operation										
A_Cover_blanks	15	15	15	15	15	15	15	15	15	15
A_Cover_flange	27	27	27	27	27	27	27	36	36	36
A_Cover_form	36	36	36	36	36	36	36	45	45	45
A_Corner_Weld	30	30	30	30	30	30	30	36	36	36
A_Grinder_cover	36	36	36	36	36	36	36	48	48	48
A_Hinge_to_cover	24	24	18	18	18	24	24	36	36	36
A_Body_blanks	15	15	15	15	15	15	15	15	15	15
A_Body_form	54	54	48	48	48	54	54	72	72	72
A_Auto_Welder_body	60	60	48	48	48	60	60	78	78	78
A_Grinder_body	30	30	30	30	30	30	30	45	45	45
A_Mounting_feet	45	45	45	45	45	45	45	54	54	54
A_Panel_studs	45	45	45	45	45	45	45	54	54	54
A_Cover_to_body	24	24	24	24	24	24	24	36	36	36
A_Load_paint	18	18	18	18	18	18	18	24	24	24
Paint										
A_Gasket	30	30	24	24	24	30	30	54	54	54
A_gasket_queue										
A_assy_1	60	60	30	30	30	60	60	90	90	90
A_assy_2	45	45	45	45	45	45	45	45	45	45
Packaging	75	75	60	60	60	75	75	90	90	90
Finished_Goods										
Total direct labor (sec)	669	669	594	594	594	669	669	873	873	873
Total direct labor (min)	11.15	11.15	9.9	9.9	9.9	11.15	11.15	14.55	14.55	14.55

Set-up time between orders was incorporated through the use of subroutines. Each time a product entered the initial work center in a given cell a subroutine was executed to identify if the current part was identical to the previous part. If the incoming part was different, then a setup cycle was executed to simulate the effects of this activity on the capacity of the operation. Setup times were normally distributed

random variables with mean and standard deviation as indicated in Table 12.

Table 10: Standard Operation Times for Family "B" (Time in Seconds)

Item	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
Size	med	med	sm	sm	sm	med	med	large	large	large
Operation										
B_body_blanks	30	30	30	30	30	30	30	45	45	45
B_punch_corner_notch	120	120	120	120	120	120	120	180	180	180
B_panel_nut_weld	120	120	100	100	100	120	120	220	220	220
B_body_brake	240	240	160	160	160	240	240	400	400	400
B_manual_weld	360	360	240	240	240	360	360	600	600	600
B_hinge_hole_punch	120	120	120	120	120	120	120	200	200	200
B_door_blanks	15	15	15	15	15	15	15	25	25	25
B_door_form	60	60	60	60	60	60	60	75	75	75
B_corner_form_trim	60	60	60	60	60	60	60	75	75	75
B_hinge_barrel_weld	75	75	75	75	75	75	75	100	100	100
B_stiffener_weld	75	75	75	75	75	75	75	100	100	100
B_load_paint	25	25	25	25	25	25	25	45	45	45
B_Gasket	60	60	50	50	50	60	60	90	90	90
B_gasket_queue										
B_assy_1	120	120	120	120	120	120	120	200	200	200
B_assy_2	150	150	150	150	150	150	150	300	300	300
B_package	120	120	120	120	120	120	120	240	240	240
Finished_Goods										
Total direct labor (sec)	1750	1750	1520	1520	1520	1750	1750	2895	2895	2895
Total direct labor (min)	29.16	29.16	25.33	25.33	25.33	29.16	29.16	48.25	48.25	48.25

Production Planning Tool

The planning tool was constructed utilizing collection of interconnected spreadsheets. The tool preformed the following tasks:

1. Determination of the coming months production schedule
2. Tracking of on-hand inventories
3. Calculation of income statements by accounting method

Table 11: Standard Operation times for Family "C" (Time in Seconds)

Item	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Size	med	med	sm	sm	sm	med	med	Large	large	large
Operation										
C_wrapper_blanks	20	20	20	20	20	20	20	30	30	30
C_end_wall_blanks	20	20	20	20	20	20	20	30	30	30
C_offset_Brake	40	40	40	40	40	40	40	60	60	60
C_body_Brake	60	60	60	60	60	60	60	90	90	90
C_endwall_Brake	40	40	40	40	40	40	40	40	40	40
C_panel_studs	60	60	40	40	40	40	40	80	80	80
C_body_weld	480	480	360	360	360	360	360	720	720	720
C_body_grind	480	480	360	360	360	360	360	720	720	720
C_body_hardware	150	150	120	120	120	120	120	180	180	180
C_cover_blanks	20	20	20	20	20	20	20	30	30	30
C_cover_hemm_form	45	45	30	30	30	30	30	60	60	60
C_cover_weld	60	60	60	60	60	60	60	120	120	120
C_cover_grind	60	60	60	60	60	60	60	120	120	120
C_hinge_to_cover	60	60	45	45	45	45	45	90	90	90
C_door_stiffiners	60	60	0	0	0	0	0	90	90	90
C_load_paint	20	20	20	20	20	20	20	40	40	40
C_gasket	75	75	60	60	60	60	60	90	90	90
C_gasket_queue										
C_assy_1	180	180	180	180	180	180	180	360	360	360
C_assy_2	120	120	120	120	120	120	120	180	180	180
C_assy_3	180	180	180	180	180	180	180	360	360	360
C_package	240	240	220	220	220	220	220	300	300	300
Finished_Goods										
Total direct labor (sec)	2290	2290	1875	1875	1875	1875	1875	3540	3540	3540
Total direct labor (min)	38.16	38.16	31.25	31.25	31.25	31.25	31.25	59	59	59

Calculation of the Coming Month Production Schedule

The formula used for the calculation of the coming months production quantity by part was:

$$= safety\ stock\ target + forecast!_{ij} - inventory!_{ij}$$

Where:

forecast!$_{ij}$ references the quantity contained in the appropriate cell on the forecast sheet for the part of interest

inventory!$_{ij}$ references the on-hand inventory for that part, (this will be elaborated on momentarily).

The safety stock level was established at twice the monthly forecast for high volume products and four times the monthly forecast for low volume products.

Table 12: Setup Times

Family / part	Mean	Standard Deviation
A / cover	20 min	2 min
A / body	20 min	2 min
B / cover	20 min	2 min
B / body	30 min	3 min
C / cover	20 min	2 min
C / body	20 min	2 min
C / end	20 min	2 min

Tracking of On-Hand Inventories

On-hand inventory quantities are maintained in a sheet dedicated to that function. On-hand levels by part are calculated at the conclusion of each month simultaneous to the creation of the next month's production schedule. The logic used to arrive at current on-hand levels by part is:

$=IF(cell_{ij}+production!cell_{ij}-sales!cell_{ij}>=0,cell_{ij}+production!cell_{ij}-$

sales!cell$_{ij}$, 0)

Where:

cell$_{ij}$ references the previous months ending inventory level

production!cell$_{ij}$ references the cell containing the quantity produced from one iteration of the simulation model for the part in question

sales!cell$_{ij}$ references the cell containing the quantity sold in the current time period for the part in question based on the randomly determined sales volume quantities discussed earlier.

The equation is formulated using an IF statement in order to provide an adjustment in the event of a stock shortage. If the quantity sold in the current period exceeds the quantity produced plus the starting balance then a negative inventory situation is experienced. The IF statement evaluates whether or not there will be a balance of inventory at the end of the period. If not then the inventory level is set to zero. No backlog is created and the quantity oversold is reduced from the quantity sold for calculation of the income statement. Thus, negative inventory is viewed as a lost sale and a missed opportunity.

Calculation of Income Statements by Accounting Method

The production planning tool maintains income statements for five accounting methods; full absorption, direct, throughput, ABC and a fifth method that is in the early stages of development referred to here as the M-K method. The subject of analysis in this research was both the gross profit and net profit values and their behavior under differing accounting methods and differing levels of aggressiveness for implementation of a lean program. This study is limited to the measure of

differences in gross and net profits as would be influenced by a lean manufacturing program. A lean program would not directly influence many of the typical selling and administrative cost components. As a result many of these costs are not modeled in the income statements, instead they are viewed as constants and left out so as not to mask the magnitude of the changes of interest. The components of interest are those that are incurred due to inventory. This would include factory indirect labor costs necessary to physically manage the inventories as well as administrative costs to account for this material. Also included would be traditional carrying costs that would include the cost for the physical plant space and the cost of having capital tied up in inventory instead of invested in interest granting investments. The basic calculations for the income statements are:

Cost of goods manufactured +(-) changes in inventory = Cost of goods sold

Sales – Cost of goods sold = gross profit

Gross profit – selling and administrative costs = net profit

Costs of goods manufactured include direct materials, direct labor and factory overhead costs that are based on an engineered standard. Reductions in factory overhead are factored into the model to simulate a reduction in this expense that is the result of declining inventory levels. Carrying cost changes resulting from inventory reduction are captured in the selling and administrative component of the income statement.

Model Execution – Data Generation

The data set for this study was generated using an iterative process in one-

month steps. The initial conditions were chosen to have on-hand inventory levels equal to the previously stated safety stock levels. The first month income statement was calculated based on the results of the application of the randomly generated sales values. The second month production schedule was automatically generated as a result of the previously described logic. This schedule was written to an excel .WK1 format file. The file was then accessed by the ProModel simulation software upon model execution. The schedule information was read into the arrivals table of the model. Once the loading of the arrivals information was complete the model ran to termination, processing the arrivals file in sequence. Model execution terminates when either all products in the production schedule are completed or a run time of 163 hours is reached. The time of 163 hours was established by using 160 hours as four weeks production hours plus three hours to charge the production lines, simulating the ending point of the previous month, i.e. work-in-process. The resulting production output from the simulation run was exported to an Excel file and inserted into the planning tool in a sheet designated for this data. This triggers the updating of the current months income statement, adjustment of on-hand inventory and calculation of the coming months production schedule. The process is repeated until twelve months have been completed.

The procedure just described is repeated for each of three scenarios:

1. No change in inventory target (safety stock targets are level)
2. Moderate change in inventory targets (50% reduction in safety stock targets by the completion of the 12^{th} month)
3. Aggressive change in inventory targets (50% reduction in safety stock target by the completion for the 6^{th} month then fixed at the new level)

The resulting series of income statements allow a comparison of the effect on gross profit and net profit resulting from the reduction in on-hand finished goods inventories.

Technical Issues With the Simulation Model

Each iteration of the ProModel simulation model is terminating, meaning that the model runs until all scheduled products have been produced or until a maximum time is reached. The model terminates upon the occurrence of either.

Queue capacities for the initial staging prior to processing, the simulated paint operation, which occurs near the middle of the production sequence, and the first operation following the paint process, which emulates another curing process, were set to levels that would prevent bottlenecks. All other operations had a queue capacity of one, forcing a one-piece-flow scenario characteristic of just-in-time or lean manufacturing environments.

A steady state condition was achieved by allowing an additional three hours of run time beyond the normal month capacity of run hours. This allowed the system to return to a state that would be present at the close of a month in a normal manufacturing environment, i.e. production lines full of product. In a sense, this served as a warm-up period without the loss of production counts during the warm up.

Replication was used as the method to capture the variance of dependent variable means. The required number of replications was estimated using the formula adapted from Law and Kelton (2000):

$$n \geq \left(\frac{t_{n-1,1-\alpha/2} * S_{(n)}}{E} \right)^2$$

where

n = number of replications

$t_{n-1,1-\alpha/2}$ = Student's t value with n-1 degrees of freedom

$S_{(n)}$ = sample standard deviation of the dependent variable

E = half-width of the confidence interval for sample means

The dependent variable chosen to measure variability for this model was the average time in system for a unit of product A1, B1, and C1 to complete. These were the highest volume parts in each family based on the pareto factors used. The model was run with ten replications, insuring a different seed in the random number stream for each replication. Descriptive statistics were generated from the ten data points in order to obtain an estimate of the standard deviation, *S*. The half width of the confidence interval, *E*, was set at 0.05% of the sample mean. Using an $\alpha = .05$ the equation identified a value for $n = 34.917$. Therefore, in order to obtain the desired level of statistical confidence 35 replications were required for each month of the 12-month simulation periods or 420 simulation runs to produce the data set for one inventory policy. 1,260 replications were required for the creation of a complete data set for three inventory policies under a given sales stochasity level. The three sales stochasity levels resulted in 3,780 total simulation runs.

CHAPTER IV

RESULTS

In this chapter the results of the data analysis are discussed and detailed analysis is presented. Analysis is based on the data collected using the modeling tools described in chapter III, Experimental Design. The tools used were Microsoft Excel for the development and operation of a pseudo production planning and control system as well as for financial reporting. ProModel simulation software was used for the development and operation of a model manufacturing environment. Microsoft Visual Basic for Applications (VBA) was used to act as a data bridge between the Excel and ProModel packages. The data was analyzed using Minitab release 14. Analysis of Variance (ANOVA) was employed for testing of the research hypotheses presented in chapter III and the Tukey all pairwise comparison method was employed to determine which factor levels had the greatest effect on the measurements of interest.

Raw Data and Descriptive Statistics

A sample of the raw data can be seen in Table 13 and a complete data set for one inventory reduction policy at one sales stochasity setting is included in Appendix A. Data was collected for gross profit and net profit in dollars and as a percent of sales. This was done for all management accounting methods, sales volatility levels, and inventory reduction policy combinations for 35 replications. Inventory value was also recorded for the 35 replications. Means for all data tables were calculated and used for creating plots of the data allowing a visual review prior to detailed testing.

Table 13: Raw Data, Gross Profit for the Full Absorption Costing Method With No Inventory Reduction Target

Dollars	Jan	Feb	Mar	Apr	May	Jun	...
Series (yr)							
1	62512.78	218387.4	96471.45	88444.78	167306.9	131101.6	...
2	74384.54	190270.8	135024.7	94349.53	75907.17	230553.4	...
3	99957.47	119442.3	163868.3	143971.1	75954.97	161201.6	...
4	135156.5	123652.3	90084.61	92479.76	119973.8	189381.9	...
5	141845	104079.5	138371.5	74051.91	146695.6	138990.1	...
.	.	.	.	.	.	.	
.	.	.	.	.	.	.	
.	.	.	.	.	.	.	
32	179780.1	23882.56	150233.8	117051.6	106857	142742.2	...
33	123784.6	117235.9	89611.7	144673.4	118892.3	140019	...
34	109134.5	165989.9	120891.7	62630.77	139415.5	135817.4	...
35	49308.64	224477.7	66843.12	182333.1	62393.64	138495.4	...
Mean	124301.1	122459.7	112477.2	114539.8	131181.5	128321.3	...
Std. Dev	35488.46	59431.07	53192.13	55940.68	46566.71	56581.41	...

Tests of Hypotheses

Results of all ANOVA tests are summarized in Tables 14 and 15 and are discussed below.

> H_1: Within a given management accounting method, does rate of inventory reduction have an effect on reported gross profit?

$H_{1,0}$: $Policy_i = 0$, for gross profit

The main effect for factor policy was significant for this performance measure. The one-way ANOVA test indicated that at least one of the three inventory reduction policies had a significant effect on the dependent measure indicating that the means

were indeed different at a significance level of $\alpha = 0.05$. As a result, hypothesis $H_{1,0}$: was rejected.

> H_2: Within a given management accounting method, does rate of inventory reduction have an effect on reported net profit?

$H_{2,0}$: $Policy_i = 0$, for net profit

The main effect for the factor policy was significant for this performance measure. The one-way ANOVA test indicated that at least one of the three inventory reduction policies had a significant effect on the dependent measure indicating that the means were indeed different at a significance level of $\alpha = 0.05$. As a result hypothesis $H_{2,0}$: was rejected, $H_{2,1}$: rate of inventory reduction has a significant effect on reported gross and net profit, was accepted.

> H_3: Within a given inventory reduction policy, does the management accounting method have an effect on reported gross profit?

$H_{3,0}$: $Acct_j = 0$, for gross profit

The main effect for the factor management accounting method was significant for this performance measure. One-way ANOVA testing indicated that at least one of the five management accounting methods had a significant effect on the mean value for gross profit at the $\alpha = 0.05$ level. Therefore, hypothesis $H_{3,0}$: was rejected.

> H_4: Within a given inventory reduction policy, does the management accounting method have an effect on reported net profit?

$H_{4,0}$: $Acct_j = 0$, for net profit

The main effect for the factor management accounting method was not always significant for this performance measure. One-way ANOVA testing of monthly net profit indicated that management accounting method had a significant effect on the mean value for net profit at the $\alpha = 0.05$ level in only two of the eleven months evaluated. Therefore, hypothesis $H_{4,0}$: was accepted, there is no evidence that the mean values for net profit are different as a result of the management accounting method used.

H_5: For a given inventory reduction policy, does the management accounting method used have an effect on reported gross profit?

$H_{5,0}$: $Policy_i * Acct_j = 0$, for gross profit

Hypothesis five is concerned with the interaction between the rate of reduction of inventory and the management accounting method used for reporting of gross profit. Two-way ANOVA testing identified that the interaction between inventory policy and management accounting method was not significant at the $\alpha = 0.05$ level. The test indicates that the effect on gross profit from rate of inventory reduction at each setting was not different under the various management accounting methods. Therefore, $H_{5,0}$: was accepted, there is no evidence that the mean values for gross profit are different as a result of the interaction between inventory reduction policy and management accounting method. With no interaction effects to consider, the results could be evaluated at the main effect level for the performance measure of gross profit.

H_6: For a given inventory reduction policy, does the management accounting method used have an effect on reported net profit?

$H_{6,0}$: $Policy_i * Acct_j = 0$, for net profit

Hypothesis six is concerned with the interaction between the rate of reduction of inventory and the management accounting method used for reporting of net profit. Two-way ANOVA testing identified that the interaction between inventory policy and management accounting method was not significant at the $\alpha = 0.05$ level. The test indicates that the effect on net profit from rate of inventory reduction at each setting was not different under the various management accounting methods. Therefore, $H_{6,0}$: was accepted. With no interaction effects to consider, the results could be evaluated at the main effect level for the performance measure of net profit.

H_7: Does inventory reduction policy affect the customer service level, measured by stock-out's, under the production and market environment modeled in this study?

$H_{7,0}$: $Policy_i = 0$

The main effect for the factor policy was significant for this performance measure. The one-way ANOVA test indicated that at least one of the three inventory reduction policies had a significant effect on the dependent measure indicating that the means were indeed different at a significance level of $\alpha = 0.05$. As a result hypothesis $H_{7,0}$: was rejected.

H_8: Does volatility in the sales demand have an affect on reported gross and net profit under the production and market environment modeled in this study?

$H_{8,0}$: $Sales_i = 0$

The main effect for the factor sales was not significant for this measure. The one-way ANOVA test indicated that sales volatility level was not significant at the $\alpha = 0.05$ level. Therefore, $H_{8,0}$: was accepted.

H_9: Does volatility in the sales demand have an affect on the customer service level, measured by stock-out's, under the production and market environment modeled in this study?

$H_{9,0}$: $Sales_i = 0$

The main effect for the factor sales was significant for this measure. One-way ANOVA testing indicated that at least one level of sales volatility produced results with mean values that were significantly different from the other levels. Therefore, $H_{9,0}$: was accepted.

In summary, the testing has shown that rate of inventory reduction and management accounting alternatives do significantly affect reported gross profit while the interaction of these factors does not have a significant effect. For net profit the results were different. Inventory reduction policy was still significant in all of the tested periods while management accounting method was significant in only 18% of the cases tested. Again the interaction of the two effects was not significant at the $\alpha = 0.05$ level under the operating conditions characterized by this model.

Results by Performance Measure and Period

The results presented in this section are limited to the operational environment detailed in Chapter III and cannot be generalized for other operational environments. However, inferences can be made from these results into other operational environments, including process manufacturing or service, as the methods of reporting gross and net profit are uniform across these operations. Lean strategies can be applied across these types of operations as well, resulting in a lowering of inventories, leading to the same effects at varying levels of magnitude.

The Tukey pairwise evaluation method was used to evaluate the mean value data in an effort to identify the factor level means that were in fact different thus causing a significant effect on the two performance measures. In addition, it was of interest to identify which factor had the greatest effect.

Gross Profit

Values for gross profit for this study were calculated for the five management accounting methods at the completion of each month of simulated operation. Sales demand was a random factor that acted as a block. Every combination of inventory reduction policy and management accounting alternative was evaluated on each block.

ANOVA Results

Summary results for ANOVA testing on the effects of inventory reduction policy and management accounting method can be seen in Table 14. Monthly gross

profit as a percentage of sales was used as the dependent variable. The results imply that both inventory reduction policy and management accounting method have a significant effect on reported gross profit at the $\alpha = 0.05$ level. The results also indicate that no interaction effect exists between inventory reduction policy and management accounting method at the gross profit level.

Evaluation of Gross Profit Mean Values

The results of the Tukey all pairwise tests on the mean values of gross profit indicate that each level of inventory reduction policy was significantly different from all other levels with policy 1, no inventory reduction, producing the highest mean value for reported gross profit for the first five months of the eleven month period evaluated. Policy 3, 50% reduction in finished goods inventory over the first six month and no further reduction for the balance of the year, produced the lowest values for reported gross profit. Starting with month seven and continuing through month twelve the mean values for policy 1 and 3 were not significantly different. Both policies produced higher values for reported gross profit then policy 2.

Results of management accounting method indicate that there is no significant difference in mean reported gross profit values for methods 1, 3, or 5, which were full absorption costing, activity based costing, and the M-K method of product costing. Both methods 2 and 4 were significantly different from all other methods; with method 4 producing the highest reported values for gross profit, followed by method 2. Method 4 was throughput costing and 2 was direct costing. These results were consistent across all periods evaluated in this study.

Table 14: ANOVA Results Summary for Gross Profit

Month	Source	Approx. F	P value
Jan	Policy	239.31	0.000
	Method	1243.96	0.000
	Policy*Method	2.23	0.024
Feb	Policy	58.34	0.000
	Method	342.20	0.000
	Policy*Method	0.45	0.891
Mar	Policy	85.95	0.000
	Method	470.66	0.000
	Policy*Method	0.82	0.584
Apr	Policy	79.40	0.000
	Method	421.86	0.000
	Policy*Method	0.76	0.636
May	Policy	100.89	0.000
	Method	547.44	0.000
	Policy*Method	0.84	0.570
Jun	Policy	87.45	0.000
	Method	396.47	0.000
	Policy*Method	0.87	0.543
Jul	Policy	21.97	0.000
	Method	339.40	0.000
	Policy*Method	0.23	0.984
Aug	Policy	19.66	0.000
	Method	348.46	0.000
	Policy*Method	0.17	0.995
Sep	Policy	30.96	0.000
	Method	553.72	0.000
	Policy*Method	0.26	0.977
Oct	Policy	35.71	0.000
	Method	456.38	0.000
	Policy*Method	0.34	0.951
Nov	Policy	25.36	0.000
	Method	352.65	0.000
	Policy*Method	0.27	0.976
Dec	Policy	30.95	0.000
	Method	442.75	0.000
	Policy*Method	0.30	0.966

Plots of the mean values indicate that inventory reduction policy 1, or no reduction in finished goods inventory level, resulted in the highest mean value for gross profit for the months during which policies 2 and 3 were causing inventory levels to be reduced. In July, or mid way through the test period, when policy 3 ceased to reduce inventory the mean values for policy 1 and 3 became equal.

Plots for management accounting method indicated that the mean monthly value for gross profit reported by throughput costing was repeatedly the highest followed by direct costing. The mean values for the remaining three methods were not significantly different. Samples of the plots are included in Figures 5 and 6.

Plots of the mean values for the complete twelve-month series for gross profit by inventory reduction policy are shown on Figure 7. This graph allows the differences in reported gross profit to be more easily identified. Figure 7 displays the results using the full absorption method of costing. The numeric results are different depending on the management accounting method due to the way that components of cost are recognized differently between methods but the trends lines in Figure 7 are typical for all management accounting methods. As can be seen, the inventory reduction policy has a very noticeable impact on the three curves. This chart identifies the magnitude of the decrease in reported gross profit that results from the reduction in on-hand finished goods inventory. Inventory reduction policy 1, or no inventory reduction, reports the highest gross profit for periods 1 through 6. The reported gross profit for policy 1 is nearly 28% higher than policy 2 and 58% higher than policy 3 in the early months of the series. This separation in plots brings focus to the principle issue between management accounting practices and the impact of their support of lean

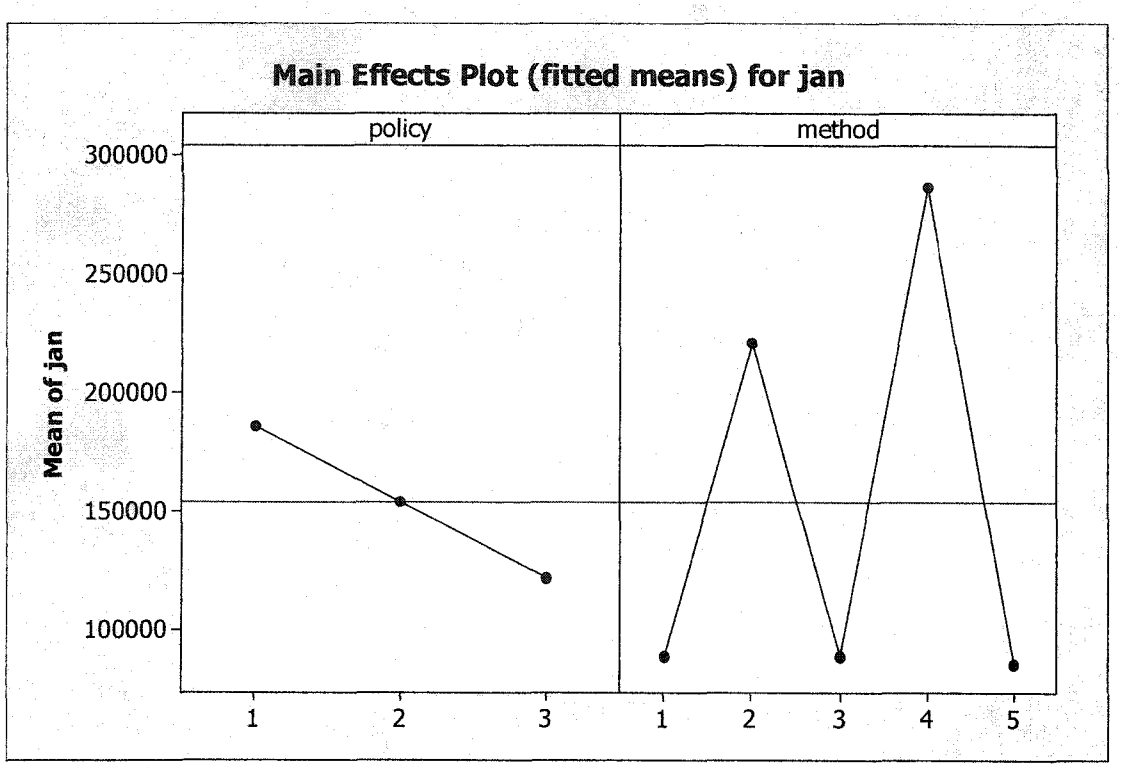

Figure 5: Sample Plot of GP Means, Typical for Months 1 – 6
Policy 1 – No Inventory Reduction, Policy 2 – 50% Reduction in Finished Goods Inventory Over 12 Reporting Periods, Policy 3 – 50% Reduction in Finished Goods Inventory Over 6 Reporting Periods and no Further Reduction. Method 1 – Full Absorption, Method 2 – Direct, Method 3 – ABC, Method 4 – TPC and Method 5 – Meade – Kinsinger

manufacturing programs. In months 7 through 12, the curves for policy 1 and 3 coincide. As discussed earlier, policy 3 caused a rapid reduction in the target level for safety stock for the first half of the modeled period. In the second half of the modeled period the target level is held constant at the new lower level, 50% of the initial target level. The graph shows that when inventory level ceases to be reduced, the reporting of gross profit returns to the level that would be experienced with no lean program. Differences in reported net income would reflect changes in other cost areas, such as inventory carrying costs, and will be discussed in the next section. The plot of mean

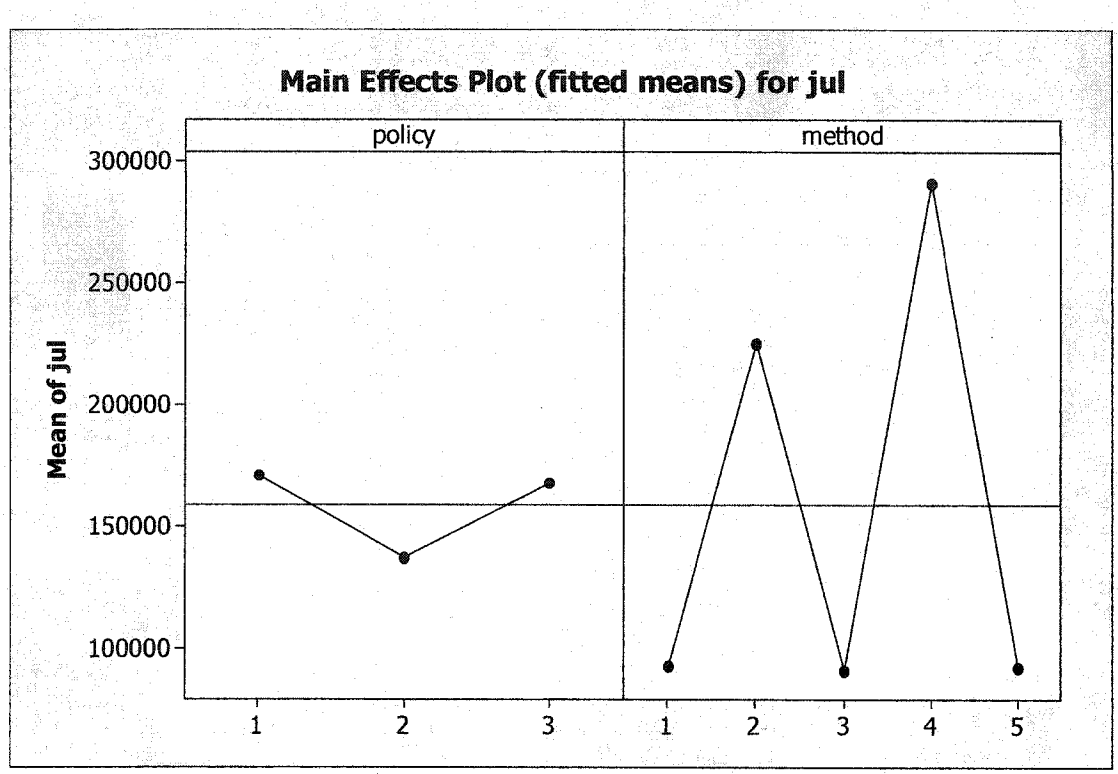

Figure 6: Sample Plot of GP Means, Typical for Months 7 – 12
Policy 1 – No Inventory Reduction, Policy 2 – 50% Reduction in Finished Goods Inventory Over 12 Reporting Periods, Policy 3 – 50% Reduction in Finished Goods Inventory Over 6 Reporting Periods and no Further Reduction. Method 1 – Full Absorption, Method 2 – Direct, Method 3 – ABC, Method 4 – TPC and Method 5 – Meade – Kinsinger

values for policy 2 indicate that as long as inventory levels continue to be driven down, reported gross profit will continue to be lower. Policy 2 reduces the target level for safety stock, in a linear fashion, to 50% of initial target over the course of the entire studied period. Figure 7 supports the previously discussed results indicating that inventory reduction policy had a significant effect on reported gross income with all mean values being significantly different in periods 1 – 6, and only policy 2 being significantly different in periods 7 – 12.

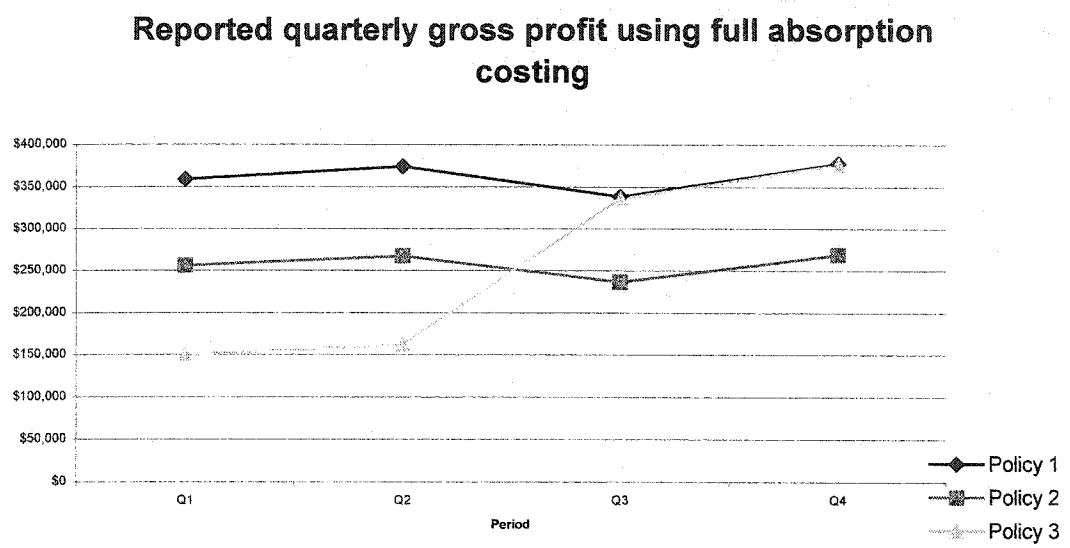

Figure 7: Trends of Reported Gross Profit by Inventory Reduction Policy, Typical for All Management Accounting Methods

In Figures 8, 9, and 10 the mean values from the 35-replication data set for inventory policy can be seen plotted with the mean inventory level in dollars. Trend lines are added for reported gross profit to more clearly display the changes in this measure over time. Figure 8 shows the data for inventory reduction policy 1. This figure can be thought of as the baseline for the 35-replication dataset. The trend line shows a slightly increasing trend over time. If a second series of 35 replications was collected this trend line could become flat or slightly decreasing. Sample data collected while developing the model exhibited this condition and can be considered a function of the stochastic nature of the model. Figure 9, and 10 use the same baseline data allowing direct comparisons to be made between the figures. Inventory reduction polices 1 and 2 exhibit an essentially flat reported gross profit for the studies period, implying that if the rate of inventory reduction is a constant then the reported level of gross profit will also be constant. Therefore, if the rate of reduction is linear over time, regardless of the slope, the trend of the impact or reduction in reported gross

profit would be parallel to other reduction slopes including zero or no reduction. The greater the slope, the lower the reported gross profit. The noticeable change in the slope of the trend line in Figure 10 is explained by the effect that ceasing further reduction has on the reported level of gross profit. This graph has essentially two significant periods. In months 1 – 6 a trend line would again be parallel to Figures 8 and 9. In addition, a trend line of periods 7 – 12 would be parallel to the other figures. This is due to the fact that in each period the rate of reduction is linear, downward in the first period and flat in the second. In the second period it can be seen that the values for reported gross income are equal to those reported under policy 1, which is expected as no reduction is taking place during this period for either method.

Figure 11 displays the differences in reported gross income as a result of management accounting method. The curves included in this figure are the result of inventory reduction policy 3, aggressive reduction periods 1-6 and no further reduction periods 7-12. As can be seen from the plots, the five curves are essentially parallel. This figure displays the magnitude of the differences between the recognition of cost components between the various management accounting alternatives. ANOVA tests on the mean values for all methods indicated that management accounting method did have a significant impact on the mean value for reported gross profit. Tukey tests on the confidence intervals indicated that methods 2 and 4 were significantly different from the other three methods. The remaining methods were not statistically different from each other. Method 4, throughput costing, reported the highest levels for gross profit followed by direct costing.

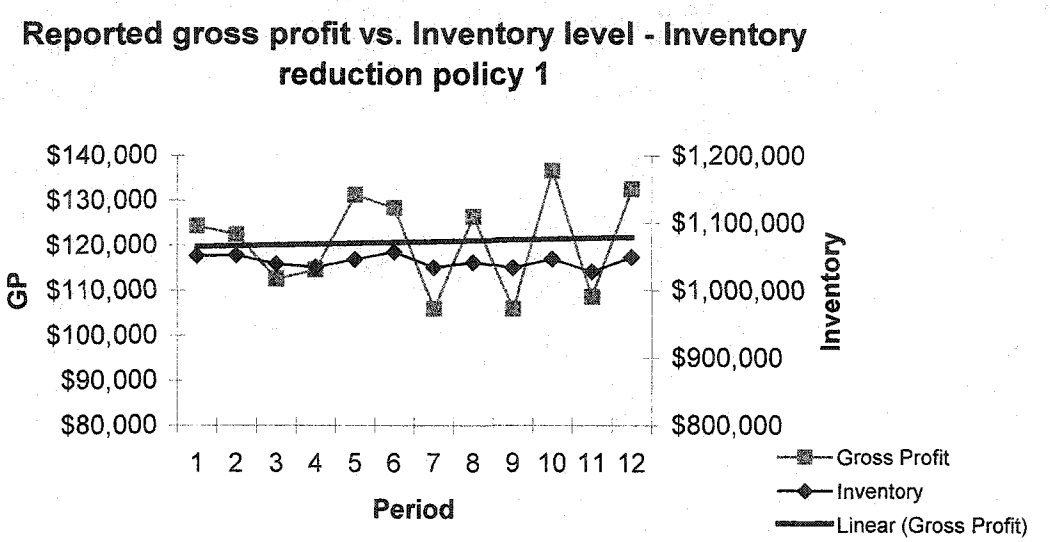

Figure 8: Trend of Reported Gross Profit Under No Inventory Reduction, Using Full Absorption Costing

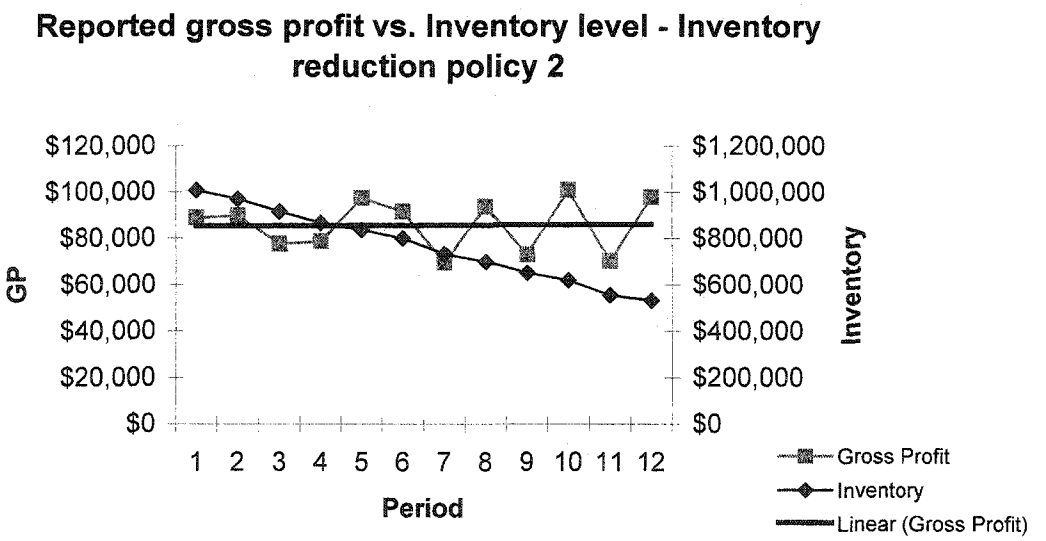

Figure 9: Trend of Reported Gross Profit Under Moderate, Linear, Inventory Reduction, Using Full Absorption Costing

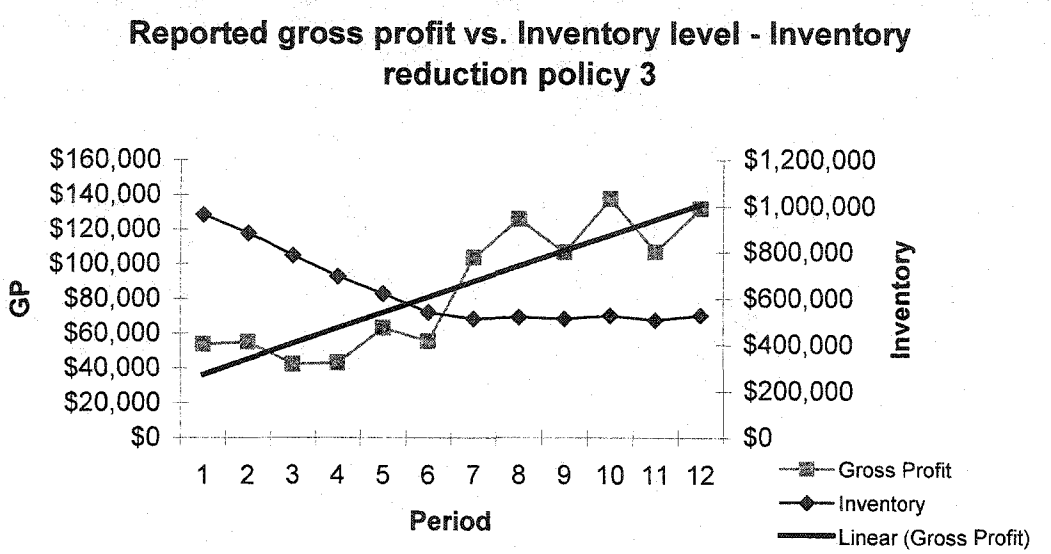

Figure 10: Trend of Reported Gross Profit Under Aggressive, Linear, Inventory Reduction in Periods 1 – 6 and No Further Reduction in Periods 7 – 12, Using Full Absorption Costing

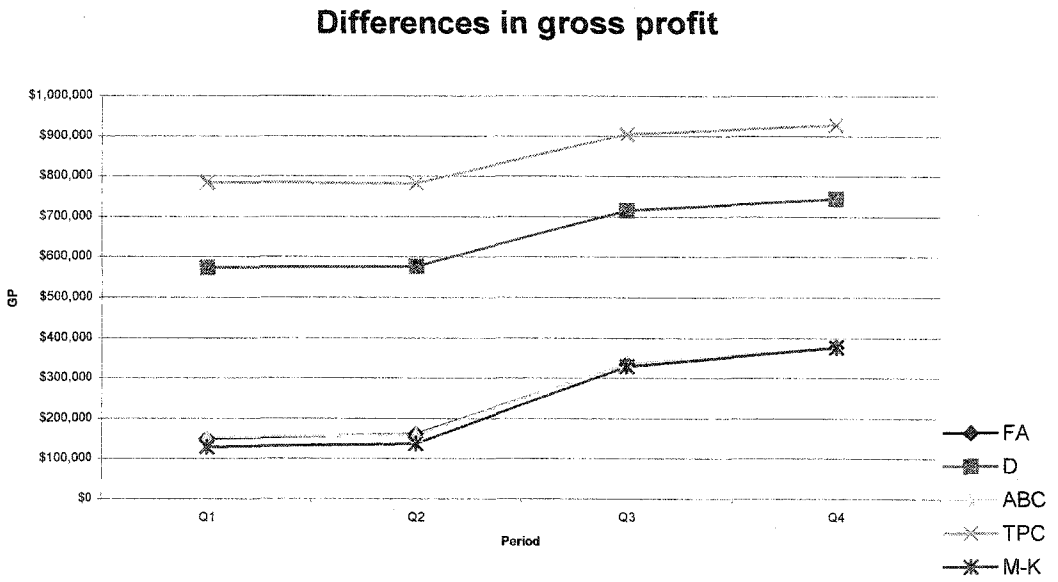

Figure 11: Trends of Reported Gross Profit by Management Accounting Method, Inventory Reduction Policy 3 by Quarter

Net Profit

Values for net profit for this study were calculated under the same operational conditions and in the same manner as for gross profit as stated above. Sales demand was a random factor that acted as a block. Every combination of inventory reduction policy and management accounting alternative was evaluated on each block. Many customary factors contained in the calculation of net profit were not distinguished individually in the profit and loss statements used to create the data set. The focus of this study was to investigate the impact on reported profit levels resulting from the adoption of lean strategies. In that light, only those measures that would be unique to a given management accounting method were separated in the profit and loss statements. For instance, cost items such as administrative salaries, depreciation, advertising, etc, were viewed as constants for all methods and as a result were not included in this study. Inventory carrying cost was considered significant in this study and thus became the sole, additional, factor included in the preparation of the income statements. The location in the income statement of the recognition of several other items of cost changed between gross and net profit categories depending on unique characteristics of the management accounting method being modeled.

ANOVA Results

Summary results for ANOVA testing on the effects of inventory reduction policy and management accounting method can be seen in Table 15. Monthly net profit as a percentage of sales was used as the dependent variable. The results imply that inventory reduction policy has a significant effect on reported gross profit at the $\alpha = 0.05$ level for all periods tested. Management accounting method was only

significant in April and June. The results also indicate that no interaction effect exists between inventory reduction policy and management accounting method at the net profit level.

Evaluation of Net Profit Mean Values

The results of the Tukey all pairwise tests on the means of net profit indicate the following: Each level of inventory reduction policy was significantly different from all other levels with policy 1, no inventory reduction, producing the highest mean value for reported net profit for the first six months of the twelve month period evaluated. Policy 3, 50% reduction in finished goods inventory over the first six month and no further reduction for the balance of the year, produced the lowest values for reported net profit during the same period. Starting with month seven and continuing through month twelve the mean values for policy 1 and 3 were not significantly different. Both policies produced higher values for reported net profit than policy 2 during the later period.

Results for management accounting method indicate that in ten out of the twelve months simulated there was no significant difference in mean value of reported net profit from any of the five methods. In January, the confidence interval lower limit for method 4 exceed zero by 3.260% when compared to method 1. If the confidence interval had contained zero, the mean values would be identified as not significantly different from method 1. Period March had a P value of 0.01 but all confidence intervals using the Tukey method contained zero, indicating no difference.

Table 15: ANOVA Results Summary for Net Profit

Month	Source	Approx. F	P value
Jan	Policy	226.46	0.000
	Method	5.56	0.000
	Policy*Method	2.21	0.025
Feb	Policy	53.43	0.000
	Method	1.96	0.099
	Policy*Method	0.45	0.890
Mar	Policy	75.21	0.000
	Method	3.33	0.010
	Policy*Method	0.82	0.589
Apr	Policy	66.73	0.000
	Method	2.90	0.022
	Policy*Method	0.76	0.642
May	Policy	80.60	0.000
	Method	2.27	0.061
	Policy*Method	0.83	0.575
Jun	Policy	67.48	0.000
	Method	1.16	0.326
	Policy*Method	0.86	0.549
Jul	Policy	21.13	0.000
	Method	1.10	0.356
	Policy*Method	0.23	0.985
Aug	Policy	18.83	0.000
	Method	0.54	0.705
	Policy*Method	0.16	0.996
Sep	Policy	29.37	0.000
	Method	1.36	0.245
	Policy*Method	0.25	0.981
Oct	Policy	32.65	0.000
	Method	0.07	0.991
	Policy*Method	0.33	0.955
Nov	Policy	21.59	0.000
	Method	1.14	0.335
	Policy*Method	0.27	0.977
Dec	Policy	24.77	0.000
	Method	0.37	0.832
	Policy*Method	0.29	0.970

Plots of the mean values indicate that inventory reduction policy 1, or no reduction in finished goods inventory level, resulted in the highest mean value for net profit for the months during which policies 2 and 3 were causing inventory levels to be reduced. In July, or mid way through the test period, when policy 3 ceased to reduce inventory, the mean values for policy 1 and 3 became equal.

Plots for management accounting method indicate that the mean monthly value for net profit reported by throughput costing was repeatedly the highest followed by direct costing. The mean values for the remaining three methods were not significantly different. Samples of the plots are included in Figures 12 and 13.

Plots of the mean values for the complete twelve-month series for net profit by inventory reduction policy are shown on Figure 14. This graph allows the differences in reported net profit to be more easily identified. Figure 14 displays the results using the full absorption method of costing. The numeric results will be different depending on the management accounting method due to differences in the way components of cost are recognized. However, the trend lines in Figure 14 are typical for all management accounting methods. The trend lines indicate that inventory reduction policy has a noticeable impact on reported gross profit. This chart identifies the magnitude of the decrease in reported net profit that results from the reduction in on-hand finished goods inventory. Inventory reduction policy 1, or no inventory reduction, reports the highest net profit for periods 1 through 6. The reported net profit for policy 1 is roughly 32% higher than policy 2 and 64% higher than policy 3 in the early months of the series. It was previously identified that during months 7 through 12 the curves for policy 1 and 3 coincided for gross profit. When looking at

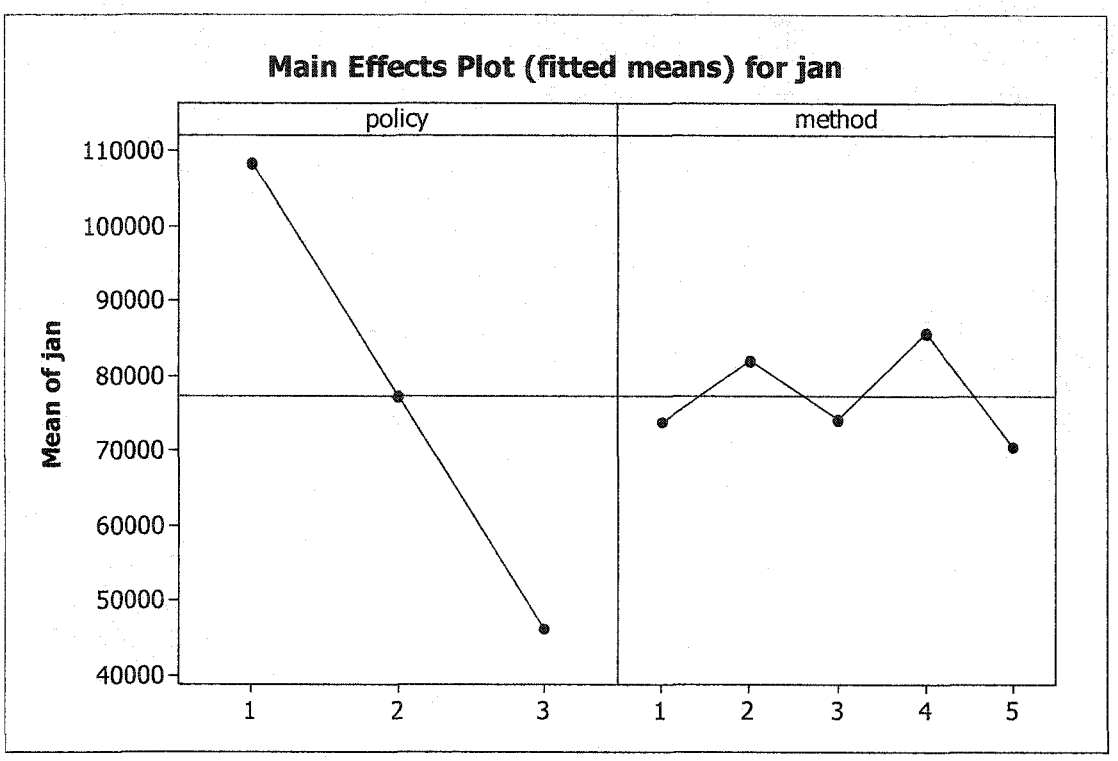

Figure 12: Sample Plot of NP Means, Typical for Months 1 – 6
Policy 1 – No Inventory Reduction, Policy 2 – 50% Reduction in Finished Goods Inventory Over 12 Reporting Periods, Policy 3 – 50% Reduction in Finished Goods Inventory Over 6 Reporting Periods and no Further Reduction. Method 1 – Full Absorption, Method 2 – Direct, Method 3 – ABC, Method 4 – TPC and Method 5 – Meade – Kinsinger

the same information in regard to net profit, however, the curve for policy 3 is at a higher level of reported gross profit. This can be explained as the impact from the benefit gained at the net profit level for a reduction in inventory carrying costs. As stated in Chapter II, the inventory carrying costs for this study were set at 1.5% per month of the inventory cost. It is however important to recall that the Tukey tests of mean confidence intervals did not find a significant difference between inventory reduction policies 1 & 3 for periods 7 – 12. The graph shows that when inventory level ceases to be reduced the reporting of gross profit returns to the level that would

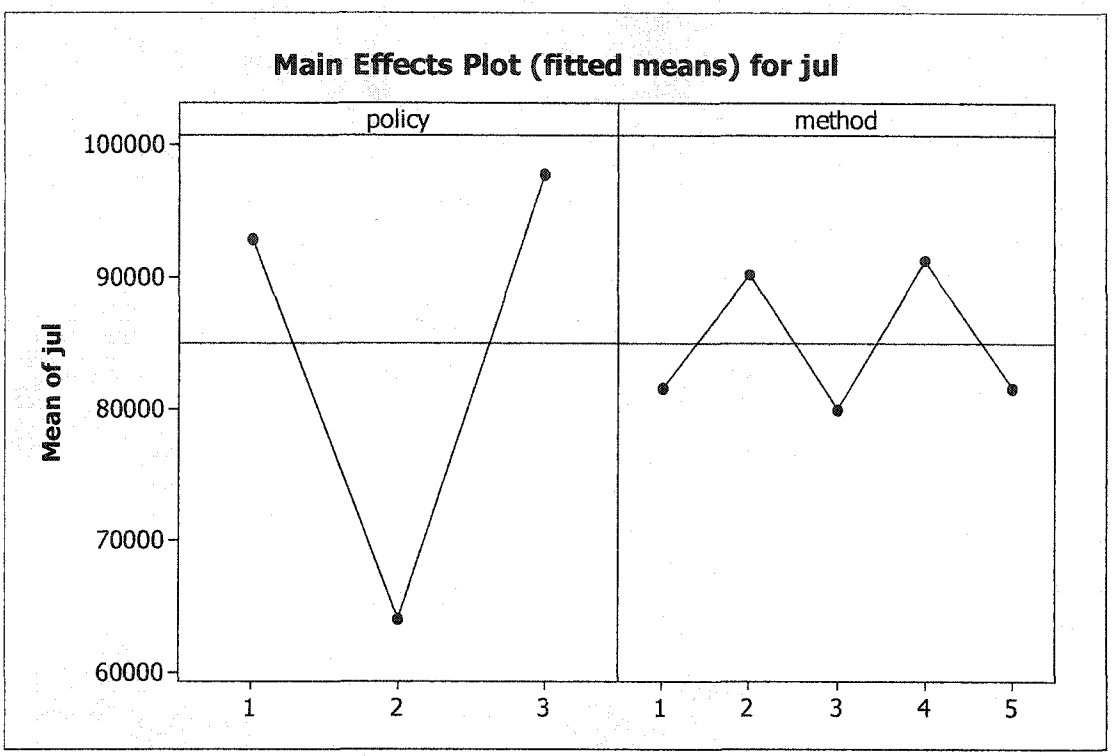

Figure 13: Sample Plot of NP Means, Typical for Months 7 – 12
Policy 1 – No Inventory Reduction, Policy 2 – 50% Reduction in Finished Goods Inventory Over 12 Reporting Periods, Policy 3 – 50% Reduction in Finished Goods Inventory Over 6 Reporting Periods and no Further Reduction. Method 1 – Full Absorption, Method 2 – Direct, Method 3 – ABC, Method 4 – TPC and Method 5 – Meade – Kinsinger

be experienced with no lean program with the addition of the benefit gained from a savings in inventory carrying costs.

The plot of mean values for policy 2 indicate that as long as inventory levels continue to be driven down, reported net profit will continue to be lower. Policy 2 reduces the target level for safety stock, in a linear fashion, by 50% of initial level over the course of the entire studied period. Figure 14 supports the previously discussed results that indicated that inventory reduction policy had a significant affect

on reported net income with all mean values being significantly different in periods 1 – 6, and only policy 2 being significantly different in periods 7 – 12.

In Figures 15, 16, and 17 the mean values from the 35-replication data set for inventory policy can be seen plotted with the mean inventory level, shown in dollars. Trend lines are added for reported net profit to more clearly display the changes in this measure over time. Figure 15 shows the data for inventory reduction policy 1. This figure can be thought of as the baseline for the 35-replication dataset. The trend line shows a slightly increasing trend over time. If a second series of 35 replications was collected this trend line could become flat or slightly decreasing. Sample data collected while developing the model exhibited this condition and can be considered a function of the stochastic nature of the model. Figure 16 and 17 use the same baseline data allowing direct comparisons to be made between the figures. Inventory reduction policies 1 and 2 exhibit an essentially flat reported gross profit for the studied period

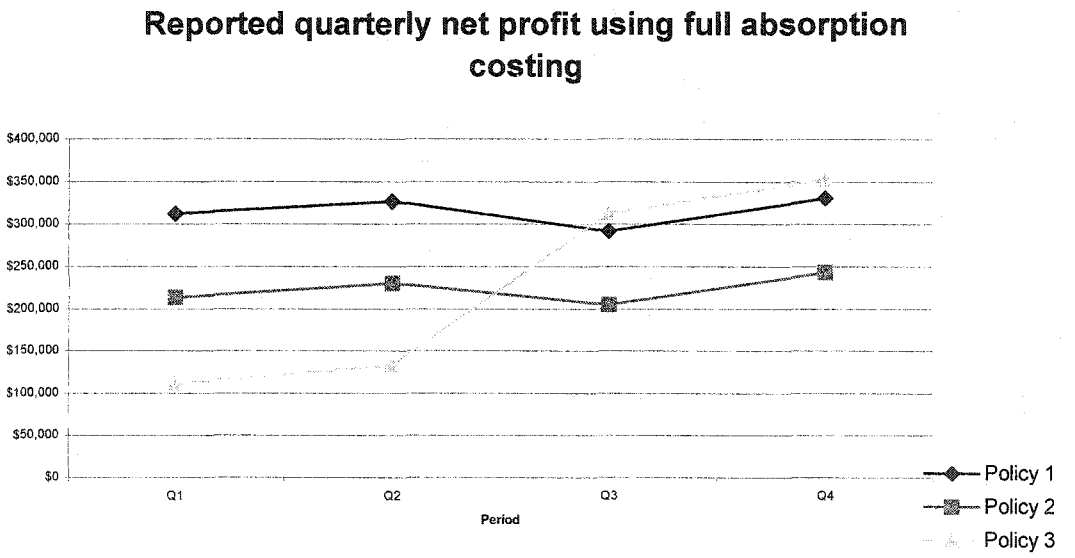

Figure 14: Trends of Reported Net Profit by Inventory Reduction Policy, Typical for All Management Accounting Methods

implying that if the rate of inventory reduction is a constant then the reported level of gross profit will also be constant. Therefore, if the rate of reduction is linear over time, regardless of the slope, the trend of the reduction in reported net profit would be parallel to other reduction slopes including zero or no reduction. The greater the slope, the lower the reported net profit. The noticeable difference in the slope of the trend line in Figure 17 is explained by the effect that ceasing further reduction has on the reported level of net profit. This graph has essentially two significant periods. In months 1 – 6, a trend line would again be parallel to Figures 15 and 16. In addition, a trend line of periods 7 – 12 would be parallel to the other figures. This is due to the fact that in each period the rate of reduction is linear, downward in the first period and flat in the second. In the second period, it can be seen that the values for reported net profit are roughly equal to those reported under policy 1 in Figure 15.

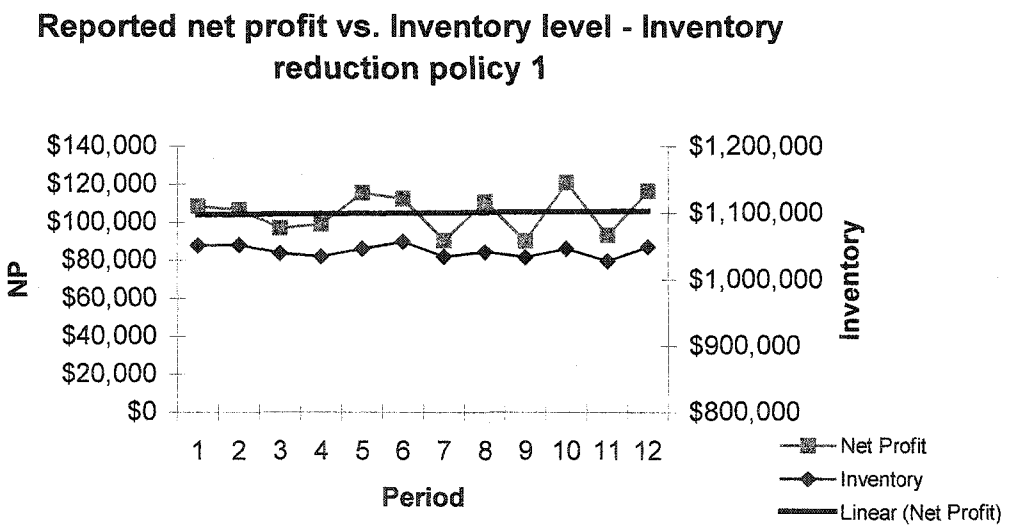

Figure 15: Trend of Reported Net Profit Under No Inventory Reduction, Using Full Absorption Costing

Figure 18 displays the differences in reported net profit as a result of management accounting method. The curves included in this figure are the result of inventory reduction policy 3, aggressive reduction periods 1 - 6 and no further reduction periods 7 - 12. As can be seen from the plots, the five curves are essentially parallel but stratified in periods 1 - 6 when inventory is being rapidly reduced. The curves then come together in periods 7 - 12 when inventory is no longer being reduced. This differs substantially from the earlier chart of gross profit. What Figure 18 shows is what occurs between the various systems under a period of change and under a stable environment. In a stable environment all methods report essentially the same results at the net profit level. At the net profit level, all the various cost components have been recognized by all systems meaning, items that are identified as fixed costs in one system and variable in another are included in the calculation of net profit. Therefore, by design all methods should report the same results under

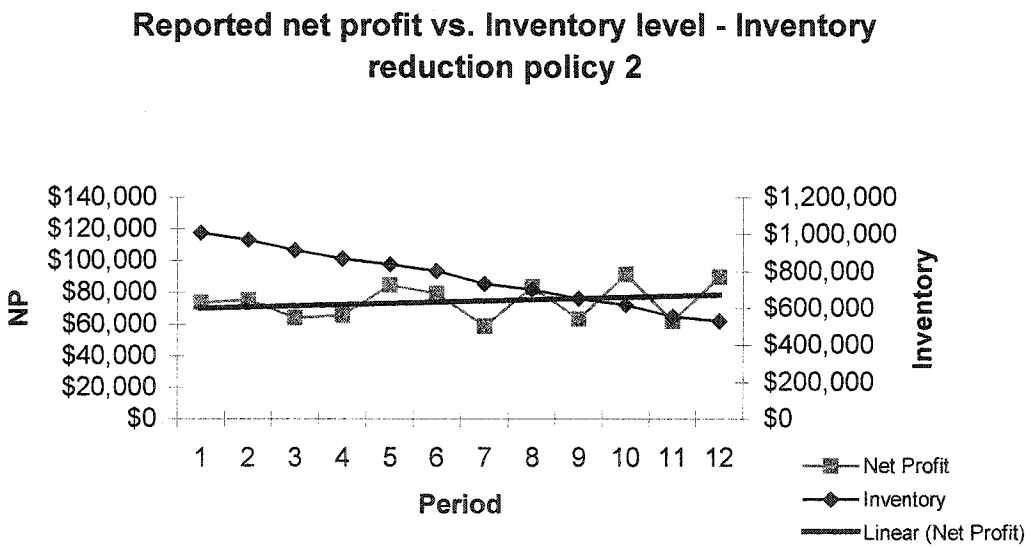

Figure 16: Trend of Reported Net Profit Under Moderate, Linear, Inventory Reduction Throughout the Modeled Period, Using Full Absorption Costing

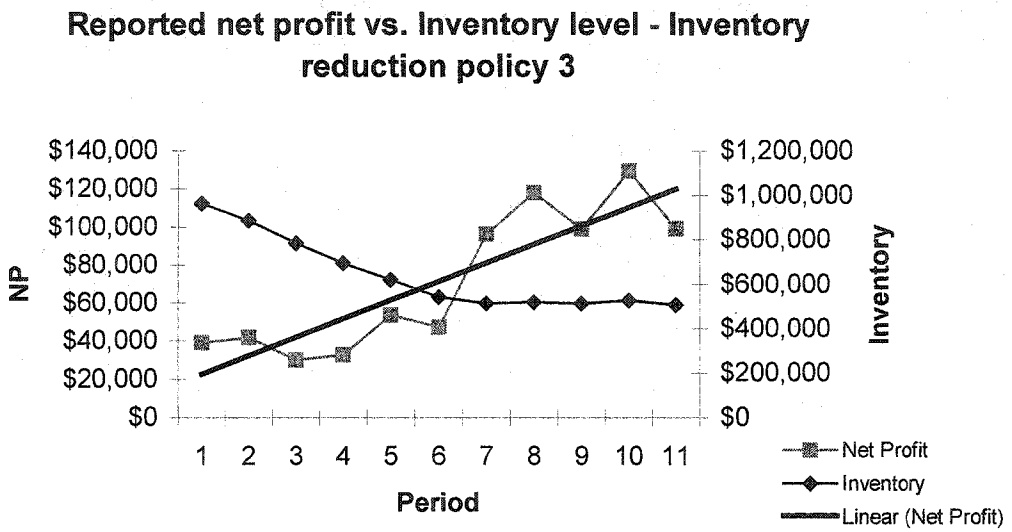

Figure 17: Trend of Reported Net Profit Under Aggressive, Linear, Inventory Reduction in Periods 1 – 6 and No Further Reduction in Periods 7 – 12, Using Full Absorption Costing

a stable environment. However, in an unstable environment the reported results are vastly different. Methods that include more of the operational cost components in product cost (variable) for inventory valuation purposes show a greater reduction in reported net profit when product is removed from inventory. Full absorption, activity based, and the M-K costing methods fit this category. Direct includes fewer of the operational cost components in the calculation of product cost and throughput includes fewer yet. This figure displays the magnitude of the differences in the recognition of cost components between the various management accounting alternatives. However, ANOVA tests on the mean values for all methods indicated that management accounting method did not have a significant impact on reported net profit in nine of the eleven months tested. Under net profit, all of the various operational components of cost are accounted for. This has the effect of bringing the reported values from the various methods back together. The variation induced by the stochastic nature of this study led to an inability to determine differences in mean

values for net profit between methods.

Sensitivity to Sales Variability

ANOVA testing was used to evaluate the effect on net profit resulting from the level of variability in the actual sales as compared to the forecast. Three settings were used to create the data set. The settings were 10%, 25%, and 40% of the forecasted value. These factors were used as the value for the standard deviation when using random numbers to create a normally distributed random number for sales with a mean equal to the forecast value. The ANOVA results are shown in Table 16. The p values indicate that a difference in the mean values of net profit between settings was not identified.

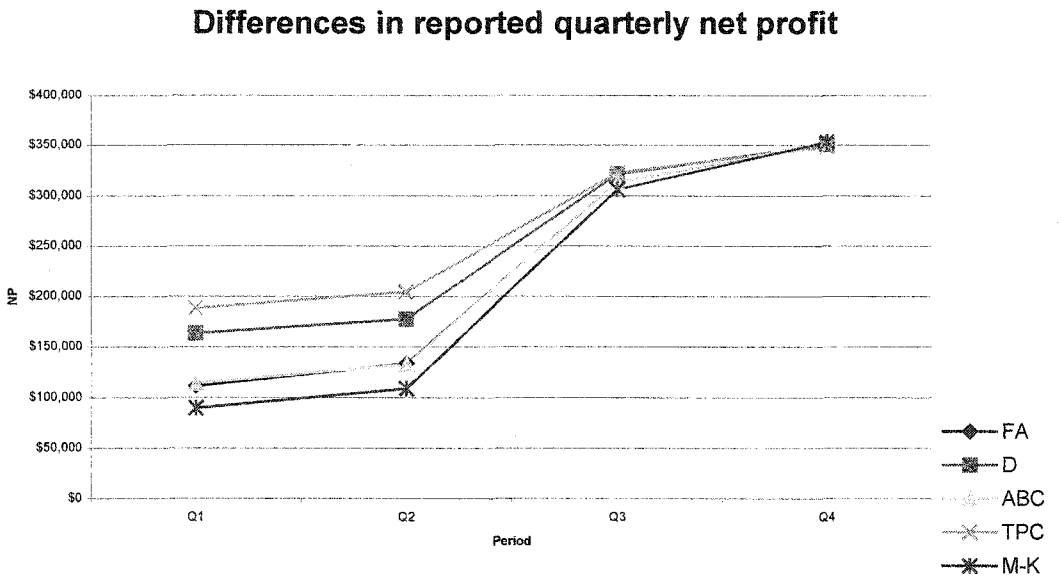

Figure 18: Trends of Reported Net Profit by Management Accounting Method, Inventory Reduction Policy 3 by Quarter

Service Level

Service level for this study is concerned with the ability to meet customer demand in each of the monthly periods modeled. If inventory was not sufficient to satisfy the demand in a given month, the sale was considered to be lost. Therefore, unsatisfied demand was not carried forward to be satisfied by a future months production output. If demand in a given month exceeded available inventory levels, a stock-out situation occurred. The total number of stock-out conditions, under the three inventory reduction policies, was captured in the data set generated for this study.

Table 16: ANOVA Results for Variation in Sales From Forecast

	10% Variation		25% Variation		40% Variation	
Month	Approx. F	p	Approx. F	p	Approx. F	P
Jan	4.17	0.018	4.17	0.018	4.17	0.018
Feb	6.74	0.002	6.21	0.003	5.93	0.004
Mar	2.63	0.077	3.10	0.49	3.29	0.041
Apr	1.40	0.250	1.53	0.221	1.43	0.243
May	1.13	0.328	0.45	0.640	0.42	0.655
Jun	0.77	0.467	0.59	0.558	0.50	0.607
Jul	0.98	.0380	0.99	0.375	1.24	0.294
Aug	1.11	0.333	1.01	0.369	1.03	0.362
Sep	0.72	0.490	0.64	0.532	0.66	0.519
Oct	0.94	0.394	0.73	0.483	0.60	0.548
Nov	0.56	0.573	0.98	0.377	0.95	0.389
Dec	1.87	0.159	1.72	0.184	1.42	0.247

This information was analyzed using one-way ANOVA in an effort to determine the affect of inventory reduction policy on service level. It is important to recall that the sales demand in this study displayed a significant level of volatility, as explained in Chapter II. Therefore, as safety stock target levels decreased the danger of a stock-out situation occurring increased. The results of the ANOVA test are shown below in table 17. The test indicates that inventory reduction policy is indeed significant in terms of the impact on the occurrence of stock-out situations. A Tukey test on the mean values for inventory reduction policy indicate that there is no significant difference in the means for policy 1 and 2. Policy 3, however, was significantly different from the other two and was the highest value of the three. Highest in this case meant more stock-outs. Therefore, reduction of the safety stock target level to 50% of the initial target over a period of six months, and then holding the target level through the balance of the year, resulted in more stock-outs than no reduction in target level or a 50% reduction in target level over a 12-month period.

Table 17: ANOVA Results, Stock-Outs Attributable to Reduction Policy

Source	**DF**	**SS**	**MS**	**F**	**P**
Policy	2	86.82	43.41	19.59	0.000
Error	87	192.83	2.22		
Total	89	279.66			

Results of ANOVA testing in regard to stock-outs resulting from variations in actual sales as compared to the forecast are shown in Table 18. The ANOVA table indicates that volatility in sales is indeed significant in terms of the impact on the

occurrence of stock-out situations. Tukey tests on the mean values for sales variability indicate that there is no significant difference in the means for policy 1 and 2. Policy 3, however, was significantly different from the other two and was the highest value of the three. Highest in this case meant more stock-outs. Therefore, using a standard deviation of 40% of the forecast value to calculate a random sales number resulted in more stock-outs than a standard deviation of 10% and a 25% of the forecast value.

Table 18: ANOVA Results, Stock-Outs Attributable to Sales Variation

Source	DF	SS	MS	F	P
Variation	2	3902.60	1951.30	64.71	0.000
Error	87	2623.50	30.20		
Total	89	6526.10			

Sensitivity Analysis

Monte Carlo simulation software (Crystal Ball) was used to perform a sensitivity analysis on a series of composite income statements assembled using mean values from the 35-replication data set. The purpose of the analysis was to determine what level of operational savings, in various areas of the income statement, would be required to offset the reported reductions in profit resulting from the decrease in inventory. The categories identified for cost reduction were inventory carrying costs, indirect labor, and direct labor. These are three areas where operational improvements are often recognized through the successful implementation of lean strategies. Three income statements were assembled for testing, all using data from the 25% sales

volatility data set. The three income statements represented a 12-month cycle for an operation under each of the three inventory reduction policies. The dependent variable tracked for comparison was the annual net profit. In the sensitivity analysis, varying values for improvement were applied to these categories on the income statements, on a trial-and-error basis, in order to identify what level of savings would be required in order to end a year at a similar profit level, under each reduction program. Figures 19, 20, and 21 display the distributions created by Monte Carlo simulation when the following settings were used:

Direct labor reduction: 0 - 3%

Carrying cost interest rate: 3 - 5%

Overhead cost reduction: 10 - 20%

The distribution depicted in Figure 17 is for policy 1 and represents the spread that would result from the variation in carrying cost interest rate. This distribution centers on an annual net profit of approximately 13%. The second and third policy distributions represent the benefit from labor, indirect cost, and savings from lower carrying costs. Policy 2 centers on approximately 12.5% annual net profit and policy 3 centers on approximately 13%. Therefore, at the above settings the annual net profits are nearly equal. Stated another way, at a carrying cost rate of 3-5% on the cost of inventory, a savings of 0-3% in direct labor, and with a 10-20% reduction in other indirect costs would need to be realized, throughout the year, in order to offset the reported negative impact from a reduction in inventory of 50% over the course of the year.

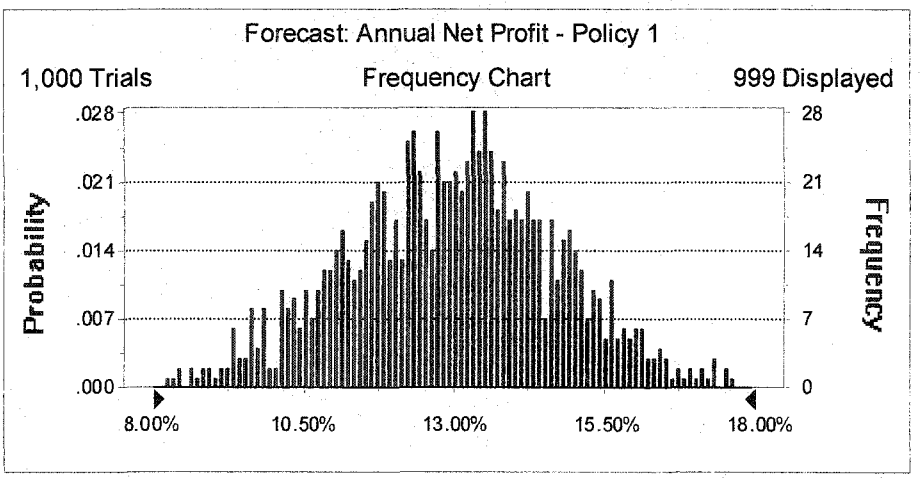

Figure 19: Distribution of Annual Net Profit From Monte Carlo Simulation, Inventory Reduction Policy 1

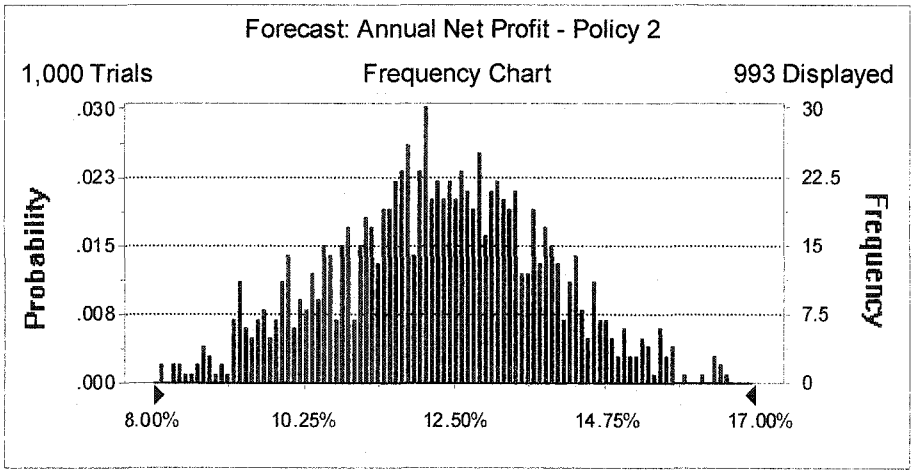

Figure 20: Distribution of Annual Net Profit From Monte Carlo Simulation, Inventory Reduction Policy 2

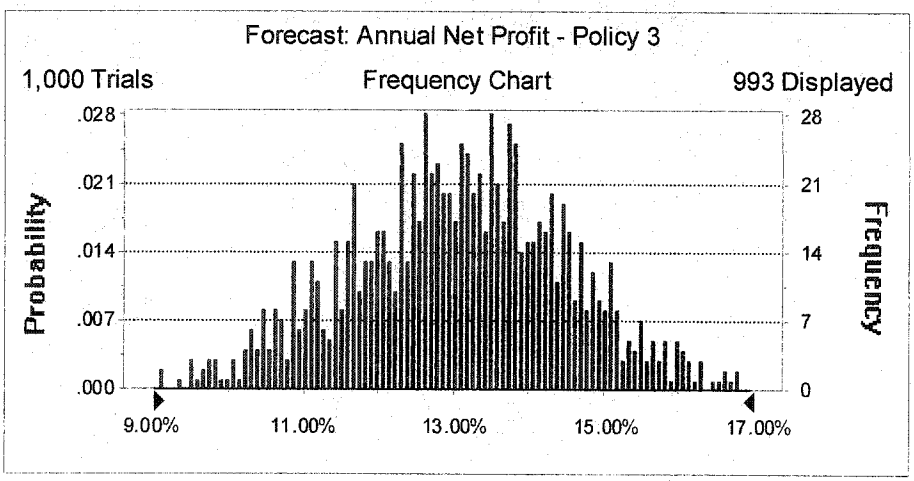

Figure 21: Distribution of Annual Net Profit From Monte Carlo Simulation, Inventory Reduction Policy 3

CHAPTER V

CONCLUSIONS

The purpose of this study was to investigate and compare the impact of a lean manufacturing program upon various internal and external operational performance measures, as reported by a number of differing management accounting methods. Previous chapters introduced the focus of the research, provided a review of the existing literature surrounding the issues researched, described the experimental design and research tools employed, and reviewed the results in terms of the research questions at the center of this study. This chapter will provide a summary of the research findings. In addition, limitations of the models and evaluation methods will be discussed as well as direction for future research.

Summary of Research Findings

The findings in this study demonstrate the significance of the impact on two of the key external performance measures used by manufacturing firms throughout the U.S. and U.K. In addition, the impact on the internal measure of shipping performance is also quantified and evaluated. A summary of the results of the testing of the research questions presented in Chapter II of this document is shown in Table 19. The findings contained within this document pertain to an operation with the following characteristics:

1. A repetitive manufacturing environment that follows a build-to-stock model
2. Multiple manufacturing cells dedicated to families of products
3. Manufacturing routings that contain 15 to 20 processing steps

4. Processing times that are normally distributed with a standard deviation of 10 – 20% of the mean processing time, N[μ, (.1 to .2) μ]
5. Set-ups required between orders of different products within a family
6. Significant differences in sales volume within families of products, such differences following a pareto distribution (20% of products accounting for 80% of sales volume)
7. Volatility in sales demand from month-to-month (forecast error) – normally distributed with a mean equal to the sales forecast and a standard deviation equal to 10 to 40% of the forecast, N(forecast, 10 - 40% of forecast), resulting in a demand that ranged from 0% of forecast to 220% of forecast 95% of the time and exceeding the upper end of this range 2.5% of the time
8. Standard overhead rates based on labor hours and ranging from 150% to 250%

As can be seen from the above list of characteristics, the results of this study would allow inferences to be made for a broad segment of operations throughout the manufacturing community.

The concern at the forefront of this study is that traditional financial reporting practices do not support the adaptation of those lean manufacturing practices that lead to a lowering of on-hand inventories. Elimination of all waste is the central focus behind lean manufacturing. In this light, excess inventories are considered a primary measure of waste. Therefore, any lean manufacturing program will lead to a lowering of inventory levels. The reduction in inventory leads to a shift in the location of

Table 19: Results of Hypotheses Tests

Hypotheses:	Result:	Page(s)
H_1: Within a given management accounting method, does rate of inventory reduction have an effect on reported gross profit?	$H_{1,0}$: was rejected	75-82
H_2: Within a given management accounting method, does rate of inventory reduction have an effect on reported net profit?	$H_{2,0}$: was rejected	85-93
H_3: Within a given inventory reduction policy, does the management accounting method have an effect on reported gross profit?	$H_{3,0}$: was rejected	75-82
H_4: Within a given inventory reduction policy, does the management accounting method have an effect on reported net profit?	$H_{4,0}$: was accepted	85-93
H_5: For a given inventory reduction policy, does the management accounting method used have an effect on reported gross profit?	$H_{5,0}$: was accepted	70
H_6: For a given inventory reduction policy, does the management accounting method used have an effect on reported net profit?	$H_{6,0}$: was accepted	71
H_7: Does inventory reduction policy have an effect on the customer service level, measured by stock-out's, under the production and market environment modeled in this study?	$H_{7,0}$: was rejected	95
H_8: Does volatility in the sales demand have an effect on reported gross and net profit under the production and market environment modeled in this study?	$H_{8,0}$: was accepted	93-94
H_9: Does volatility in the sales demand have an effect on the customer service level, measured by stock-out's, under the production and market environment modeled in this study?	$H_{9,0}$: was accepted	96

recognition of the inventory costs, reporting period by reporting period. This shift is from the balance sheet, where the inventory is categorized as an asset, to the income statement. This shift results in a negative effect on the reported gross and net profits.

The research has shown that the magnitude of the impact on these external measures is influenced by the aggressiveness of the lean program. Under a moderate rate of inventory reduction, the drop in the performance measure of gross profit was nearly 30%. Under an aggressive rate of reduction, the performance measure for gross profit decreased nearly 60%. Results of this sort would lead to great concern in the viewpoint of a stakeholder.

This reductions in reported gross and net profit continued as long as inventory continued to be lowered. A linear reduction program, where inventory was reduced at a steady rate over a series of months resulted in a uniform lowering of the gross and net profit. When inventory reduction ceased, the gross profit figure immediately returned to a level equal to the baseline condition of "no reduction." The net profit rose to a level that exceeded the baseline condition due to the benefits of reduced carrying costs. However, this improvement was not substantiated by ANOVA testing. The improvement was evident when the mean values were graphed but the increase was not found to be significantly different using pair wise comparisons on the means. This indicates that the benefit gained from a reduction in carrying costs, when carrying costs are calculated at 1.5% per month of the inventory value, were not distinguishable. The stochasity built into the model, both in the sales level and in the production capacity of the manufacturing model, likely lead to a high level of variation in the individual measures for gross and net profit. This would lead to an

inability to identify a significant difference between the mean values for the base line and the reduced inventory steady-state conditions for net profit.

The key issue that must be kept in the forefront when evaluating the results discussed here is that the decreases in reported gross and net profit are, in a sense, a report on past poor performance. The fact that the reductions in reported gross and net profit coincide with the operational improvements brought by a lean program are unfortunate. The source of the problem, which ultimately led to the decline in the financial reports, is overproduction in past periods. Overproduction in traditional management accounting systems is recognized as an asset and is tracked on the balance sheet where it does not directly impact the income statement in the period in which it was produced. In a sense, overproduction is viewed as a positive by management accounting systems. Operations managers realize that they can increase machine utilization, a typical internal performance measure in manufacturing, by producing in excess of demand if necessary. When this occurs, the income statement for the period does not suffer, as the overproduction is moved to the balance sheet for tracking purposes. Included in the costs of the overproduction could be direct labor, direct materials, as well as factory overhead, depending on the management accounting method in use. Recognition of these stored costs is avoided in the current period and therefore does not negatively impact the income statement at that time. When this occurs, carrying costs on the overproduction begin to accrue immediately. In addition, the risks of obsolescence or damage now exist. In order to later liquidate this inventory without negatively impacting the income statement, offsetting costs in other areas must be identified and eliminated. The costs that fit this category would need to be period costs that can be eliminated short-term to provide the balancing

transaction. Such costs are difficult to identify. Some authors argue that all costs are fixed in the short term, meaning that it is difficult to eliminate costs on an immediate basis. As a result, it is inevitable that reported operational performance would be negatively impacted by a lean program, particularly in the early months. The negative impact will continue until the benefits of reduced inventory carrying costs, indirect labor, scrap, and obsolescence costs reach a level sufficient to offset the negative impacts of the management accounting methods or until the inventory reduction subsides.

Also of interest in this study was the incidence of stock outages that occurred that could be identified as attributable to the lean effort. ANOVA testing identified that a difference did exist between the mean number of stock-outs between the three-inventory reduction policies modeled. Tukey tests on the means identified that the only mean that was different was that of the aggressive reduction program. The substantial variability in the sales demand created a risky environment as inventory levels were lowered. Safety stocks levels were initially two times forecast for the high volume products. This target was reduced to 50% of the initial in both inventory reduction policies. As stated earlier the actual sales demand in any one month period could range from 0% of forecast to 220% of forecast, when the stochasity factor was set at the highest level with the standard deviation equal to 40% for the forecast value. Lower safety stocks offered less protection in the event that the latter occurred. In the extreme case of sales stochasity, with the standard deviation of the normal distribution equal to 40% of the forecast values, the incidence of stock-outs was nearly ten times the quantity for inventory reduction policy 3 than the number of stock-outs under the mid value for stochasity, 25% of the forecast value.

Comparison to Previous Studies

Previous research has chosen to focus in the area of evaluating which combination of manufacturing environment and management accounting system results in superior firm performance (Lea, 1998, Boyd, 1999). Net profit and total net profit are used as the metric for evaluation. Total net profit is defined as the accumulation of period net profit over some given time horizon. The current research is not concerned with the evaluation of manufacturing methods in an effort to determine the best. It is an extremely difficult problem to identify the best manufacturing environment in terms of short or long term profit. MRP or batch may be superior to JIT in ship building for instance, while TPC or theory of constraints may be superior to JIT and MRP in industries with very high capital equipment costs. Lean strategies, on the other hand, can be defended in nearly any manufacturing environment. It is true that lean strategies would be most closely aligned with a JIT method of manufacturing, but aspects of lean could be applied to any manufacturing environment. If the strategies implemented had the effect of reducing on-hand inventories then the impact on the income statement as previously discussed would be present. The research discussed in this document assumes that the benefits to a firm, which will come as the result of the adaptation of lean strategies, are evident and that lean has been accepted as the improvement strategy of choice. Additionally, this study accepts the fact that management accounting methods, required for the external reporting of operation performance, cannot be changed in the near future. It is believed that this view positions this study to be much better aligned with real-world application.

Implications for Practice

The issue of greatest significance that was quantified by this research has to do with the ability of the financial reporting system to effectively erase the operational improvements brought by a lean manufacturing program during the initial stages. This issue is identified in the literature (Womack and Jones, 2003) but no previous study has explored the significance of this issue. This study has identified that the negative impact resulting from the shift of assets from the balance sheet to the income statement is essentially impossible to offset in the short term with operational savings brought by the lean program. It has been further identified that it is very likely that the financial reports will continue to report poorer firm performance until the decrease in inventory level ceases. This is due to the significant influence that the transfer of assets from the balance sheet to the income statement has on reported gross and net profit. This means that the problems in the design of the financial systems will cause a perceived decrease in financial performance of the firm for many months and possibly years while a firm works toward bringing down inventory levels. If this issue is not well understood by the leadership of the firm and the other significant stakeholders, issues will arise with the lean program. These issues could easily result in resistance to the continuation of the program as stated by Cunningham and Fiume (2003),

> "Managers who use standard cost-based financial statements say; I don't know what you're doing, but whatever it is, stop it. Your killing profits."

Armed with an understanding of the inevitable impact on the financial reports, managers of firms initiating lean manufacturing programs would be in a better position to be successful. This could be accomplished by pre selling projects with the understanding that the reported gross and net profits will go down fictitiously

throughout the initial months following the initiation of the program. Using a model following the design of the Excel model used for this study, a manager could emulate the impact on the financial statements allowing them to predict, for a future range of months or quarters, what the actual impact would be. The more complete the model the better the prediction, understanding that many uncontrollable variables would need to be included in the model. The knowledge of the fact that gross and net profit will decreased during the initial stages of the lean program, specifically while inventories are being reduced, will help to prevent the program from stalling. Having the ability to accurately quantify the magnitude of the decrease through a range of months or quarters would result in an increase in the confidence level in the implementation team. The model in this study identified that a decrease in net profit of nearly 1/3 would be realized under a lean manufacturing program that would have the effect of reducing on-hand inventories by 50% over the course of one year and a reduction of 2/3 would be experienced if the inventory levels were reduced at twice that rate. It was also identified that in the second case the reductions would continue for two quarters followed by an immediate return to previous reported levels of profit plus the gains from a lower inventory carrying cost. In an actual operation, additional benefits would be identified prior to the initiation of the project that could be quantified and added to the projections for pre-selling purposes. These abilities would significantly reduce the risks of a lean program becoming stalled due to pressures from stakeholders who use gross and net profit as a measure of financial health. Additionally, having the ability to predict the impact on key financial measures would provide an additional tracking tool to the project manager.

Another important conclusion of this research is that the management

accounting system can have a significant impact on the scale of the reported decreases in gross and net profit. The management accounting systems that include fewer cost categories in the attached costs of a product are more favorable to lean programs. These systems include direct costing and throughput costing, throughput being the least detrimental to a lean program. Unfortunately, neither of these systems is approved by the Securities and Exchange Commission and the Internal Revenue Service for external reporting. The systems most common throughout the manufacturing community, full absorption and ABC (Drury and Tayles, 1997), report the largest reductions in gross and net profit. However, reductions in gross and net profit will be reported regardless of the management accounting system used if the lean program leads to a reduction in on-hand inventories. For this reason, it is very important that additional metrics be established that will reflect operational improvements in the period in which they occur. Cash flow is a traditional measure that should be given a greater level of influence during a lean program, as it is a measure that will track the positive aspect of liquidating inventories. Additional metrics should be established that would track improvements in direct and indirect labor on a monthly basis. These improvements will be masked in any of the known management accounting systems except throughput costing. The reason for this is that the inventory being liquidated includes stored costs for direct labor and indirect labor. Until the reduction ceases, these stored costs will continue to confound the current financial reports.

An additional interesting discovery of this research has to do with the similarities in reported gross and net profit between the Meade-Kinsinger (M-K) costing method and the most commonly used method of full absorption costing

(Drury and Tayles, 1997). The two methods followed similar trend lines for gross and net profit under all inventory reduction policies. This implies that the M-K method, as well as the Activity Based Costing (ABC) method, emulate the performance of the method approved for external reporting by the SEC and IRS, meaning that the M-K method is absorbing manufacturing costs proportionally to full absorption. However, the overhead rates that the M-K method uses are significantly different from either full absorption or ABC costing. The reason for the difference, as explained in Chapter III, is that the M-K method applies overhead costs using sales transactions as the allocation base as opposed to direct labor or some other traditional approach. The result of this allocation scheme shifts a greater proportion of the overhead costs to the low volume products. This results in a moderate decrease in product cost to high volume products while substantially increasing product costs of the low volume items. This shift would have a monumental impact on product mix decisions for production planners, sales managers, and other product line decision makers. Traditional allocation schemes are commonly attacked in the literature [Johnson and Kaplan (1991), Druery and Tayles (1997)]. The issue cited is that the allocation schemes do not allow an appropriate proportion of indirect costs to be allocated to the appropriate product. ABC attempts to correct this problem through a more elaborate system of allocation. Unfortunately, ABC has proven to be difficult and costly to maintain. The M-K method on the other hand has the benefit of being no more difficult to maintain than a full absorption system using direct labor as the allocation base, while moving closer to the product costing accuracies offered by ABC. The M-K method has the potential of providing product costs that are more accurate than ABC in situations where cost allocation is accomplished through product families verses individual products. The significance here is that better product cost

information will lead to better decisions relating to product mix and financial management.

Limitations

This research is the first study of the longer-term dynamics of the impact on reported financial performance of a firm that results from the implementation of lean manufacturing strategies. Several interesting discoveries are presented and quantified but the reader must be cautioned that the results are unique to the operational characteristics modeled. However, as was stated previously, the modeled environment had many factors and attributes that would be common in a broad cross-section of manufacturing. Therefore, the findings contained within this study have application beyond the restrictions of the modeled environment and can be safely generalized to other operational situations.

The limitations of this study are primarily in the area of model operational mechanics and robustness. Further integration of the tools developed for the creation of the data set would allow different scenarios to be run more easily. For instance, the tools provide for the entry of several operational factors, such as a rate for inventory carrying cost or rate of inventory reduction, that provide for flexibility in matching operational characteristics of other model firms. However, once changed, a new data set must be run. The current interface between software packages requires a substantial manual effort. Automating the interface would allow new data sets to be generated for a large variety of operational scenarios, further expanding the body of knowledge in this area.

This study is limited to the manufacturing parameters described earlier in this chapter under the heading of Summary of Research Findings. More specifically, the simulation model contained three manufacturing cells, each supporting a specific product family. The numbers of operations were 18 for product family 1, 23 for product family 2 and, 18 for product family 3. Product families consisted of 10 products per family. The sales demand level within a family was distributed in a pareto fashion with 50% of the family volume coming from one product, 36% from a second, 4% from the third and the remaining 10% distributed across the other seven products in a descending manner. This distribution is common in firms with multiple items within a family of products (Kinsinger, 2003). The allocation base was direct labor and a 200% rate was used to determine manufacturing overhead for full absorption costing. Family rates were used for activity based costing and were 150%, 200% and, 250% for families A, B, and C respectively. Inventory carrying costs were set at 1.5% per month calculated on the ending inventory value each month for the full absorption cost method. No other operational benefits were modeled and impact quantified. Reduction of indirect labor, reduction in scrap costs due to obsolescence, improvements in on-time shipping performance are all parameters that could be added to the model, enhancing the model's ability to more closely emulate a real world application.

Many additional scenarios of model parameters can be envisioned that, if studied, would lead to a better understanding of the impact of this problem within a specific manufacturing operation. In addition, the study does not account for down times attributable to machine failure or material shortages, quality related problems, absenteeism, etc. Additionally, many items have been left out of the calculation for

gross and net profit that would be present in a standard income statement. In order to be able to directly apply the calculated results from the modeling tools, these items would need to be added to the model. Their impact was viewed as uniform across management accounting methods in regard to this study and was therefore not included.

Suggestions for Future Research

As the scope of this study provides only a limited understanding of the issues discussed the following recommendations for expansion of this research is presented.

Expansion of time horizon

In application, it may be difficult to invoke the reductions in on-hand inventory at the rates modeled in this study. It would also be presumptuous to assume that all manufacturing operations would be able to work within the same time window of twelve months for the implementation of a lean program. Extending the models time horizon would allow much more flexibility in matching the simulated environment with the real world environment. An additional benefit from the expansion of the time horizon would be that results of gross and net profit could be evaluated for a series of years instead of months. This information could be used to communicate the long-term projected benefits of a lean program after the stakeholders have been informed of the short-term impacts that are expected.

Expansion of the number of inventory reduction policies modeled per data set

It would be interesting to see the results of more then three inventory reduction policies per replication of the model. The current model included no

inventory reduction, 50% reduction in safety-stock target level over the course of twelve months and, 50% reduction in safety stock target level over six months and then level for the balance of the year. Once the parameters are chosen for inventory carrying cost, sales volume distribution within a family and, time horizon for the study more could be learned by generating data from a broader set of inventory reduction scenarios. Reduction rates other than linear over a series of months would be more likely in practice and of significant interest from a research standpoint.

Customer service level measures

The measure of customer service level for this study was limited to counting stock-out situations. In the event of a stock-out, the sale that caused it was lost. An expansion of the model could include measures for fill rate, days late and lost sales based on model parameters.

Reduction in reporting cycle

Reducing the model execution cycle from a monthly schedule to a weekly or daily schedule would substantially enhance the tool's ability to model a real-world operation. This improvement would not be practical without and automated interface between software packages. This enhancement would be particularly enabling to the modeling of a just-in-time operation.

Expansion of income statements

Expanding the income statements to include all cost categories of the operation to be modeled would be necessary in order to be able to directly apply the results from the simulation to projections for the operation. This expansion would

move the model from being a generic tool with broad application to one with limited application, but with substantially better accuracy in regard to the application of the results. Thought should be given to the creation of a user interface within the Visual Basic application that would allow users to customize the tool for their application by selecting operational parameters, filling in data windows and, importing data files from actual operational performance for model set up purposes.

Use of distributions other than normal

In this study, all programmed model variability utilized a normal distribution. The argument for the use of this distribution is as follows:

1. Sales variability from forecast: It was the developers opinion that there is typically an equal likelihood of missing the sales forecast on the high side as on the low side. In addition, there is a greater likelihood of the forecast missing the actual sales figure slightly than missing it substantially. For these reasons normal was chosen.

2. Processing time variability: The manufacturing system modeled in this study was based on an operation that incorporated a significant level of manual operation, i.e. little automation. It was the developers opinion that, with manual operations, there is an equal likelihood of an operation finishing before the standard time as after. In addition, the likelihood of finishing near the standard time is higher than significantly early or late. Therefore, the normal distribution was chosen as the most appropriate.

The use of distributions other than normal could result in significantly different results. A strong case could be made for the application of other distributions if the design assumptions were changed. For instance, if a highly automated process was being modeled, the negative exponential or Weibull may be more appropriate choices with the likelihood of more operations ending above the mean than below. This expansion of the model would provide a more robust understanding of the impact on

the financial measures resulting from a lean program.

Further development of the Meade-Kinsinger product costing method

The M-K method for allocating overhead costs offers significant advantages over systems in use today. The M-K method provides allocation factors that follow the logic of ABC costing to a certain degree without the significant costs of maintenance common with ABC systems. The fact that the M-K method includes all the components of costs, including direct labor, direct material, and factory overhead, make this method a candidate for becoming an approved system for external reporting purposes. The focus of this study was in an area that did not allow the potential of the M-K method to be quantified or understood. Future research activity should focus in the area of identifying differences in firm financial performance resulting from the application of the M-K method in product mix decisions. An additional aspect of future work in this area should focus in the area of verification of the accuracy of the M-K method in identifying actual product costs when compared to established methods.

REFERENCES

Boyd, L. H. (1999). Production Planning and Control and Cost Accounting Systems: Effects on Management Decision Making and Firm Performance. *Doctoral Dissertation*, Ann Arbor, MI: UMI Co.

Chandler, A. (1977). *The Visible Hand: The Management Revolution in American Business*. Cambridge, Mass.: Harvard University Press.

Cooper, R. & Kaplan, R. S. (April 1988). How Cost Accounting Distorts Product Costs. *Management Accounting,* vol 69, No. 10, pp. 20-27.

Cunningham, J. & Fiume, O. (2003). *Real Numbers: Management Accounting in a Lean Organization*. Durham, NC: Managing Times Press.

Drury, C., & Tayles, M. (1997). Evidence on the Financial Accounting Mentality Debate: A Research Note. *British Accounting Review*, vol 29, pp. 263-276

Elnicki, R. A. (April 1971). The Genesis of Management Accounting. *Management Accounting*, pp.16

Fullerton, R. R., & McWatters, C. S. (2001). The production performance benefits from JIT implementation. *Journal of Operations Management*, vol. 19, pp. 81-96.

Garrison, R. H., & Noreen, E. W. (1994). *Managerial Accounting*. Burr Ridge, IL: Irwin, Inc.

Goldratt, E. M. & Cox, J. (1982). *The Goal*, Second Revised Ed., New York, NY: McGraw Hill.

Hartley, R. V. (1983). *Cost and Managerial Accounting.* Newton, MA: Allyn and Bacon, Inc.

Hillier, F. S. & Lieberman, G. J. (2001). *Introduction to Operations Research*, Seventh Ed. New York, NY: McGraw Hill.

Hoffer, C. W. (Winter 1994). MAN Class Handout, The University of Georgia.

Horngren, C. T. (1995). Management accounting: this century and beyond. *Management Accounting Research*, vol. 6, pp. 281-286.

Johnson, H. T., Kaplan, R. S. (1987). *Relevance Lost: The Rise and Fall of Management Accounting.* Boston, MA: Harvard Business School Press.

Kaplan, R. S. (1994). Management Accounting (1984-1994): Development of New Practice and Theory. *Management Accounting Research*, vol. 5, pp. 247-260.

Kinsinger, K. (Spring 2004). Allocation Schemes in Cost Accounting. Personal Interviews.

Krajewski, King, Ritzman & Wong.(1987). Kanban, MRP, and Shaping the Manufacturing Environment. *Management Science*, vol. 33, No. 1, pp. 39-57.

Law, A. M. & Kelton, W. D. (2000). *Simulation Modeling and Analysis,* Third Ed. New York, NY: McGraw Hill.

Lea, Bih-Ru (1998). The Impact of Management Accounting Alternatives in Different Manufacturing Environments. *Doctoral Dissertation*, Ann Arbor, MI: UMI Co.

Lere, J. C. (2001). Your Product-costing System Seems to Be Broken: Now What? *Industrial Marketing Management*, vol. 30, pp. 587-598.

Little, T.M. (1981). Interpretation and Presentation of Result, *HortScience*, vol 19, pp.637-640.

Martin-Vega, L. A.(2001). *Maynard's Industrial Engineering Handbook*, Fifth Ed. New York, NY: McGraw Hill.

Nachtmann, H. & Needy, K. (2003) Methods for Handling Uncertainty in Activity Based Costing Systems. *The Engineering Economist*, vol. 48, No. 3, pp. 259-282.

Pine, B. J. (1993). *Mass Customization: The New Frontier in Business Competition.* Boston, MA: Harvard Business School Press.

Ramasesh, R. (1990). Dynamic Job Scheduling: A Survey of Simulation Research. *Omega*, vol. 18, No. 1.

Schonberger, R. J. (1982). *Japanese Manufacturing Techniques: Nine Hidden Lessons in Simplicity*. New York, NY: The Free Press.

Schonberger, R. J. (1982). Some Observations on the Advantages and Implementation Issues of Just-in-Time Production Systems. *Journal of Operations Management*, vol.3, No. 1.

Scott, D.R. (1931). *The Cultural Significance of Accounts*. New York, NY: Henry Holt.

Shah, R. & Ward, P. T. (2003). Lean Manufacturing: Context, Practice Bundles, and Performance. *Journal of Operations Management*, vol. 21, 129-149.

Soloman, J. M. (2003). *Who's Counting?* Fort Wayne, IN: WCM Associates.

Sugimori, Y., Kusunoki, F., Cho, F, & Uchikawa, S. (1977). Toyota Production and Kanban System: Materialization of Just-in-Time and Respect for Human Systems. *International Journal of Production Research*, vol 15, pp. 553 – 564.

Wantuck, K. A. (1989). *Just in Time for America: A common sense production strategy*. Southfield, MI: KWA Media.

Womak, J. & Jones, D. (2003). *Lean Thinking: Banish Waste and Create Wealth in Your Corporation.* New York, NY: The Free Press.

APPENDICES

APPENDIX A

Sample Data Set for Inventory Reduction Policy 2, 50% Reduction in Inventory Over 12 Months

Gross Profit Using the Full Absorption Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Percent	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	0.036244	0.340352	0.095191	0.066077	0.249045	0.161995	0.110456	0.158342	0.019373	0.138248	0.147963	0.230583	0.1461558	1.75387	0.092603893
2	0.053919	0.301166	0.145797	0.094389	0.057653	0.341199	0.104788	0.113983	0.09182	0.07353	0.225934	0.003544	0.1339769	1.607722	0.103126756
3	0.095107	0.112531	0.216047	0.156017	0.062686	0.223202	0.074207	0.433452	0.011002	0.147812	0.016131	0.259566	0.1506467	1.80776	0.119519241
4	0.181542	0.149886	0.086885	0.090508	0.118217	0.243165	0.082794	0.134435	0.081696	0.319675	-0.008844	0.3501	0.1525049	1.830059	0.105148209
5	0.182411	0.116368	0.177833	0.078294	0.162898	0.194464	-0.093908	0.305982	0.170517	0.266645	-0.001565	0.089682	0.1374683	1.64962	0.109882451
6	0.18861	0.156559	0.076466	0.148795	0.142865	0.257603	0.024257	0.217242	0.010834	0.09819	0.346784	0.035708	0.1419929	1.703915	0.100892943
7	0.043462	0.371922	-0.045289	0.190111	0.140314	0.372169	0.074358	-0.013735	0.255999	0.251737	-0.047981	0.226865	0.151661	1.819932	0.150450092
8	0.211106	0.082393	0.242089	-0.06535	0.308544	0.094183	0.192683	0.023209	0.210239	0.153992	0.086121	0.362041	0.1584373	1.901248	0.121034454
9	0.168325	0.180297	0.20674	-0.017896	0.196272	0.109687	0.231473	0.115388	0.04526	0.082967	0.272155	0.104391	0.1412549	1.695059	0.083018301
10	0.253889	0.016393	0.28508	0.044212	0.095578	0.180813	0.070022	0.259984	0.174527	0.013126	0.093386	0.295549	0.1485467	1.78256	0.106252462
11	0.125199	0.158112	0.116724	0.187892	0.089206	0.172472	0.121414	0.140459	0.158086	0.212001	0.214777	0.030282	0.1438853	1.726624	0.052503019
12	0.169057	0.100249	0.09273	0.171981	0.204369	0.036599	0.207175	0.241242	0.065761	0.173833	0.098043	0.105898	0.1389115	1.666937	0.063849676
13	0.221276	0.082469	0.147366	0.204442	0.114521	0.086786	0.264283	0.061582	-0.017813	0.386901	0.012545	0.16894	0.1444414	1.733297	0.113582253
14	0.096433	0.210307	0.068928	0.285769	0.095972	0.163893	0.055271	0.20576	0.172062	0.176558	0.071105	0.078798	0.1400713	1.680855	0.072620001
15	0.163896	0.163505	0.054429	0.25328	0.193821	-0.045628	0.141457	0.296751	0.000869	0.148974	0.223227	0.222935	0.1514597	1.817516	0.102191043
16	0.218922	0.186349	-0.026681	0.181441	0.225645	-0.012455	0.270727	0.049655	0.188827	0.2148	0.149131	0.015431	0.1384827	1.661792	0.103246802
17	0.268585	0.008503	0.186164	0.289066	0.02105	0.09347	0.233288	0.036203	0.210017	0.095476	0.043438	0.167911	0.1377642	1.653171	0.100406501
18	0.18451	-0.02313	0.424888	-0.005979	0.191455	0.343144	-0.067598	0.556338	-0.051015	0.145311	0.05968	0.276891	0.1695411	2.034494	0.200600484
19	0.089859	0.237251	0.05269	0.256855	0.090768	0.25533	-0.010687	0.140903	0.244225	0.178962	0.059404	0.135219	0.1442316	1.73078	0.090637612
20	0.03688	0.37132	0.026032	0.293403	0.013429	0.319064	0.061961	0.088648	0.168282	0.041456	0.26795	0.251819	0.1616871	1.940245	0.131845921
21	0.157986	0.177894	0.024211	0.052002	0.429667	0.089573	0.138466	0.079771	0.194042	0.082703	0.234324	0.07002	0.1442216	1.730659	0.109865042
22	0.25698	-0.034952	0.268159	0.076662	0.103322	0.222028	0.262809	0.029476	0.203645	0.082002	0.131574	0.171797	0.1477918	1.773502	0.099026293
23	0.190597	0.057174	0.162515	0.08588	0.147962	0.281168	-0.00149	0.147333	0.254762	0.291879	0.035568	0.057458	0.1425673	1.710807	0.098534082
24	0.264672	0.057717	0.001501	0.284574	0.228529	0.087085	0.148017	0.137846	0.081208	0.065851	0.300257	0.102836	0.1466743	1.760092	0.099355583
25	0.145007	0.135809	0.188811	0.02541	0.282774	0.112606	0.085434	0.173604	0.153705	0.304798	-0.054247	0.290596	0.1536922	1.844307	0.107155459
26	0.159754	0.225644	0.042128	0.156906	0.180679	0.20588	-0.027736	0.196698	0.114425	0.255359	0.104913	0.14825	0.1469085	1.762902	0.079557399
27	0.164118	0.091373	0.178446	0.113439	0.251917	-0.072516	0.484135	-0.023407	0.150473	0.392549	-0.017802	0.094058	0.1505652	1.806782	0.164458383
28	0.168111	0.041248	0.156509	0.202775	0.161267	0.242992	0.001385	0.243734	0.016538	0.227812	0.111996	0.248967	0.1519446	1.823335	0.090297353
29	0.119584	0.169894	0.091299	0.17884	0.160352	0.034463	0.231968	0.284273	0.0425	0.212712	0.06876	0.073272	0.1389933	1.667919	0.07995724
30	0.102599	0.188312	0.28334	-0.046347	0.278644	0.037682	0.115291	0.33719	0.119178	0.03198	0.188499	0.174134	0.1508753	1.810503	0.113774094
31	0.055998	0.295963	0.124206	0.006115	0.343237	0.139081	0.097608	0.152664	0.124722	0.240529	-0.023333	0.281955	0.1532289	1.838746	0.115949721
32	0.294787	-0.018113	0.200799	0.14677	0.109513	0.200287	0.048246	0.123947	0.104452	0.196208	0.130126	0.241544	0.1482139	1.778567	0.085260946
33	0.142123	0.135219	0.088077	0.174366	0.139585	0.161815	0.074156	0.115479	0.139211	0.242814	0.236822	0.040161	0.1408191	1.689829	0.059713615
34	0.110951	0.230894	0.149908	0.042988	0.164506	0.166173	0.189084	0.053531	0.119057	0.101975	0.102371	0.30367	0.1445923	1.735107	0.073621946
35	0.019873	0.374236	0.024584	0.249243	0.043524	0.185863	0.185488	0.07551	0.20051	0.062767	0.165262	0.190968	0.1481524	1.777828	0.106282544
Mean	0.152639	0.155746	0.131846	0.132941	0.165708	0.162438	0.119465	0.162671	0.120829	0.174632	0.115556	0.168624			
Std. Dev	0.072492	0.112943	0.099579	0.100812	0.092483	0.108371	0.113838	0.12429	0.082625	0.098147	0.104957	0.101576			

Gross Profit Using the Full Absorption Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Dollars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	27166.25	195883.4	57030.18	44236.6	141779.2	85978.98	67053.13	92678.07	13607.22	92729.61	104369.6	142964.2	88789.701	1065476	52578.1513
2	39038.01	172062.3	85125.87	56303.43	40589.47	195220.8	58144.8	62890.58	55212.73	48864.95	139547.2	2765.071	79647.101	955765.2	58335.99534
3	64610.93	84083.2	140500.8	96698.87	41005.77	143334	56426.88	202610.4	6648.875	86853.15	11803.64	154856.4	90786.081	1089433	59999.21105
4	99810.01	88293.17	54846.61	56923.41	84656.07	154049.3	51650.42	86962.68	58138.57	181324.9	-6171.179	198371.7	92404.645	1108856	59021.64133
5	106498.5	68720.42	106946.3	47909.15	98151.54	103657.5	-73927.9	193316.2	103626.6	160433.9	-1103.583	62348.38	81381.414	976577	70002.04166
6	106648.1	84538.4	49346.7	88684.92	81064.1	138797.2	15114.45	121465.4	6883.067	70835	198391.1	22264.88	82002.772	984033.3	55485.67722
7	28721.26	210053.8	-31145.48	133724.1	90235.58	193560.9	38291.38	-9449.546	146397.2	125317.1	-32846.77	134971.8	85652.613	1027831	84938.40584
8	122842.3	47511.9	136287.6	-46842	177675.7	60310.1	117892.2	15077.44	133861.3	97662.31	59517.66	183833	92135.779	1105629	67671.38893
9	100841.6	102166.9	102048.4	-11321.49	116451.2	66126.66	131274.4	63792	29292.32	57065.78	163116.9	67838.25	82391.077	988692.9	46951.98787
10	128235.2	10625.26	160934.7	23474.23	61080.55	108614.5	47706.86	154901.1	97457.38	7986.175	63365.9	159448.5	85319.187	1023830	57567.98744
11	81544.32	100455.3	71484.85	108715.6	60664.6	108225.2	77708.7	85590.95	102805.3	117371.6	109065.7	18301.34	86827.791	1041933	27853.12365
12	96545.64	64548.34	58843.02	105076.1	117177	24194.62	131849.3	134527.5	40474.46	103176.1	61195.59	66948.17	83712.982	1004556	35935.32788
13	125285.2	48645.34	91055.9	105264.9	67346.4	49436.47	137105.3	32335.64	-12149.1	193393.5	7762.508	101348.9	78902.576	946830.9	58333.43148
14	61636.4	121525.9	44184.5	157177.6	57816.1	91479.25	35093.13	128353.8	89780.6	91268.58	39892.12	46308.19	80376.348	964516.2	39593.48879
15	96290.97	92140.2	35445.07	144044.3	97429.91	-30118.81	98048.4	170714	589.5333	99636.97	129469.7	129662.3	88612.716	1063353	58929.39771
16	123655.6	95701.85	-16673.75	111509.5	123071.1	-8959.217	158988.3	33052.33	114686.9	123896.5	81730.66	10466.3	79260.511	951126.1	59287.11021
17	146777	5529.054	110432.2	145395	12274.45	59816.89	127590	21453.67	120385.7	56257.15	30748.33	107836.4	78707.981	944495.8	53316.88102
18	100315.6	-17926.48	238753.2	-4038.342	113116.1	163693.9	-47830.03	244885.2	-30131.33	83336.18	39411.32	148732.5	86026.487	1032318	100892.4464
19	60638.57	139304.6	35880.66	149892.8	59277.72	131880.1	-7101.204	94455.34	144143.1	107645.4	39956.39	90897.35	87239.224	1046871	50101.63112
20	26889.46	199194.1	18430.25	155122	8854.858	165620.1	36218.25	56714.42	99996.8	30446.22	169531.3	133197.4	91684.601	1100215	69659.25082
21	97738.61	102295.4	16700.99	38488.76	238564.6	51288.4	81802.95	52225.2	116500.3	49912.21	127578.1	43485.47	84715.075	1016581	59430.03383
22	137386.1	-22870.48	154362.4	52338.59	75076.68	130250	139438.1	19075.1	120223.4	51216	78634.45	101459.8	86382.503	1036590	54259.00363
23	113468.5	37606.73	106960.5	59605.92	103731.6	160738.1	-1036.929	104787.9	152881.1	151979.4	20647.84	39017.65	87532.357	1050388	55051.58963
24	133318.5	31847.23	1087.838	168021.6	126502.3	51677.03	86460.76	76079.15	48952.74	44562.79	176209.4	57908.41	83552.306	1002628	55572.08722
25	88749.85	82063.76	111553.2	17220.33	160182.4	69586.32	54000.25	111785.7	94548.6	139388	-33828.17	165114.8	88363.754	1060365	57479.03919
26	98670.2	114922.3	24349.53	96312.62	98704.67	99877.62	-18920.24	118834	69591.5	146745.4	57688.85	83086.07	82488.544	989862.5	44686.56801
27	95852.8	55221.31	108227.5	75131.01	133047.3	-54446.72	244648.2	-15993.63	99909.38	204765.7	-9925.671	59455.24	82991.036	995892.4	87002.48876
28	97942.82	29211.44	105241.7	128033.5	95372.87	133137.5	937.1542	148933.5	11070.81	138352.7	72739.99	142628.4	91966.858	1103602	52502.19262
29	75308.9	99968.36	54672.37	105194.3	91719.53	25635.94	148115	153989.8	26539.54	119076.3	43736.43	45065.98	82418.53	989022.4	44470.76299
30	71636.25	121288.3	139225.3	-30386.28	161931.8	24939.46	83715.51	192007.7	65424.45	21875.49	120532.5	101884.7	89506.273	1074075	63532.21181
31	38723.11	173779.8	71680.82	4160.121	193249.7	80368.61	57176.48	89481.37	75503.18	129753	-16095.88	153553.4	87611.152	1051334	64807.92347
32	144433.5	-11476.55	114995.8	88108.34	64926.17	107409.6	30733.84	77124.67	64903.32	123679.4	86354.04	137822.7	85751.23	1029015	45072.39496
33	88438.02	81876.82	54373.7	109117	83574.65	104686.4	51371.31	82000.07	91568.22	158908.6	136481.9	24995.54	88949.358	1067392	36481.66206
34	73787.94	130630.8	85653.69	27074.42	104097.8	100484.8	107754.4	35426.54	75714.67	70971.07	76105.04	171115.8	88234.751	1058817	39075.68402
35	13962.11	203893.1	16830.57	146776.8	27075.94	112734.8	109864.2	49109.07	119447.7	43297.45	111364.4	115218.2	89131.185	1069574	58779.52386
Mean	88954.52	89809.01	77590.67	78661.36	97356.44	91522.46	69524.5	93748.38	72985.32	100856.7	70199.35	97862.09			
Std. Dev	35488.46	63119.26	55869.83	57688.32	49938.8	59367.89	64079.32	62695.28	48936.2	49688.78	62075.79	54821.62			

Net Profit Using the Full Absorption Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Percent	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	0.018298	0.314488	0.071902	0.047454	0.226329	0.137863	0.09196	0.139825	0.006865	0.125565	0.137407	0.217995	0.1279958	1.535949	0.090713782
2	0.034902	0.275015	0.121567	0.07203	0.041463	0.319678	0.083404	0.093614	0.075191	0.060611	0.212215	-0.003995	0.1154744	1.385693	0.100370939
3	0.074063	0.095362	0.196261	0.135681	0.044359	0.205331	0.061943	0.408165	-0.00549	0.131638	0.006388	0.246469	0.1333477	1.600172	0.117100859
4	0.152683	0.124867	0.065375	0.069922	0.102528	0.224895	0.065107	0.118823	0.069518	0.30251	-0.019647	0.335174	0.1343128	1.611754	0.104493353
5	0.155959	0.09145	0.15466	0.056863	0.141989	0.170476	-0.105422	0.291024	0.154884	0.251229	-0.011799	0.080012	0.1192771	1.431325	0.107784849
6	0.160898	0.128187	0.055706	0.126427	0.119898	0.234006	0.006526	0.19729	-0.004269	0.087243	0.330992	0.023429	0.1221944	1.466333	0.09911592
7	0.021489	0.345305	-0.064043	0.172991	0.121473	0.34729	0.050394	-0.027707	0.238212	0.230489	-0.05921	0.213232	0.132493	1.589916	0.147890985
8	0.184523	0.056649	0.216524	-0.081927	0.28608	0.076234	0.1744	0.007715	0.195371	0.13989	0.075109	0.344013	0.1395483	1.67458	0.119476632
9	0.142846	0.153842	0.175937	-0.038285	0.174838	0.089863	0.210813	0.095078	0.030655	0.070891	0.257617	0.092937	0.1214194	1.457032	0.081282194
10	0.221435	-0.005248	0.25963	0.017641	0.076539	0.16089	0.05484	0.241998	0.155715	-0.002089	0.081932	0.279299	0.1285487	1.542584	0.104781213
11	0.102728	0.13583	0.094205	0.164483	0.072039	0.153905	0.104474	0.123453	0.14361	0.194079	0.195459	0.017054	0.1251099	1.501319	0.051274224
12	0.141726	0.078389	0.071405	0.150455	0.181778	0.0196	0.190059	0.2212	0.04979	0.157925	0.084549	0.093784	0.1200552	1.440662	0.062414204
13	0.193621	0.057527	0.125147	0.176637	0.092793	0.065108	0.240572	0.039568	-0.031031	0.365801	-0.001159	0.155516	0.1233418	1.480101	0.111336029
14	0.073301	0.184589	0.047942	0.260526	0.075036	0.141516	0.038092	0.189115	0.151068	0.15653	0.054759	0.06487	0.1197786	1.437343	0.070619116
15	0.137679	0.137155	0.033961	0.229258	0.166352	-0.062685	0.126725	0.277696	-0.012506	0.136485	0.207801	0.208735	0.1322212	1.586655	0.100906343
16	0.191181	0.155906	-0.048522	0.160104	0.201278	-0.027111	0.251509	0.034812	0.172481	0.198082	0.132107	0.004946	0.1188979	1.426775	0.100627071
17	0.239494	-0.013012	0.16251	0.26032	-0.000974	0.075501	0.211428	0.018137	0.191967	0.079384	0.032977	0.156178	0.1178258	1.413909	0.097454748
18	0.155224	-0.039251	0.400159	-0.024306	0.170167	0.314923	-0.081761	0.528349	-0.068159	0.128433	0.047591	0.260508	0.1493232	1.791878	0.196335772
19	0.06859	0.212175	0.033631	0.233862	0.072405	0.230214	-0.026549	0.126244	0.227069	0.163419	0.047754	0.124543	0.1261132	1.513358	0.088231354
20	0.018086	0.342897	0.00817	0.26683	-0.004649	0.29411	0.04228	0.072724	0.151308	0.030913	0.254819	0.234999	0.1427072	1.712487	0.128767471
21	0.133677	0.151998	0.005556	0.036634	0.406088	0.068087	0.119126	0.064476	0.177353	0.067249	0.217111	0.057478	0.1254027	1.504832	0.107848507
22	0.226981	-0.05625	0.243427	0.058655	0.088524	0.201826	0.239882	0.013863	0.186656	0.067488	0.116968	0.15798	0.1288333	1.546	0.096552086
23	0.16487	0.036026	0.142381	0.068542	0.131822	0.259614	-0.016105	0.134219	0.238073	0.272065	0.020167	0.047009	0.1248902	1.498683	0.096598805
24	0.232105	0.030203	-0.015615	0.261874	0.20477	0.066755	0.128319	0.117481	0.064647	0.053378	0.285146	0.087766	0.1264024	1.516829	0.097500585
25	0.120325	0.111719	0.164995	0.007268	0.259904	0.093566	0.068112	0.157859	0.137718	0.280581	-0.067748	0.275762	0.1341719	1.610063	0.105485977
26	0.135398	0.194849	0.017539	0.135523	0.156364	0.178351	-0.042895	0.179126	0.098121	0.238536	0.087988	0.133044	0.1259953	1.511944	0.077828274
27	0.137677	0.067311	0.155685	0.094504	0.226377	-0.086057	0.459544	-0.037548	0.136545	0.372827	-0.034326	0.08195	0.1312073	1.574488	0.161485087
28	0.141579	0.022483	0.137084	0.182591	0.139729	0.219969	-0.013976	0.226511	0.00282	0.212552	0.099512	0.234356	0.1337673	1.605207	0.08912783
29	0.09593	0.144844	0.067979	0.156018	0.137686	0.020674	0.215349	0.263277	0.026915	0.19513	0.055765	0.060505	0.1200059	1.440071	0.078028702
30	0.082442	0.166786	0.2523	-0.06559	0.256517	0.020699	0.101784	0.318734	0.099929	0.019776	0.175613	0.160071	0.1324216	1.58906	0.111667427
31	0.035531	0.270838	0.09954	-0.011982	0.319998	0.117893	0.077994	0.134167	0.108272	0.221827	-0.034374	0.265968	0.1338059	1.605671	0.114037873
32	0.260948	-0.040496	0.175861	0.124652	0.088051	0.176515	0.031558	0.107391	0.089059	0.181935	0.118143	0.22684	0.1283714	1.540456	0.083302931
33	0.118033	0.111207	0.065817	0.153639	0.118652	0.144167	0.059419	0.102583	0.125403	0.229598	0.221217	0.027664	0.1231166	1.477399	0.059850734
34	0.08917	0.204784	0.124909	0.022465	0.145158	0.146509	0.168593	0.038545	0.104097	0.090161	0.092972	0.288946	0.126359	1.516308	0.072575327
35	-8.3E-05	0.346238	0.005694	0.226444	0.023632	0.166489	0.166206	0.060041	0.183605	0.050753	0.153977	0.177689	0.1300571	1.560686	0.104135989
Mean	0.127523	0.131276	0.109294	0.111663	0.144714	0.141905	0.101534	0.145081	0.104899	0.15894	0.102166	0.155221			
Std. Dev	0.068668	0.110922	0.097566	0.098762	0.090802	0.105745	0.111605	0.122097	0.081768	0.095757	0.103869	0.099955			

Net Profit Using the Full Absorption Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Dollars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	13714.7	180997.9	43077.13	31769	128847.1	73170.83	55824.63	81840.31	4821.657	84222.28	96923.53	135159.4	77530.705	930368.5	52422.89761
2	25269.02	157121.6	70978.75	42966.2	29190.77	182907.4	46279.06	51651.68	45212.96	40279.65	131074	-3116.87	68317.849	819814.2	57347.01759
3	50315	71254.54	127633.5	84095.06	29017.4	131857.7	47101.32	190790.3	-3317.552	77349.45	4674.502	147043.2	79817.869	957814.4	59548.16923
4	83943.71	73555.08	41268.16	43976.02	73420.93	142475.1	40616.65	76863.79	49471.67	171588.6	-13709.1	189914.3	81115.411	973384.9	59184.11114
5	91054.86	54005.24	93010.12	34795.33	85553.51	90870.93	-82991.99	183866.2	94125.6	151158.9	-8318.532	55625.55	70229.64	842755.7	69430.23392
6	90978.57	69217.9	35949.13	75353	68032.02	126082.7	4066.531	110309.7	-2712.26	62937.81	189356.7	14608.81	70348.389	844180.7	55103.02041
7	14200.86	195021.3	-44042.77	121682.3	78119.13	180621.8	25951.03	-19061.88	136225	114739.7	-40534.13	126861	74148.611	889783.3	84330.48452
8	107373.9	32666.36	121895.6	-58724.03	164739.6	48816.45	106705.5	5011.826	124394.9	88718.69	51907.71	174679	80682.127	968185.5	67604.23576
9	85577.25	87176.27	86843.74	-24220.65	103734.4	54175.75	119557	52563.25	19840.3	48759.51	154403.8	60395.22	70733.827	848805.9	46733.50152
10	111843.6	-3401.731	146567.5	9366.606	48913.43	96647.23	37362.7	144184.9	86952.42	-1270.775	55594.06	150682	73620.161	883441.9	57467.58734
11	66908.22	86298.42	57693.83	95171.03	48990.02	96575.07	66867.01	75228.17	93391.36	107449.3	99255.53	10306.5	75344.536	904134.4	27421.05831
12	80937.86	50473.22	45310.92	91924.37	104224.4	12957.11	120956.8	123351.1	30644.71	93733.99	52772.85	59289.55	72214.738	866576.9	35578.42065
13	109626.9	33933.14	77327.48	90948.26	54568.87	37088.31	124804.1	20776.75	-21164.56	182846.7	-716.8622	93296.2	66944.604	803335.2	57673.26113
14	46851.5	106664.4	30732.24	143293.6	45203.37	78989.7	24185.74	117970.6	78825.84	80915.45	30721.39	38122.87	68539.722	822476.7	38870.72128
15	80887.73	77290.93	22115.78	130382.5	83621.73	-41377.85	87837.23	159752.2	-8487.454	91284.23	120522.8	121403.5	77102.774	925233.3	58989.69141
16	107986.3	80067.34	-30322.93	98396.59	109781	-19500.97	147701.8	23172.7	104759	114253.5	72401.16	3354.603	67670.847	812050.2	58610.83497
17	130879.2	-8461.811	96400.76	130936.2	-567.7741	48317.78	115633.9	10747.81	110039.2	46775.28	23343.26	100301.1	67028.739	804344.9	52611.39598
18	84393.2	-30421.03	224857.7	-16415.78	100538.9	150231.6	-57850.93	232565.3	-40256.65	73656.69	31428.31	139931.9	74388.26	892659.1	100090.9847
19	46286.01	124581	22901.83	136474.8	47285.39	118907.6	-17641.88	84628.53	134017.4	98296.71	32120.3	83720.58	75964.852	911578.2	49613.66499
20	13186.83	183946.6	5784.453	141072.6	-3065.606	152666.7	24714.27	46526.56	89910.46	22702.98	161223.6	124300.5	80247.494	962969.9	69284.83217
21	82699.4	87404.49	3832.701	27114.36	225472.9	38986.05	70376.9	42211.87	106480.5	40585.42	118206.1	35695.99	73255.558	879066.7	58896.62843
22	121348.2	-36806.09	140126.2	40044.83	64323.84	118398.8	127273.9	8971.179	110193.4	42150.77	69905.28	93299.56	74935.819	899229.8	53834.9897
23	98152.41	23696.61	93709.34	47571.69	92416.27	148415.9	-11207.93	95460.53	142865.9	141662.5	11707.16	31922.21	76364.388	916372.7	54525.3105
24	116914.1	16665.42	-11315.19	154619.2	113350.7	39613.39	74954.92	64839.2	38969.42	36121.94	167341.2	49422.36	71791.382	861496.6	55303.08278
25	73643.94	67507.18	97482.03	4925.676	147227.2	57820.3	43051.86	101647.6	84714.65	128313.4	-42246.71	156685.9	76731.092	920773.1	57236.86588
26	83626.99	99238.18	10137.09	83186.9	85421.41	86522.73	-29260.9	108217.9	59675.67	137077.6	48381.97	74563.49	70565.752	846789	44428.18815
27	80410.24	40679.24	94423.08	62590.03	119558.8	-64613.96	232222	-25656.35	90661.49	194477.9	-19138.24	51801.57	71451.31	857415.7	86253.18973
28	82485.2	15922.14	92179.65	115289.1	82635.23	120522.6	-9458.189	138409.2	1887.399	129084.8	64631.47	134258	80653.881	967846.6	52444.88672
29	60412.6	85228.37	40707.74	91770.04	78754.93	15378.56	137503.1	142616.1	16807.05	109233.8	35470.61	37213.58	70924.708	851096.5	43871.15303
30	57562.24	107423.8	123972.7	-43002.91	149072.6	13699.11	73907.67	181498.2	54857.46	13527.57	112292.9	93656.46	78205.655	938467.9	63293.03654
31	24570.11	159027.1	57445.97	-8151.809	180165.6	68125	45686.65	78639.42	65544.69	119664.1	-23712.73	144846.7	75987.572	911850.9	64315.30025
32	127853.7	-25658.54	100713.8	74830.19	52202.42	94661.07	20103.47	66823.09	55338.31	114682	78401.7	129432.2	74115.291	889383.5	45226.65933
33	73447.36	67337.55	40631.23	96146.09	71041.09	93268.94	41162.21	72842.59	82485.85	150259.9	127488.6	17217.8	77777.429	933329.2	36816.40177
34	59302.56	115858.5	71370.04	14148.73	91854.68	88593.72	96076.8	25508.87	66200.79	62749.27	69117.85	162818.8	76966.725	923600.7	39222.2061
35	-58.28267	188638.9	3898.303	133351.1	14701.47	100983.3	98443.75	39048.27	109377.1	35009.97	103759.6	107206.6	77863.348	934360.2	58549.1428
Mean	73845.31	75261.41	63865.65	65647.89	84809.94	79510.18	58529.05	83251.92	63221.54	91571.42	61887.19	89883.44			
Std. Dev	34754.44	62733.77	55526.15	57292.43	49626.86	58825.53	63573.68	62372.07	48748.62	49179.6	61805.12	54380.57			

Gross Profit Using the Direct Costing Method
Inventory Reduction Policy 2: 59% Reduction Over 12 Months

Percent	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	0.276386	0.521331	0.316036	0.301327	0.424242	0.392206	0.333782	0.368103	0.264305	0.352406	0.355528	0.421829	0.3606234	4.327481	0.072214884
2	0.284501	0.488572	0.358043	0.320777	0.292244	0.507056	0.317772	0.340627	0.312825	0.311653	0.42194	0.254292	0.3508586	4.210303	0.080180848
3	0.322373	0.335399	0.420795	0.360776	0.285663	0.434659	0.302698	0.583511	0.261783	0.358298	0.256057	0.445544	0.363963	4.367556	0.094215109
4	0.376622	0.366676	0.313855	0.329848	0.333694	0.434455	0.307082	0.355986	0.300864	0.488049	0.244838	0.516389	0.3640298	4.368358	0.079675426
5	0.387211	0.342689	0.385802	0.302403	0.363792	0.415966	0.170743	0.489238	0.391696	0.451559	0.246736	0.318809	0.3555536	4.266643	0.087576527
6	0.391554	0.371011	0.305686	0.35899	0.362619	0.457609	0.263173	0.418257	0.255834	0.320069	0.521497	0.278045	0.3586953	4.304343	0.080675657
7	0.281981	0.539906	0.209557	0.393795	0.352732	0.538208	0.300521	0.23979	0.442282	0.439677	0.209841	0.423345	0.3643028	4.371634	0.117351272
8	0.423184	0.301217	0.448156	0.195806	0.481119	0.32017	0.395433	0.26764	0.411292	0.370297	0.308872	0.530498	0.3711403	4.453683	0.095893762
9	0.378752	0.388038	0.414387	0.225815	0.398424	0.324937	0.430443	0.339223	0.290466	0.307847	0.457545	0.328136	0.357001	4.284012	0.066180355
10	0.441322	0.263084	0.469902	0.274751	0.322596	0.391264	0.295575	0.455336	0.385616	0.265994	0.320846	0.47133	0.3631346	4.357616	0.082169793
11	0.350539	0.370268	0.336426	0.391394	0.316262	0.370811	0.345292	0.356908	0.365072	0.413385	0.42249	0.26182	0.3583889	4.300666	0.043044297
12	0.385328	0.323891	0.313994	0.379042	0.401078	0.277638	0.400362	0.448802	0.289034	0.383024	0.325202	0.335332	0.3552275	4.26273	0.051806152
13	0.421424	0.305858	0.363893	0.405707	0.33352	0.312909	0.447541	0.313439	0.233709	0.549501	0.255432	0.37789	0.3600686	4.320823	0.087735747
14	0.313932	0.409216	0.306446	0.466411	0.330235	0.377248	0.280977	0.414544	0.374098	0.389731	0.296701	0.304389	0.3553273	4.263927	0.058042875
15	0.372999	0.380182	0.292282	0.443611	0.39237	0.213376	0.34945	0.478423	0.249831	0.366112	0.420996	0.410296	0.3641605	4.369926	0.078074489
16	0.41949	0.393426	0.226449	0.380557	0.429498	0.243518	0.44509	0.290531	0.388754	0.415595	0.362138	0.257297	0.3543618	4.252341	0.078316133
17	0.453557	0.260926	0.384553	0.467392	0.266387	0.322727	0.431099	0.273021	0.409688	0.320828	0.279683	0.381386	0.3542705	4.251246	0.076274071
18	0.389164	0.238273	0.573079	0.245632	0.394445	0.50189	0.205418	0.68305	0.208231	0.363178	0.295406	0.466662	0.3803691	4.564429	0.152953249
19	0.319744	0.42808	0.294349	0.449436	0.318557	0.446341	0.237209	0.359808	0.424995	0.390699	0.292607	0.353143	0.3595806	4.314967	0.069129558
20	0.268305	0.543085	0.270877	0.469895	0.2556	0.497046	0.294123	0.322286	0.374209	0.276826	0.452389	0.440824	0.3721223	4.465467	0.103491625
21	0.366098	0.391446	0.275273	0.28318	0.567131	0.319832	0.350819	0.313703	0.396703	0.301876	0.428254	0.310004	0.3586934	4.304321	0.081304
22	0.451751	0.218759	0.455928	0.318216	0.321509	0.415427	0.455339	0.277052	0.400474	0.316059	0.342975	0.374444	0.3623278	4.347933	0.076182352
23	0.3989	0.281284	0.383442	0.300811	0.359365	0.465894	0.243944	0.361786	0.44683	0.474352	0.263699	0.305157	0.357122	4.285464	0.07934182
24	0.450127	0.290152	0.250261	0.465933	0.427202	0.320508	0.366773	0.345281	0.312569	0.303742	0.476173	0.331424	0.3616788	4.340146	0.075255788
25	0.36234	0.360303	0.408106	0.262199	0.466786	0.342709	0.304613	0.380575	0.367683	0.468777	0.206894	0.47674	0.3673105	4.407727	0.082791098
26	0.367484	0.434994	0.274353	0.363866	0.38988	0.410635	0.229895	0.398499	0.334476	0.45621	0.321082	0.366516	0.3623241	4.347889	0.06487519
27	0.376852	0.31825	0.378961	0.339003	0.437205	0.197504	0.619014	0.23024	0.357094	0.562165	0.225951	0.329824	0.3643385	4.372062	0.127440397
28	0.388213	0.279403	0.368636	0.401129	0.369665	0.432733	0.247406	0.432334	0.270952	0.414584	0.337283	0.445619	0.3656631	4.387958	0.067905004
29	0.345684	0.371364	0.319639	0.395538	0.360809	0.277852	0.419784	0.46941	0.282634	0.400278	0.30586	0.312229	0.3550901	4.261081	0.058814994
30	0.330242	0.395209	0.481149	0.211131	0.456082	0.273959	0.343621	0.502596	0.344833	0.269544	0.398128	0.377148	0.3653035	4.383642	0.08843265
31	0.29161	0.481024	0.345713	0.243157	0.510136	0.361561	0.31719	0.369795	0.340654	0.43047	0.23438	0.468953	0.3662202	4.394642	0.090543436
32	0.471517	0.235986	0.405179	0.365152	0.334384	0.392275	0.293031	0.343777	0.321253	0.403774	0.343556	0.441819	0.362642	4.351703	0.065106508
33	0.35782	0.349502	0.31792	0.390828	0.350654	0.377755	0.311618	0.329805	0.344336	0.440414	0.417182	0.281809	0.3558035	4.269642	0.045101173
34	0.342966	0.416208	0.375669	0.267655	0.387206	0.37109	0.386128	0.303263	0.327007	0.321924	0.324479	0.481468	0.3587552	4.305063	0.056827835
35	0.259363	0.542274	0.263011	0.43476	0.284605	0.387696	0.388155	0.296882	0.409112	0.30277	0.366307	0.395707	0.3608868	4.330642	0.083431015
Mean	0.366267	0.369637	0.351652	0.348741	0.373648	0.37507	0.338032	0.375815	0.339748	0.382905	0.335399	0.379318			
Std. Dev	0.05678	0.089314	0.078524	0.078827	0.069844	0.083084	0.087222	0.096023	0.062845	0.075828	0.081441	0.077743			

Gross Profit Using the Direct Costing Method
Inventory Reduction Policy 2: 59% Reduction Over 12 Months

Dollars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	207160.1	300042.4	189340.4	201729.6	241517.8	208163.2	202624.2	215452.5	185640.8	236375.9	250780.8	261538.7	225030.53	2700366	33830.00004
2	205981.3	279131.3	209049.4	191345.3	205748	290117.4	176325.9	187941.8	188105.5	207112.5	260609.5	198411.3	216656.61	2599879	37963.11031
3	219005.1	250609.2	273653.5	223608.5	186864.9	279126.2	230170.5	272752.9	158205.4	210533.5	187362.4	265810.8	229808.58	2757703	39574.24109
4	207062.9	215997.5	198122.8	207451.9	238961.4	275235.4	191570.5	230279.2	214106.9	276828.8	170842.9	292593.8	226587.83	2719054	37626.84332
5	226068.6	202373	232015.3	185043.8	219197.1	221727.4	134415.4	309095.3	238041.2	271692.3	173946.9	221642.4	219604.89	2635259	44822.35151
6	221401	200337.5	197271	213964.9	205755.8	246560.4	163981.5	233857.5	162538.1	230900.1	298342.8	173368.3	212356.56	2548279	38390.0894
7	186342.1	304927.6	144114.2	276995.7	226841.5	279916.2	154755.7	164970.9	252926	218875.2	143653.5	251867	217182.13	2606186	57294.20154
8	246250.2	173696	252295.9	140350.5	277053.3	205021.8	241943.1	173872.7	261874.2	234844.3	213460.3	269370.1	224169.37	2690032	43226.92174
9	226905.8	219885.8	204544.5	142860.1	236391.4	195893.7	244114.7	187538	187991.7	211741	274231.2	213238.8	212111.39	2545337	33104.44188
10	222904.7	170515.9	265270.9	145877.5	206159.1	235032.9	201377.5	271293.9	215330.6	161831.7	217705.6	254282.8	213965.26	2567583	39937.50082
11	228311.5	235246.7	206036.2	226463.7	215072.9	232682.6	220997.9	217487.2	237411.2	228865.4	214544.2	158233.6	218446.08	2621353	21166.78743
12	220055.1	208548.2	199248.2	231584.8	229961.9	183540.9	254797	250272.3	177895	227338.1	202981.3	211994.4	216518.1	2598217	23906.36616
13	238607.3	180414.6	224846	208894.4	196133.7	178245	232175.9	164582.8	159398.5	274669.4	158053.3	226700.9	203560.16	2442722	36795.27499
14	200653.9	236465	196440.3	256533.5	198941.8	210567.2	178400.9	258594.3	195200.9	201464.4	166458.3	178884.3	206550.4	2478605	29592.1192
15	219141	214244.2	190338.1	252287.9	197236.4	140847	242215.5	275225.6	169546.1	244864.3	244174.5	238634	219062.88	2628755	38574.48933
16	236944.1	202048.2	141514.5	233881.4	234256.2	175164.2	261385.2	193390.2	236115.2	239714.1	198468.8	174515.4	210616.47	2527398	35317.43542
17	247861.1	169676.3	228115.5	235089.7	155334.1	206532.8	235776.2	161790.2	234841.1	189040.8	197976.2	244935.4	208914.11	2506969	33593.00197
18	211583.7	184670.7	322024.5	165893.3	233047.4	239422.4	145346.7	300660.9	122987.7	208283.6	195080.2	250668.3	214972.46	2579669	58844.30674
19	215769.4	251351.5	200444.4	262276.7	208040.5	230538.9	157624.9	241199.3	250834.4	235005.4	196814.4	237391.1	223940.9	2687291	29533.17488
20	195622.7	291336.9	191777.5	248433.1	168535	258007.3	171924	206189.7	222363.4	203307.7	286225.8	233169.9	223074.41	2676893	41135.5706
21	226487.5	225095.3	189888.1	209592.4	314889.5	183132.6	207256.4	205377.9	238175.4	182186.6	233163.2	192525	217314.17	2607770	36211.89031
22	241514	143141.2	262449.8	217252.6	233616.8	243705.8	241588.2	179290.9	236422.6	197399.7	204976.8	221138.7	218541.43	2622497	33073.26847
23	237477.9	185016.4	252365.8	208779.7	251939.1	266342.1	169766.5	257313.1	268139.8	246992.1	153080.5	207221	225369.51	2704434	39459.63462
24	226734.3	160100.9	181353.3	275102.2	236477.8	190193.1	214242.8	190564.9	188418.9	205549.1	279447.8	186630.3	211234.63	2534816	37117.01564
25	221766.7	217715.8	241116.3	177689.2	264419.5	211782.5	192536.9	245057.2	226172.9	214377.8	129016.9	270880.7	217711.04	2612532	38777.63976
26	226971.6	221545.4	158573	223349.2	212990.8	199209.8	156824.7	240750.2	203422.9	262166.8	176553.7	205411.6	207314.14	2487770	31566.09132
27	220099.9	192334.7	229840.1	224522.7	230905.5	148291	312806.7	157319.8	237099.1	293242.4	125977.8	208485	215077.08	2580925	54792.537
28	226176.1	197870.9	247883.2	253275	218618.3	237097.8	167427.6	264177.5	181376.2	251781.2	219061.1	255287.1	226669.34	2720032	31095.8071
29	217696.7	218516.3	191408.2	232656.8	206378.3	206686	268037.7	254277.7	176491.8	224075.4	194548.2	192037.2	215234.19	2582810	26794.34999
30	230580.8	254546.8	236422.7	138423.1	265048.6	181315.3	249511.5	286195.6	189300.7	184377.3	254576.6	220666.4	224247.11	2690965	42852.34045
31	201652	282441	199515.5	165428.6	287216.9	208930.1	185801.3	216748.6	206222.1	232216.3	161685.2	255393	216937.55	2603251	40825.30852
32	231023.9	149524.2	232042.5	219205.9	198244.2	210368.5	186668.7	213912.3	199616.4	254517.7	227989.4	252097.1	214600.89	2575211	29075.68371
33	222658.6	211627.9	196264.4	244576.9	209949.1	244388.6	215872.8	234189.1	226491.9	288227.2	240424.1	175394.9	225838.79	2710065	28370.12736
34	228090.2	235474	214647.5	168571.9	245020.5	224397.9	220044.7	200697.4	207961.5	224049.2	241226.2	271303.7	223457.06	2681485	25400.22919
35	182218.8	295443.9	180059.4	256026.4	177051.4	235156	229903.5	193080.4	243716.1	208854.5	246841.5	238745.3	223924.76	2687097	36285.5663
Mean	220708	219483.2	213722.7	213286.2	223823.3	219524	207434.7	224440	208582.3	228094.3	209722.3	226013.4			
Std. Dev	15326.57	43328.31	37128.25	38809.93	32980.09	36080.78	40557.39	41289.99	33850.3	30907.71	44679.32	34069.65			

Net Profit Using the Direct Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Percent	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	0.088069	0.273588	0.0796	0.091959	0.177216	0.127474	0.104929	0.131413	0.069987	0.149341	0.163936	0.20328	0.1383995	1.660794	0.059452022
2	0.091181	0.241535	0.117674	0.086858	0.096804	0.264973	0.068958	0.091538	0.086327	0.10884	0.203903	0.085015	0.1286339	1.543607	0.06762424
3	0.109592	0.143902	0.200713	0.13028	0.06821	0.213949	0.119132	0.279559	0.029754	0.120444	0.068299	0.214114	0.1414956	1.697947	0.072862663
4	0.1179	0.12712	0.092146	0.108323	0.141528	0.216702	0.086817	0.14501	0.1111	0.248082	0.052923	0.278425	0.1438397	1.726076	0.068603364
5	0.141951	0.101448	0.150204	0.072202	0.130865	0.152319	-0.003045	0.272079	0.165853	0.223823	0.055296	0.125386	0.132365	1.58838	0.07306042
6	0.148925	0.117587	0.096617	0.132731	0.125483	0.208468	0.050411	0.18096	0.049455	0.14067	0.293286	0.07087	0.134622	1.615463	0.069574584
7	0.073799	0.295411	0.011871	0.201735	0.142548	0.27673	0.0376	0.046957	0.209317	0.17124	0.018863	0.202882	0.1407462	1.688954	0.100458073
8	0.182028	0.058945	0.200801	0.005034	0.241828	0.107235	0.173078	0.059951	0.200323	0.159319	0.117191	0.266571	0.1476921	1.772305	0.079221071
9	0.151167	0.147912	0.138289	0.014039	0.172918	0.104274	0.196285	0.099901	0.088782	0.119735	0.240991	0.130363	0.1337213	1.604655	0.057243656
10	0.169683	0.05505	0.23045	0.020644	0.114516	0.170229	0.103073	0.234586	0.150458	0.052212	0.131349	0.231153	0.1386168	1.663402	0.072972631
11	0.138361	0.15351	0.112155	0.154441	0.117403	0.155338	0.135302	0.137136	0.160597	0.172287	0.159855	0.044146	0.136711	1.640532	0.034197606
12	0.141567	0.11007	0.097887	0.155215	0.162915	0.073672	0.189033	0.207113	0.072244	0.158871	0.113684	0.127707	0.1341648	1.609977	0.042765986
13	0.188219	0.083616	0.153323	0.151872	0.11389	0.086926	0.199495	0.069785	0.049854	0.295571	0.053644	0.170471	0.1347221	1.616665	0.072720695
14	0.106382	0.17951	0.101578	0.226859	0.113634	0.143692	0.078151	0.20894	0.127202	0.141678	0.070253	0.089888	0.132314	1.587768	0.050301236
15	0.137464	0.135607	0.082972	0.203353	0.12026	0.010017	0.157298	0.2456	0.055247	0.169754	0.19354	0.184657	0.1413141	1.695769	0.06669864
16	0.176203	0.125916	0.009788	0.161119	0.181911	0.059605	0.218557	0.092786	0.171954	0.1878	0.122965	0.067312	0.1313264	1.575916	0.062890505
17	0.203789	0.05396	0.1576	0.198883	0.03755	0.116316	0.188737	0.051449	0.181254	0.100068	0.098854	0.181874	0.130861	1.570333	0.061984795
18	0.136972	0.065784	0.332677	0.047862	0.168035	0.219622	0.019977	0.379736	-0.014101	0.134983	0.0998	0.22466	0.1513339	1.816007	0.121037198
19	0.109169	0.185436	0.087695	0.207536	0.104584	0.173897	0.0291	0.154582	0.191393	0.162775	0.091033	0.15243	0.1374692	1.64963	0.052968263
20	0.079124	0.283082	0.077545	0.208348	0.049113	0.232764	0.061912	0.112182	0.148171	0.097129	0.242908	0.189137	0.1484513	1.781415	0.08007923
21	0.142032	0.150642	0.077469	0.100843	0.320979	0.08252	0.122297	0.109647	0.17418	0.081655	0.184059	0.098473	0.1370662	1.644794	0.068082579
22	0.189823	0.007966	0.215796	0.118593	0.136068	0.183863	0.198713	0.069836	0.173453	0.103017	0.120899	0.150675	0.1390585	1.668702	0.059835533
23	0.157754	0.065162	0.168453	0.098695	0.160295	0.220008	0.045048	0.168356	0.216431	0.20824	0.027379	0.105851	0.136806	1.641671	0.066939892
24	0.180067	0.045836	0.068063	0.240624	0.187333	0.098585	0.142279	0.108164	0.097557	0.114494	0.257219	0.103915	0.1370113	1.644135	0.0661498
25	0.138404	0.134392	0.177877	0.064104	0.228631	0.126325	0.094351	0.175438	0.153442	0.177889	-0.002171	0.247274	0.1429962	1.715955	0.068649318
26	0.153467	0.174198	0.047093	0.151644	0.151138	0.141641	0.043015	0.18703	0.125564	0.235543	0.091122	0.142294	0.136979	1.643748	0.055172811
27	0.139864	0.090713	0.153447	0.134397	0.17883	0.020183	0.351078	0.03613	0.157961	0.306701	-0.011129	0.123177	0.1401126	1.681351	0.106635591
28	0.143812	0.081404	0.160445	0.179913	0.133495	0.178042	0.044478	0.207382	0.067613	0.190316	0.129364	0.20944	0.1438088	1.725705	0.054893282
29	0.126131	0.136651	0.090302	0.162978	0.122459	0.098216	0.209952	0.220668	0.069486	0.162316	0.09891	0.09888	0.133079	1.596948	0.047606712
30	0.128649	0.176997	0.192295	-0.001335	0.215967	0.065565	0.155651	0.261671	0.094819	0.072142	0.187127	0.146569	0.1413432	1.696118	0.073519823
31	0.095219	0.248711	0.11025	0.046246	0.270823	0.129847	0.089894	0.143744	0.123246	0.186253	0.046989	0.229585	0.1434006	1.720807	0.075195724
32	0.190916	0.022789	0.169127	0.141634	0.108992	0.143055	0.086551	0.132919	0.111284	0.197697	0.149384	0.215223	0.1391309	1.669571	0.053044301
33	0.127924	0.113991	0.088212	0.165455	0.115828	0.162155	0.112015	0.136556	0.13583	0.231513	0.179359	0.063548	0.1360323	1.632388	0.044332992
34	0.130881	0.166395	0.129165	0.046179	0.167852	0.142128	0.143549	0.097036	0.113035	0.128261	0.144839	0.242141	0.1376217	1.65146	0.046310761
35	0.059656	0.282482	0.059655	0.197514	0.061712	0.160116	0.155659	0.087233	0.180217	0.107682	0.167616	0.173115	0.1410548	1.692658	0.067816962
Mean	0.137033	0.138209	0.126835	0.126479	0.146903	0.144756	0.120266	0.152659	0.122837	0.160524	0.124673	0.159729			
Std. Dev	0.035622	0.076194	0.065376	0.067255	0.059679	0.063766	0.073052	0.078104	0.055976	0.05909	0.074247	0.063406			

Net Profit Using the Direct Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Dollars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	66010.52	157458.8	47689.28	61563.97	100887.6	67656.99	63697.65	76916.67	49157.18	100170.5	115636.7	126035.9	86073.48	1032882	34042.91045
2	66015.75	137994.2	68705.77	51811.5	68152.83	151607.4	38263.67	50506.43	51909.23	72330.71	125939.8	66332.86	79130.841	949570.1	37534.10553
3	74451.68	107523	130528.7	80747.12	44618.97	137392.4	90587.41	130675.2	17981.42	70772.27	49975.73	127740.1	88582.837	1062994	39075.48882
4	64820	74882.79	58167.77	68127.89	101349.6	137284.6	54160.08	93803.65	79063.34	140715.8	36928.35	157759.8	88921.976	1067064	38261.78638
5	82876.49	59909.29	90330.67	44181.42	78850.59	81192.34	-2397.239	171896.8	100791.7	134668.8	38983.4	87171.03	80704.597	968455.2	44911.49139
6	84208.73	63494.27	62350.64	79110.25	71200.94	112323.1	31410.8	101179.1	31420	101480.2	167785.7	44189.46	79179.43	950153.2	38537.07769
7	48768.84	166842.2	8164.075	141901	91672.24	143924.3	19362.55	32305.72	119701	85244.92	12913.33	120703.4	82625.296	991503.5	56698.28549
8	105922	33990.57	113044	3608.53	139257.4	68668.22	105896.6	38947.21	127547.9	101040.8	80990.48	135356.2	87855.82	1054270	43422.27353
9	90562.09	83815.75	68260.48	8881.549	102595.2	62863.34	111318	55229.87	57460.31	82355.36	144438.7	84716.34	79374.746	952497	33580.06966
10	85704.12	35679.93	130094.7	10960.91	73182.95	102256.7	70224.33	139768.8	84016.67	31765.76	89124.74	124707.3	81457.241	977486.9	40318.7112
11	90116.92	97531.4	68686.72	89360.65	79839.81	97473.94	86597.7	83565.9	104438.7	95384.58	81175.59	26680.32	83404.356	1000852	20284.68918
12	80846.71	70872.42	62115.43	94832.39	93408.67	48702.8	120303.9	115495.2	44464.64	94295.39	70957.88	80735.1	81419.212	977030.5	23727.16041
13	106568.4	49321.81	94736.99	78197.09	66975.58	49516.22	103494.1	36643.28	34002.45	147741.9	33193.26	102267.6	75221.563	902658.8	36326.29419
14	67995.64	103730	65114.64	124776.2	68455.65	80204.27	49620.09	130337.7	66372.78	73237.87	39414.23	52825.6	76840.386	922084.6	28637.41473
15	80761.75	76418.9	54032.8	115650.1	60452.2	6611.999	109028.3	141287.8	37493.08	113535.5	112251.6	107399.1	84576.936	1014923	39076.09351
16	99526.34	64665.37	6116.927	99020.13	99217.77	42874.04	128350.4	61762.23	104439	108322.9	67390.96	45655.34	77278.446	927341.3	35037.70897
17	111367.1	35089.18	93487.89	100034.7	21895.67	74437.44	103224	30488.12	103898.3	58962.69	69974.91	116803.9	76638.658	919663.9	33459.8372
18	74470.13	50985.02	186937.9	32324.74	99279.08	104769	14134.69	167149.9	-8328.754	77413	65906.08	120676.5	82143.105	985717.3	58080.17657
19	73669.43	108880.6	59718.23	121111.3	68300.84	89819.07	19336.82	103625.1	112961.4	97909.27	61230.91	102466.9	84919.159	1019030	29265.18932
20	57689.44	151858.8	54901.11	110153.1	32383.96	120823.3	36189.38	71771.18	88046.44	71333.85	153687.5	100042.4	87406.697	1048880	40937.42109
21	87868.18	86624.32	53439.71	74637.87	178217.7	47250.16	72250.25	71784.44	104575.5	49279.69	100211.2	61155.35	82274.532	987294.4	35593.7133
22	101482.8	5212.378	124220.3	80965.59	98870.67	107861.4	105430.8	45193.76	102399.4	64341.25	72254.38	88985.22	83101.493	997217.9	32716.20881
23	93915.98	42860.42	110868.8	68499.56	112378	125774	31349.67	119739.9	129878.8	108429.3	15893.99	71879.69	85955.675	1031468	39073.18587
24	90702.09	25291.27	49322.5	142072	103698.3	58501.64	83109.13	59697.17	58807.74	77480.39	150951.8	58516.47	79845.88	958150.6	37292.65254
25	84708.57	81207.05	105093	43442.35	129512.1	78064.23	59636.32	112966.8	94386.78	81351.07	-1353.866	140499.6	84126.169	1009514	38411.16037
26	94787.16	88720.04	27219.32	93082.19	82566.33	68713.63	29342.76	112992.8	76365.85	135357.7	50105.61	79747.81	78250.099	939001.2	31586.7725
27	81687.31	54822.66	93065.73	89011.71	94446.95	15153.72	177410.5	24687.11	104881.2	159984.6	-6204.768	77861.36	80567.338	966808.1	54187.6564
28	83786.15	57649.25	107888.9	113598.2	78948.37	97550.63	30099.88	126720.8	45260.45	115581	84020.27	119984.4	88424.029	1061088	31099.10374
29	79431.72	80407.62	54074.91	95863.95	70045.03	73059.96	134057.1	119535.3	43390.68	90864.34	62913.76	60816.16	80371.715	964460.6	26411.6395
30	89825.05	114000.6	94488.36	-875.2499	125507.7	43393.26	113022	149004.4	52052.03	49347.67	119655.3	85756.46	86264.799	1035178	42769.69608
31	65845.23	146034.5	63626.93	31462.95	152479.1	75032.79	52657.76	84252.96	74609.84	100473.7	32414.58	125032.6	83660.239	1003923	40235.86273
32	93541.2	14439.25	96857.6	85024.76	64617.48	76717.04	55135.38	82707.76	69148.39	124617.4	99134.09	122803.7	82062.003	984744	30029.83324
33	79602.63	69023.38	54456.62	103540.7	69350.3	104905.8	77598.42	96966.31	89344.21	151513.2	103365.4	39551.84	86601.569	1039219	28943.65809
34	87042.69	94139.55	73801.68	29084.07	106215.3	85944.71	81804.92	64217.55	71885.43	89265.24	107676.9	136444.6	85626.884	1027523	26248.89816
35	41911.97	153903.2	40840.62	116314.3	38390.43	97118.03	92196.52	56733.13	107359	74280.52	112950.2	104447.2	86370.436	1036445	36252.50161
Mean	81956.88	81293.71	76355.71	76630.84	87634.89	83869.79	72797.27	90301.6	75176.63	95167.12	77768.25	94392.79			
Std. Dev	15618.38	42084.88	36505.57	38823.75	32713.61	34380.95	40556.89	40412.25	33110.87	30543.77	44309.97	33116.94			

Gross Profit Using the Activity Based Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Percent	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	0.037173	0.348218	0.088906	0.066801	0.234953	0.192349	0.102521	0.153165	0.021589	0.136358	0.141192	0.225298	0.1457101	1.748521	0.093493658
2	0.048917	0.310908	0.143618	0.09607	0.058772	0.331948	0.095032	0.12963	0.086416	0.083269	0.227086	0.007004	0.1348893	1.618671	0.102721283
3	0.097918	0.114313	0.219396	0.143847	0.058881	0.242005	0.06692	0.432488	0.018787	0.141509	0.008622	0.262941	0.1506355	1.807626	0.121481911
4	0.171004	0.156213	0.088363	0.107512	0.106741	0.242729	0.078692	0.142769	0.074327	0.312709	0.00387	0.345599	0.1525439	1.830526	0.101545956
5	0.178726	0.121122	0.173205	0.079255	0.15158	0.224557	-0.103773	0.305971	0.188285	0.258451	-0.009152	0.097477	0.1388087	1.665705	0.113339329
6	0.186213	0.164058	0.0702	0.150328	0.145369	0.262861	0.019503	0.218584	0.013281	0.092792	0.348111	0.042332	0.1428027	1.713632	0.102048551
7	0.04737	0.373835	-0.050773	0.188207	0.139931	0.375784	0.066534	-0.009698	0.25388	0.252788	-0.045703	0.228968	0.1517603	1.821124	0.151300121
8	0.224112	0.062255	0.255638	-0.06727	0.303997	0.092778	0.190954	0.029921	0.209237	0.160276	0.077238	0.363406	0.1585452	1.902542	0.123662905
9	0.167535	0.178257	0.218465	-0.024207	0.192847	0.103343	0.242519	0.116212	0.053249	0.079815	0.269502	0.102125	0.1416385	1.699662	0.08521435
10	0.249073	0.018488	0.289742	0.036083	0.096208	0.185087	0.064559	0.269323	0.174923	0.024397	0.09052	0.282824	0.1484356	1.781227	0.105669507
11	0.131733	0.153925	0.11472	0.188884	0.088244	0.161124	0.12715	0.147906	0.152692	0.217454	0.223751	0.017117	0.1437249	1.724699	0.056207175
12	0.178009	0.092546	0.091861	0.173602	0.200485	0.042957	0.196931	0.256955	0.053987	0.175619	0.10316	0.106916	0.139419	1.673028	0.066231699
13	0.223544	0.071137	0.155688	0.200488	0.111194	0.088404	0.260011	0.090583	-0.022044	0.381184	0.009059	0.169473	0.1448935	1.738722	0.112054358
14	0.087722	0.217176	0.076816	0.282235	0.10147	0.164922	0.041291	0.21299	0.171724	0.179232	0.064014	0.079894	0.1399571	1.679486	0.075088445
15	0.157423	0.172008	0.057331	0.24921	0.188176	-0.039676	0.13492	0.298376	0.004806	0.155321	0.22604	0.208688	0.1510519	1.812623	0.099530637
16	0.224905	0.182442	-0.026024	0.170489	0.239419	-0.007731	0.255707	0.062301	0.181401	0.219568	0.14949	0.012292	0.1386882	1.664258	0.101382038
17	0.263082	0.01755	0.175029	0.282825	0.029735	0.09826	0.230029	0.035141	0.211961	0.096217	0.04577	0.172664	0.1381887	1.658265	0.096187621
18	0.187162	-0.015205	0.41121	-0.005526	0.193585	0.332144	-0.051641	0.554166	-0.057002	0.14514	0.061106	0.277235	0.1693646	2.032375	0.196015529
19	0.090515	0.233565	0.062486	0.257261	0.087914	0.25219	-0.013552	0.148396	0.227492	0.18688	0.061823	0.134819	0.144149	1.729788	0.088263197
20	0.031142	0.385524	0.023731	0.287885	0.014246	0.319236	0.061097	0.096754	0.161313	0.041359	0.268352	0.248803	0.1616201	1.939442	0.133635664
21	0.151415	0.187583	0.034459	0.047244	0.412243	0.098675	0.13501	0.086633	0.195915	0.070973	0.239217	0.081205	0.1450477	1.740572	0.105192618
22	0.259444	-0.03541	0.266045	0.088098	0.090745	0.220958	0.267304	0.038487	0.19358	0.087588	0.124764	0.165538	0.1472616	1.76714	0.09769046
23	0.19541	0.042345	0.180964	0.072075	0.148316	0.28872	-0.003776	0.154968	0.253433	0.293848	0.022301	0.073643	0.1435205	1.722246	0.102967233
24	0.259241	0.05421	0.007865	0.282403	0.232338	0.089309	0.1509	0.125634	0.089809	0.069468	0.293189	0.108092	0.1468714	1.762457	0.096365769
25	0.150335	0.144715	0.19204	0.01202	0.289129	0.111662	0.075112	0.172083	0.161301	0.286385	-0.046427	0.29666	0.1537511	1.845013	0.107199467
26	0.154574	0.243773	0.026979	0.159829	0.185176	0.206061	-0.025588	0.197868	0.11109	0.263858	0.087732	0.159816	0.1475973	1.771167	0.085242989
27	0.164386	0.090555	0.173467	0.116416	0.248565	-0.060414	0.478031	-0.025783	0.151479	0.397448	-0.027157	0.10815	0.151262	1.815144	0.163000723
28	0.183077	0.032885	0.162706	0.192033	0.15726	0.243565	-0.003104	0.242879	0.035197	0.214617	0.113894	0.253653	0.1523884	1.82866	0.088905986
29	0.126784	0.158514	0.09638	0.193779	0.139061	0.041813	0.222726	0.28669	0.045286	0.199647	0.07545	0.090155	0.1396903	1.676284	0.075374234
30	0.106635	0.183879	0.302497	-0.053484	0.265618	0.03743	0.129984	0.324543	0.125227	0.026318	0.192329	0.169693	0.1508892	1.81067	0.113888196
31	0.057018	0.301411	0.120189	-0.002181	0.345411	0.145927	0.092168	0.157535	0.119582	0.234592	-0.014262	0.284341	0.1534775	1.84173	0.116847707
32	0.287642	-0.009889	0.197557	0.151824	0.1138	0.176349	0.06233	0.12468	0.101118	0.207257	0.119208	0.252744	0.1487184	1.784621	0.082163391
33	0.143776	0.133598	0.094849	0.183595	0.127072	0.164906	0.076762	0.102822	0.137652	0.250927	0.219721	0.049654	0.1404445	1.685334	0.0579882
34	0.123013	0.21227	0.167616	0.02238	0.184675	0.155129	0.179267	0.071608	0.103062	0.103538	0.103492	0.312111	0.1448469	1.738163	0.075027141
35	0.019876	0.379315	0.021581	0.242878	0.047911	0.183666	0.188135	0.069643	0.208416	0.072796	0.148707	0.1978	0.1483937	1.780725	0.106911614
Mean	0.153311	0.156517	0.133852	0.130654	0.163745	0.164829	0.116876	0.166349	0.120356	0.174846	0.1136	0.171118			
Std. Dev	0.072135	0.115539	0.100383	0.10187	0.090839	0.106594	0.11299	0.122154	0.081377	0.096594	0.104468	0.099907			

Gross Profit Using the Activity Based Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Dollars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	27862.27	200410.5	53264.32	44721.3	133757.1	102089.1	62236.05	89648	15163.26	91461.68	99593.61	139687	88324.52	1059894	52581.41838
2	35416.46	177628.2	83853.95	57306.39	41377.06	189927.4	52731.4	71523.95	51963.14	55337.21	140258.9	5464.976	80232.426	962789.1	58012.75925
3	66520.5	85414.29	142678.8	89156.15	38516.43	155408.7	50885.93	202159.5	11353.97	83149.68	6308.918	156870.2	90701.922	1088423	61856.60561
4	94016.11	92020.26	55779.44	67617.35	76438.29	153773.2	49091.17	92354.01	52894	177373.7	2700.232	195821.5	92489.936	1109879	56711.63805
5	104347.1	71527.77	104163	48496.8	91332.41	119698.6	-81693.73	193309.1	114424.3	155504.1	-6452.347	67768.22	81868.78	982425.4	72234.9103
6	105292.6	88587.36	45302.96	89598.72	82484.97	141629.9	12152.18	122215.3	8437.561	66940.74	199150.4	26395.24	82348.995	988187.9	55999.3225
7	31303.48	211134.4	-34916.91	132385	89989.78	195440.8	34262.36	-6671.938	145185.2	125840.4	-31287.38	136223.4	85740.719	1028889	85306.36784
8	130410.6	35899.45	143915.2	-48217.79	175057.2	59410.88	116834.1	19438.14	133223.4	101647.7	53378.62	184526.2	92126.966	1105524	69194.26928
9	100368.2	101011.3	107835.9	-15314.63	114419.6	62301.9	137538.5	64247.24	34463.38	54897.7	161527.2	66365.86	82471.843	989662.1	47897.40502
10	125802.8	11982.65	163566.2	19158.27	61482.71	111182.4	43984.57	160465.5	97678.5	14843.3	61421.09	152583.4	85345.949	1024151	57465.2667
11	85799.77	97795.39	70257.59	109289.5	60009.73	101104.6	81379.98	90128.81	99297.5	120390.4	113622.9	10344.82	86618.421	1039421	29715.46343
12	101658.4	59588.58	58291.54	106066	114950	28397.95	125329.9	143289.7	33228.17	104235.7	64389.1	67591.79	83918.079	1007017	36889.88039
13	126569.4	41961.35	96198.14	103229.2	65389.92	50358.5	134888.6	47563.81	-15034.62	190535.8	5605.639	101668.7	79077.875	948934.5	57854.17938
14	56068.32	125495	49241.46	155233.8	61128.25	92054.11	26216.6	132864.2	89604.12	92650.73	35913.77	46952.18	80285.212	963422.5	41258.06775
15	92487.59	96931.9	37334.47	141729.1	94592.25	-26190.01	93517.9	171648.9	3261.658	103882.2	131101.4	121376.1	88472.799	1061674	57260.16259
16	127034.7	93694.96	-16263.38	104778.9	130583.7	-5561.214	150167.4	41470.19	110176.8	126646.2	81927.81	8337.485	79416.125	952993.5	57831.68124
17	143769.9	11412.78	103826.9	142255.9	17338.74	62882.78	125807.5	20824.34	121500.2	56693.93	32398.84	110888.9	79133.403	949600.8	50910.15027
18	101757.6	-11784.82	231067.4	-3731.839	114374.3	158446.6	-36539.28	243929.5	-33667.34	83238.39	40353.44	148917.2	86363.42	1036361	97833.91062
19	61081.08	137140.1	42551.57	150129.3	57414.15	130258.1	-9005.243	99477.93	134266.7	112408.7	41583.72	90628.57	87327.881	1047935	48822.80747
20	22705.41	206813.5	16801.12	152204.4	9393.203	165709.2	35713.38	61900.68	95855.62	30375.17	169786	131602.2	91571.65	1098860	70725.89107
21	93672.9	107866.6	23770.61	34966.81	228890.8	56500.56	79760.81	56717.58	117624.8	42833.44	130241.9	50431.78	85273.214	1023279	56631.07621
22	138703.7	-23170.19	153145.7	60146.22	65937.71	129622.3	141822.9	24906.23	114281.2	54704.56	74564.35	97763.17	86035.646	1032428	53150.87667
23	116334	27852.48	119102.8	50024.21	103979.7	165054.9	-2627.963	110218.1	152083.4	153004.7	12945.91	50008.22	88165.053	1057981	58105.26497
24	130582.8	29912.15	5699.232	166739.9	128610.8	52996.74	88144.8	69339.19	54137.62	47010.26	172061.4	60868.33	83841.929	1006103	53771.71647
25	92010.98	87444.8	113460.9	8145.676	163782.2	69003	47475.85	110806.2	99221.18	130967.5	-28951.49	168560.1	88493.919	1061927	58344.05037
26	95470.57	124155.5	15593.32	98106.47	101161.4	99965.73	-17455.21	119540.7	67563.02	151629	48241.2	89568.2	82794.991	993539.9	47543.61988
27	96009.39	54726.91	105208.1	77102.57	131276.8	-45360.01	241563.7	-17616.92	100577.7	207321.3	-15141.22	68362.86	83669.264	1004031	85904.32892
28	106661.8	23288.61	109409.3	121250.6	93002.97	133451	-2100.56	148411.3	23560.74	130339.1	73972.32	145313	92213.353	1106560	51497.39293
29	79842.94	93271.89	57714.72	113981.5	79541.13	31103.26	142213.4	155299.1	28279.09	111762.4	47991.54	55449.95	83037.575	996450.9	41516.18484
30	74454.58	118432.7	148638.3	-35065.32	154361.8	24772.51	94384.63	184806.3	68745.37	18002.22	122981.4	99286.17	89483.384	1073801	63489.88955
31	39428.93	176978.2	69362.75	-1483.69	194473.3	84324.69	53989.39	92336.2	72391.25	126550.1	-9838.514	154853.1	87780.475	1053366	65315.61228
32	140932.8	-6265.671	113139.3	91142.25	67467.91	94571.98	39706.15	77581.17	62831.61	130643.8	79108.24	144213.1	86256.045	1035073	43578.32534
33	89466.82	80895.1	58554.29	114892.3	76082.63	106686.1	53176.71	73012.22	90542.43	164218.5	126626.3	30903.99	88754.781	1065057	35843.33934
34	81810.17	120094	95771.72	14095.1	116861.1	93806.37	102159.8	47389.9	65542.78	72059.41	76938.48	175872.3	88533.435	1062401	40346.16432
35	13964.24	206660	14774.32	143029	29805.38	111402.2	111432.1	45292.88	124157.6	50215.71	100208.4	119340.5	89190.197	1070282	58859.01331
Mean	89417.68	90194.52	78802.71	77233.3	96150.44	93035	67975.6	95995.06	72709.01	101123.3	69006.63	99451.68			
Std. Dev	35619.11	64347.4	56201.06	58586.65	48991.03	58118.28	63692.32	61401.6	48106.99	49073.97	61552.83	53769.36			

Net Profit Using the Activity Based Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Percent	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	0.019226	0.322354	0.065616	0.048178	0.212237	0.168217	0.084025	0.134648	0.00908	0.123674	0.130636	0.212709	0.1275501	1.530601	0.091403539
2	0.029899	0.284757	0.119388	0.073711	0.042581	0.310427	0.073648	0.109261	0.069786	0.07035	0.213368	-0.000534	0.1163869	1.396642	0.100000827
3	0.076874	0.097144	0.19961	0.123512	0.040554	0.224134	0.054656	0.4072	0.002296	0.125335	-0.001121	0.249845	0.1333366	1.600039	0.119056928
4	0.142145	0.131194	0.066852	0.086925	0.091052	0.224459	0.061005	0.127157	0.062148	0.295544	-0.006933	0.330673	0.1343518	1.612221	0.100905673
5	0.152274	0.096204	0.150032	0.057824	0.130672	0.20057	-0.115287	0.291013	0.172651	0.243036	-0.019386	0.087807	0.1206174	1.447409	0.111174144
6	0.158501	0.135685	0.04944	0.12796	0.122402	0.239263	0.001772	0.198632	-0.001822	0.081845	0.332319	0.030054	0.1230042	1.47605	0.100235482
7	0.025397	0.347218	-0.069527	0.171087	0.121091	0.350905	0.04257	-0.02367	0.236092	0.23154	-0.056932	0.215335	0.1325924	1.591109	0.148774563
8	0.197529	0.036511	0.230073	-0.083847	0.281533	0.074829	0.172671	0.014427	0.194369	0.146174	0.066226	0.345378	0.1396561	1.675874	0.12209174
9	0.142056	0.151803	0.187662	-0.044597	0.171414	0.083519	0.221858	0.095901	0.038645	0.067738	0.254965	0.090672	0.121803	1.461636	0.083385602
10	0.21662	-0.003154	0.264292	0.009513	0.077169	0.165165	0.049376	0.251337	0.156111	0.009182	0.079066	0.266574	0.1284376	1.541251	0.104242497
11	0.109262	0.131643	0.092201	0.165475	0.071076	0.142558	0.11021	0.1309	0.138216	0.199531	0.204433	0.003888	0.1249495	1.499394	0.054923544
12	0.150679	0.070686	0.070536	0.152076	0.177894	0.025958	0.179815	0.236913	0.038017	0.159711	0.089665	0.094802	0.1205627	1.446753	0.064765557
13	0.195889	0.046196	0.13347	0.172683	0.089466	0.066727	0.236299	0.06857	-0.035262	0.360084	-0.004644	0.15605	0.1237938	1.485526	0.109757543
14	0.06459	0.191457	0.055831	0.256992	0.080534	0.142546	0.024112	0.196345	0.15073	0.159204	0.047668	0.065966	0.1196645	1.435974	0.073101131
15	0.131205	0.145658	0.036862	0.225187	0.160707	-0.056733	0.120189	0.279322	-0.008569	0.142832	0.210614	0.194488	0.1318134	1.581761	0.098244252
16	0.197163	0.151998	-0.047866	0.149153	0.215052	-0.022387	0.236488	0.047459	0.165056	0.20285	0.132467	0.001807	0.1191034	1.429241	0.098699212
17	0.233991	-0.003965	0.151375	0.254079	0.007711	0.080292	0.208169	0.017075	0.193911	0.080125	0.035309	0.160931	0.1182503	1.419004	0.093293068
18	0.157876	-0.031327	0.386482	-0.023852	0.172297	0.303924	-0.065803	0.526178	-0.074145	0.128263	0.049018	0.260851	0.1491467	1.78976	0.191774077
19	0.069246	0.208489	0.043427	0.234268	0.069551	0.227074	-0.029415	0.133737	0.210335	0.171338	0.050173	0.124143	0.1260305	1.512367	0.085866086
20	0.012348	0.3571	0.005869	0.261311	-0.003833	0.294281	0.041417	0.08083	0.144339	0.030816	0.255222	0.231983	0.1426403	1.711683	0.130536933
21	0.127105	0.161687	0.015805	0.031876	0.388665	0.07719	0.115669	0.071338	0.179226	0.055519	0.222003	0.068663	0.1262288	1.514745	0.103155255
22	0.229446	-0.056708	0.241314	0.070091	0.075947	0.200756	0.244377	0.022873	0.17659	0.073074	0.110158	0.151721	0.1283031	1.539638	0.095087353
23	0.169683	0.021197	0.16083	0.054736	0.132176	0.267165	-0.018391	0.141854	0.236743	0.274034	0.006899	0.063194	0.1258434	1.510121	0.101155589
24	0.226674	0.026696	-0.009251	0.259704	0.208579	0.068979	0.131202	0.105269	0.073248	0.056994	0.278078	0.093022	0.1265995	1.519194	0.094603931
25	0.125654	0.120625	0.168224	-0.006122	0.266259	0.092622	0.05779	0.156338	0.145314	0.262169	-0.059927	0.281825	0.1342308	1.610769	0.105563498
26	0.130218	0.212979	0.002389	0.138445	0.160861	0.178533	-0.040747	0.180296	0.094786	0.247034	0.070806	0.14461	0.1266841	1.520209	0.083533221
27	0.137945	0.066493	0.150706	0.09748	0.223025	-0.073955	0.45344	-0.039924	0.137551	0.377726	-0.04368	0.096042	0.1319041	1.58285	0.160119692
28	0.156545	0.01412	0.143281	0.171849	0.135722	0.220541	-0.018465	0.225656	0.021478	0.199357	0.101409	0.239042	0.1342111	1.610533	0.087679733
29	0.10313	0.133463	0.07306	0.170957	0.116395	0.028024	0.206106	0.265694	0.029701	0.182065	0.062455	0.077388	0.120703	1.448436	0.073550681
30	0.086478	0.162352	0.271456	-0.072727	0.243491	0.020446	0.116477	0.306087	0.105979	0.014114	0.179443	0.15563	0.1324355	1.589226	0.111664128
31	0.036552	0.276285	0.095524	-0.020278	0.322172	0.124739	0.072553	0.139037	0.103131	0.21589	-0.025303	0.268354	0.1340546	1.608655	0.114972754
32	0.253803	-0.032271	0.172619	0.129705	0.092339	0.152577	0.045643	0.108125	0.085725	0.192983	0.107224	0.238039	0.1288758	1.54651	0.080397627
33	0.119686	0.109586	0.072589	0.162868	0.106139	0.147258	0.062025	0.089926	0.123844	0.237712	0.204116	0.037157	0.122742	1.472904	0.058085994
34	0.101232	0.18616	0.142618	0.001857	0.165328	0.135465	0.158776	0.056622	0.088102	0.091725	0.094093	0.297387	0.1266136	1.519363	0.074126461
35	-7.99E-05	0.351317	0.002691	0.22008	0.02802	0.164292	0.168854	0.054173	0.191511	0.060782	0.137422	0.184522	0.1302985	1.563582	0.104733662
Mean	0.128195	0.132047	0.111299	0.109376	0.142751	0.144296	0.098945	0.14876	0.104426	0.159153	0.100209	0.157715			
Std. Dev	0.068354	0.113513	0.098354	0.099838	0.089117	0.103964	0.110772	0.119923	0.080518	0.094244	0.10339	0.098297			

Net Profit Using the Activity Based Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Dollars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	14410.72	185525	39311.28	32253.7	120825	89280.98	51007.54	78810.24	6377.696	82954.35	92147.59	131882.2	77065.524	924786.3	52338.5095
2	21647.47	162687.6	69706.83	43969.15	29978.36	177614	40865.67	60285.05	41963.37	46751.91	131785.7	-416.9644	68903.174	826838.1	57064.9094
3	52224.57	72585.63	129811.5	76552.35	26528.05	143932.4	41560.37	190339.3	1387.54	73645.98	-820.2174	149057	79733.709	956804.5	61377.16319
4	78149.81	77282.18	42201	54669.95	65203.15	142199	38057.4	82255.12	44227.09	167637.3	-4837.692	187364	81200.701	974408.4	56889.27842
5	88903.5	56812.58	90226.87	35382.98	78734.39	106912	-90757.82	183859.1	104923.3	146229	-13667.3	61045.4	70717.006	848604.1	71661.58528
6	89623.07	73266.85	31905.39	76266.8	69452.89	128915.4	1104.261	111059.6	-1157.765	59043.55	190116.1	18739.17	70694.611	848335.3	55614.97734
7	16783.07	196101.9	-47814.2	120343.1	77873.33	182501.8	21922	-16284.27	135013	115263	-38974.74	128112.6	74236.717	890840.6	84711.30342
8	114942.2	21053.92	129523.2	-60099.82	162121.1	47917.23	105647.4	9372.531	123757	92704.06	45768.68	175372.3	80673.313	968079.8	69107.02755
9	85103.92	86020.61	92631.28	-28213.78	101702.7	50350.98	125821.2	53018.49	25011.36	46591.43	152814.1	58922.83	70814.593	849775.1	47657.19207
10	109411.2	-2044.345	149199	5050.64	49315.59	99215.19	33640.41	149749.4	87173.53	5586.35	53649.26	143816.9	73646.923	883763.1	57365.34812
11	71163.67	83638.55	56466.57	95744.93	48335.15	89454.46	70538.29	79766.04	89883.52	110468.1	103812.8	2349.979	75135.166	901622	29253.1802
12	86050.61	45513.46	44759.44	92914.31	101997.4	17160.45	114437.4	132113.4	23398.42	94793.65	55966.36	59933.16	72419.835	869038	36534.44003
13	110911.1	27249.15	82469.72	88912.59	52612.39	38010.33	122587.5	36004.92	-24050.08	179989	-2873.732	93616.02	67119.902	805438.8	57186.34568
14	41283.42	110633.5	35789.2	141349.8	48515.52	79564.55	15309.22	122481	78649.35	82297.6	26743.04	38766.87	68448.587	821383	40540.80603
15	77084.36	82082.63	24005.18	128067.3	80784.07	-37449.04	83306.74	160687.1	-5815.329	95529.45	122154.5	113117.3	76962.857	923554.3	57321.63171
16	111365.3	78060.44	-29912.56	91665.93	117293.6	-16102.97	138881	31590.56	100248.9	117003.2	72598.31	1225.784	67826.461	813917.5	57130.2538
17	127872.1	-2578.088	89795.51	127797.1	4496.509	51383.68	113851.5	10118.49	111153.7	47212.06	24993.77	103353.6	67454.161	809449.9	50243.3328
18	85835.16	-24279.37	217171.9	-16109.28	101797.1	144984.3	-46560.17	231609.5	-43792.67	73558.9	32370.43	140116.5	74725.193	896702.3	97036.61817
19	46728.52	122416.5	29572.74	136711.3	45421.82	117285.6	-19545.92	89651.13	124141.1	103059.9	33747.64	83451.8	76053.51	912642.1	48334.18031
20	9002.779	191565.9	4155.328	138155	-2527.262	152755.8	24209.39	51712.82	85769.27	22631.93	161478.2	122705.3	80134.543	961614.5	70340.40453
21	78633.69	92975.76	10902.33	23592.41	215799	44198.2	68334.75	46704.26	107605	33506.66	120869.9	42642.29	73813.696	885764.4	56104.40581
22	122665.7	-37105.8	138909.5	47852.47	55184.87	117771.1	129658.7	14802.3	104251.2	45639.33	65835.19	89602.95	74588.962	895067.5	52663.0651
23	101017.9	13942.35	105851.7	37989.99	92664.43	152732.7	-12798.97	100890.7	142068.3	142687.8	4005.227	42912.78	76997.084	923965	57652.34368
24	114178.4	14730.34	-6703.798	153337.5	115459.2	40933.1	76638.96	58099.25	44154.3	38569.41	163193.2	52382.28	72081.005	864972.1	53539.67529
25	76905.07	72888.22	99389.79	-4148.977	150827	57236.98	36527.46	100668.1	89387.22	119893	-37370.04	160131.3	76861.256	922335.1	58096.25158
26	80427.36	108471.4	1380.877	84980.75	87878.15	86610.84	-27795.87	108924.5	57647.19	141961.2	38934.32	81045.63	70872.199	850466.4	47295.44141
27	80566.83	40184.84	91403.69	64561.59	117788.3	-55527.26	229137.5	-27279.64	91329.78	197033.5	-24353.8	60709.19	72129.538	865554.5	85197.19301
28	91204.2	9999.305	96347.25	108506.2	80265.33	120836.1	-12495.9	137886.9	14377.33	121071.3	65863.8	136942.7	80900.376	970804.5	51438.64138
29	64946.64	78531.9	43750.09	100557.3	66576.54	20845.88	131601.5	143925.4	18546.6	101920	39725.72	47597.54	71543.753	858525	40970.97566
30	60380.57	104568.2	133385.7	-47681.95	141502.6	13532.16	84576.79	174296.8	58178.38	9654.305	114741.8	91057.88	78182.766	938193.2	63223.23003
31	25275.92	162225.5	55127.89	-13795.62	181389.2	72081.07	42499.57	81494.25	62432.76	116461.2	-17455.36	146146.3	76156.895	913882.7	64847.14268
32	124352.9	-20447.66	98857.28	77864.09	54744.16	81823.48	29075.77	67279.59	53266.59	121646.5	71155.91	135822.6	74620.106	895441.3	43806.92551
33	74476.16	66355.83	44811.82	101921.4	63549.07	95268.67	42967.61	63854.74	81460.06	155569.8	117632.9	23126.25	77582.853	930994.2	36137.27865
34	67324.79	105321.8	81488.07	1169.414	104618	81915.33	90482.19	37472.23	56028.91	63837.62	69951.29	167575.3	77265.409	927184.9	40522.76367
35	-56.14656	191405.9	1842.05	129603.3	17430.91	99650.73	100011.6	35232.08	114087	41928.23	92603.66	111329	77922.361	935068.3	58616.64534
Mean	74308.47	75646.92	65077.69	64219.83	83603.93	81022.72	56980.14	85498.6	62945.23	91838.02	60694.47	91473.02			
Std. Dev	34896.72	63961.25	55858.24	58189.85	48664.91	57578.66	63189.46	61069.4	47920.26	48577.13	61282.63	53334.17			

Gross Profit Using the Throughput Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Percent	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	0.396457	0.61182	0.426458	0.418952	0.511841	0.507311	0.445445	0.472984	0.386771	0.459485	0.45931	0.517452	0.4678572	5.614286	0.062614524
2	0.399792	0.582275	0.464167	0.433971	0.40954	0.589984	0.424264	0.453949	0.423328	0.430715	0.519943	0.379666	0.4592995	5.511594	0.068933447
3	0.436007	0.446833	0.523169	0.463156	0.397151	0.540388	0.416943	0.65854	0.387173	0.463541	0.37602	0.538534	0.4706212	5.647455	0.081807098
4	0.474162	0.475071	0.42734	0.449518	0.441433	0.530101	0.419227	0.466761	0.410447	0.572235	0.371679	0.599534	0.4697923	5.637508	0.067246605
5	0.489611	0.455849	0.489786	0.414457	0.464239	0.526717	0.303069	0.580865	0.502286	0.544016	0.370887	0.433373	0.4645962	5.575154	0.076754472
6	0.493025	0.478237	0.420296	0.464087	0.472495	0.557611	0.38263	0.518765	0.378334	0.431008	0.608854	0.399214	0.4670465	5.604558	0.070650391
7	0.40124	0.623897	0.33698	0.495637	0.458941	0.621228	0.413603	0.366552	0.535424	0.533647	0.338751	0.521586	0.4706238	5.647485	0.100838358
8	0.529223	0.410628	0.551189	0.326385	0.567406	0.433164	0.496808	0.389856	0.511819	0.47845	0.420248	0.614726	0.4774918	5.729901	0.083559148
9	0.483966	0.491909	0.51821	0.347671	0.4995	0.432562	0.529927	0.45114	0.41307	0.420286	0.55024	0.440008	0.4648741	5.578489	0.057932327
10	0.535038	0.38643	0.562313	0.390021	0.436104	0.496489	0.408351	0.553012	0.49116	0.392427	0.434576	0.559221	0.4704286	5.645143	0.070293417
11	0.463209	0.476345	0.446277	0.493145	0.429789	0.469981	0.457231	0.465132	0.468565	0.514077	0.526347	0.377589	0.4656406	5.587688	0.038635898
12	0.493464	0.435713	0.424626	0.482572	0.499433	0.398158	0.496956	0.552582	0.400671	0.48762	0.438782	0.450049	0.4633855	5.560626	0.04620274
13	0.521497	0.417552	0.472156	0.50634	0.443019	0.42597	0.53917	0.439368	0.359471	0.630801	0.376875	0.482366	0.4678822	5.614587	0.075052932
14	0.422682	0.50867	0.425205	0.556731	0.447367	0.483926	0.393831	0.518936	0.475116	0.496317	0.409498	0.417185	0.4629553	5.555463	0.051114017
15	0.47755	0.48852	0.411208	0.538776	0.491644	0.342877	0.453446	0.569259	0.374311	0.474682	0.519881	0.503976	0.4705109	5.646131	0.066167313
16	0.519774	0.496964	0.353014	0.480114	0.531424	0.371505	0.532271	0.410969	0.488717	0.515992	0.468641	0.37823	0.4623013	5.547616	0.066062672
17	0.546043	0.387138	0.483747	0.556555	0.389056	0.437356	0.530004	0.391429	0.509524	0.433504	0.397805	0.488123	0.4625236	5.550283	0.06430373
18	0.491491	0.368974	0.647174	0.371437	0.49594	0.581263	0.341926	0.746407	0.337854	0.472112	0.413269	0.561548	0.485783	5.829396	0.129230859
19	0.434686	0.523494	0.415178	0.545726	0.432451	0.541847	0.361157	0.46926	0.51538	0.496567	0.409209	0.462106	0.4672551	5.607061	0.058543336
20	0.384018	0.628967	0.3933	0.558141	0.376685	0.586038	0.410203	0.439105	0.477173	0.394511	0.544609	0.535326	0.4773399	5.728078	0.089419936
21	0.470154	0.498222	0.400805	0.398769	0.635864	0.434962	0.456996	0.430669	0.498033	0.411463	0.525219	0.429996	0.4659293	5.591151	0.067268775
22	0.549136	0.345615	0.549813	0.438994	0.430602	0.512127	0.551603	0.40084	0.498888	0.433087	0.448676	0.475768	0.4695957	5.635149	0.065030014
23	0.503051	0.393339	0.493906	0.408276	0.465066	0.558257	0.366662	0.469012	0.542863	0.565589	0.377765	0.429007	0.4643994	5.572793	0.070130952
24	0.542854	0.40637	0.374641	0.556613	0.526538	0.43722	0.476152	0.448998	0.42825	0.422688	0.564131	0.445718	0.4691811	5.630173	0.063335617
25	0.471007	0.47255	0.517753	0.380593	0.558792	0.457761	0.414203	0.484061	0.474672	0.550767	0.337465	0.569812	0.4741197	5.689437	0.071028756
26	0.471348	0.539669	0.390465	0.467346	0.49448	0.513013	0.358711	0.499399	0.444502	0.556635	0.429166	0.475648	0.4700318	5.640382	0.057794678
27	0.483219	0.431688	0.479218	0.451785	0.52985	0.332514	0.686453	0.357063	0.460404	0.646973	0.347828	0.447707	0.4712251	5.654702	0.109114882
28	0.498264	0.398481	0.474699	0.500305	0.473864	0.527603	0.370416	0.526634	0.398159	0.50797	0.449927	0.543946	0.4725224	5.670269	0.056976231
29	0.458734	0.472099	0.433809	0.503887	0.461037	0.399546	0.513691	0.561978	0.402701	0.49406	0.42441	0.431707	0.4631385	5.557662	0.048701519
30	0.444063	0.498658	0.580053	0.339869	0.544801	0.392098	0.457786	0.585299	0.45766	0.388326	0.502943	0.478655	0.4725176	5.670212	0.076010545
31	0.409417	0.573554	0.456467	0.361677	0.593585	0.472801	0.42698	0.47836	0.44862	0.525441	0.363237	0.562452	0.4727158	5.67259	0.077986162
32	0.559882	0.363035	0.507369	0.474342	0.44682	0.488269	0.415424	0.453692	0.429653	0.507557	0.45027	0.541956	0.469856	5.638271	0.055313984
33	0.465669	0.456643	0.432841	0.499059	0.456188	0.485725	0.430349	0.436968	0.446899	0.539214	0.507362	0.402633	0.4632956	5.559548	0.038426817
34	0.458974	0.508865	0.488549	0.379988	0.498556	0.473548	0.48465	0.428129	0.430982	0.431899	0.435533	0.570367	0.4658367	5.59004	0.049453039
35	0.379108	0.626292	0.382224	0.527519	0.405146	0.488613	0.489488	0.407568	0.513413	0.422771	0.466829	0.498076	0.467254	5.607048	0.072208539
Mean	0.473081	0.476582	0.461554	0.45664	0.477619	0.481387	0.447315	0.482387	0.449208	0.487041	0.44532	0.484665			
Std. Dev	0.049184	0.077685	0.068231	0.068095	0.058796	0.07078	0.07412	0.082098	0.053287	0.064952	0.069859	0.066022			

Gross Profit Using the Throughput Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Dollars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	297157.1	352121.9	255495.5	280476.1	291387	269255.3	270409.8	276839.7	271657.6	308199	323986.4	320826	293150.94	3517811	28339.94817
2	289452.9	332665.9	271011.2	258866.2	288327.3	337565.6	235416.5	250467.5	254551.9	286236.3	321140.7	296234.4	285161.37	3421936	32968.89602
3	296202.3	333872.3	340229.9	287063.3	259794.4	347022.3	317042.3	307824.1	233983.6	272373.7	275141.8	321288	299319.83	3591838	34789.93256
4	260689.4	279849.7	269761	282716.1	316114	335828.5	261530.5	301937.4	292091	324580.8	259349.9	339704.9	293679.43	3524153	29553.9039
5	285853.7	269199.3	294549.9	253611.1	279719.9	280762.4	238587	366984.9	305248.4	327321.5	261472.1	301289.4	288716.63	3464600	34513.02208
6	278777.5	258237.1	271233.1	276604.9	268101.6	300441.9	238415	290053.6	240365.6	310932.7	348318.6	248920	277533.46	3330402	31682.29843
7	265152.5	352364.5	231744	348631.4	295144.5	323093.9	212987.9	252181.1	306190.4	265654.2	231903.7	310314.6	282946.89	3395363	46580.02949
8	307954.2	236788.1	310300	233946.7	326742.2	277377.6	303968.6	253270.4	325880.7	303435.3	290431.6	312138.6	290186.16	3482234	32640.25241
9	289937.9	278745.2	255792.6	219950.9	296361.5	260777.1	300534.9	249411	267341.4	289078.6	329788.3	285939	276971.55	3323659	28498.10562
10	270239.5	250461.2	317439	207079.2	278698.3	298242.1	278212.8	329490.4	274267.3	238754.5	294875.4	301699.9	278288.29	3339459	34198.5597
11	301695.1	302642.4	273311.9	285337.8	292277	294911.3	292642.4	283435.3	304714.1	284612.3	267283.5	228199.8	284255.23	3411063	21021.6958
12	281809.9	280548.1	269450.8	294839.1	286354.4	263214.1	316270.9	308144.6	246605.3	289419.1	273874.1	284517.5	282920.65	3395048	18888.19024
13	295268.4	246299.3	291741.1	260709.1	260527.4	242649.3	279711.2	230706.4	245172.4	315307.4	233198.6	289377	265888.95	3190667	27685.6873
14	270162.7	293934.5	272568.2	306211.5	269504.6	270111.2	250054.7	323714.5	247911.1	256562.3	229741.5	245172.4	269637.43	3235649	27099.40109
15	280566	275296.1	267784.6	306409.8	247139.6	226330	314299	327481.4	254024.3	317477.9	301526.9	293119.9	284287.96	3411455	31267.97631
16	293588.3	255221.4	220608.6	295067.4	289848.8	267225.8	312583.7	273559.2	296829.4	297623	256837.9	256539.9	276294.44	3315533	25993.40558
17	298403.2	251749.9	286957.2	279937	226863.9	279890.7	289869.4	231958.4	292068.7	255432.6	281590.1	313484.9	274017.17	3288206	26726.65371
18	267217.7	285969.3	363660.2	250859.1	293013.1	277286.7	241935.1	328548.8	199547.2	270757.3	272914.7	301636.1	279445.44	3353345	41672.50149
19	293334.8	307375	282726.3	318468.6	282421.9	279868.4	239987.9	314571.3	304180	298685.3	275243.4	310637.9	292291.73	3507501	21947.41938
20	279989.3	337408.3	278451.1	295088.6	248375.1	304200.9	239776.8	280927.3	283546.7	289738.4	344573.1	283156.1	288769.32	3465232	30293.42542
21	290862	286495.3	276481.7	295144.2	353052	249054.8	269983.2	281954.2	299013	248323.8	285955.8	267044.7	283613.72	3403365	27322.54714
22	293578	226147.1	316493.5	299709.6	312886.8	300433.8	292663.3	259398.9	294522.1	270491.6	268148	280978.2	284620.9	3415451	25361.17948
23	299482.6	258721.3	325068.5	283366.5	326042.9	319144.1	255168.3	333575.8	325769.1	294498.4	219296.9	291322.7	294288.08	3531457	35268.24915
24	273442.2	224227.7	271486.1	328642.6	291465.5	259451.1	278133.8	247807.8	258152	286042.2	331067	250991.3	275075.78	3300909	31417.84045
25	288275.1	285541.9	305897.9	257923.6	316538.1	282880.5	261805.3	311693	291985.1	251872.7	210439.4	323763.6	282384.68	3388616	32412.89143
26	291122.3	274856.9	225684.8	286867.4	270133.9	248875.9	244697.1	301708.3	270338.6	319877.4	235986.2	266574.4	269726.94	3236723	27741.73764
27	282223.4	260891.5	290646.5	299218.5	279834.6	249659.8	346886	243976.6	305694	337480.8	193929.6	282999.9	281120.1	3373441	41463.067
28	290292.8	282200.6	319204	315895.7	280241.1	289078	250672.8	321799.5	266528.9	308495.4	292221.7	311616.5	294020.59	3528247	22175.96338
29	288890.6	277790.2	259776.1	296388.1	263707.6	297211	327999	304421.6	251468	276575	269954.1	265522.8	281642.02	3379704	22007.11255
30	310053	321176.1	285021.3	222827.8	316606.9	259503.2	332409.6	333289.6	251238.9	265628.2	321598.6	280057.3	291617.53	3499410	36161.07163
31	283116.4	336771.5	263432.9	246062.9	334200.5	273210.9	250113.7	280382.3	271581.5	283447.9	250575.7	306312.8	281600.74	3379209	30370.74602
32	274319.1	230024.6	290565.9	284754.6	264903.2	261847.9	264636.1	282306.1	266972.9	319936.9	298807	309234.3	279025.72	3348309	24166.9479
33	289768.9	276503.5	267209.7	312306.9	273136.4	314239.7	298123.6	310283.6	293953.7	352886.5	292395.1	250594.5	294283.5	3531402	26726.3012
34	305241.4	287895.6	279144.4	239320.7	315481.9	286354.5	276189.9	283332.8	274084.9	300588.3	323786.9	321397.7	291068.22	3492819	23931.40203
35	266347.2	341219.3	261673.8	310651.3	252039.1	296366.6	289923.1	265066.1	305850.2	291633	314580.1	300508.8	291321.54	3495859	26046.36409
Mean	286584.8	284320.4	281788.7	280598.7	287056.8	283524.8	276389.7	289785.8	276380.9	291713.2	279483.8	290089			
Std. Dev	12571.07	36107.01	30169.68	32212.68	27552.52	28234.19	32566.64	33465	28106.96	26624.43	38912.07	26445.1			

Net Profit Using the Throughput Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Percent	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	0.075824	0.273227	0.100208	0.097527	0.195952	0.170988	0.117941	0.149706	0.071364	0.146623	0.151159	0.206619	0.1464282	1.757138	0.059351299
2	0.082822	0.248009	0.135572	0.109768	0.092068	0.264982	0.110092	0.132755	0.109015	0.113428	0.200428	0.067499	0.1388699	1.666439	0.06416778
3	0.1111	0.12527	0.195069	0.143365	0.087744	0.211477	0.099846	0.32738	0.063712	0.145195	0.068244	0.226085	0.1503741	1.804489	0.07732729
4	0.152074	0.147392	0.104645	0.120463	0.122508	0.207665	0.104265	0.147086	0.103432	0.258788	0.061427	0.280458	0.1508503	1.810203	0.06604499
5	0.160352	0.124859	0.160049	0.094915	0.148799	0.191079	-0.007191	0.257527	0.173657	0.217088	0.057369	0.121503	0.1416673	1.700007	0.071002155
6	0.163008	0.145797	0.096062	0.142692	0.146253	0.217889	0.061272	0.192099	0.062137	0.12039	0.283435	0.081397	0.1427025	1.71243	0.065979696
7	0.078623	0.285695	0.018811	0.175262	0.141787	0.287627	0.090107	0.050939	0.21707	0.209292	0.028352	0.206546	0.1491759	1.790111	0.095235095
8	0.188093	0.086399	0.210501	0.008301	0.244883	0.113174	0.17544	0.074309	0.191258	0.157029	0.109028	0.291012	0.1541189	1.849426	0.079247356
9	0.153695	0.16013	0.177134	0.030618	0.177602	0.117932	0.204631	0.126427	0.090461	0.107593	0.231367	0.124771	0.1418634	1.702361	0.054138549
10	0.200589	0.06133	0.22835	0.067718	0.114924	0.170357	0.094301	0.226982	0.163441	0.069572	0.11837	0.23986	0.1463162	1.755794	0.067126625
11	0.132488	0.147648	0.121953	0.167817	0.109475	0.156721	0.138686	0.146588	0.153559	0.193853	0.195163	0.066441	0.1441994	1.730393	0.035415885
12	0.158476	0.109155	0.106111	0.161183	0.177252	0.080137	0.181855	0.21934	0.085577	0.169594	0.122634	0.131492	0.1419005	1.702806	0.04272126
13	0.186825	0.09279	0.145747	0.17596	0.118677	0.106165	0.214332	0.104087	0.04159	0.299212	0.060536	0.166115	0.1426696	1.712036	0.071417986
14	0.103996	0.183747	0.100196	0.225956	0.116183	0.153453	0.079481	0.193856	0.155201	0.16909	0.093854	0.106604	0.1401348	1.681618	0.046530598
15	0.149252	0.154284	0.084825	0.207705	0.163112	0.026287	0.142542	0.246988	0.060294	0.157511	0.19913	0.188753	0.1483903	1.780684	0.063620829
16	0.184567	0.159809	0.031131	0.161185	0.199768	0.050092	0.215867	0.094331	0.173354	0.194794	0.148824	0.068397	0.1401765	1.682118	0.06288247
17	0.211545	0.059354	0.160832	0.226174	0.06541	0.115041	0.201325	0.073291	0.188036	0.115738	0.087007	0.172961	0.1397262	1.676714	0.060805183
18	0.16017	0.045351	0.313602	0.048616	0.172829	0.254716	0.020793	0.402502	0.015852	0.149193	0.097057	0.235385	0.1596722	1.916066	0.123216199
19	0.109039	0.195503	0.089854	0.213624	0.107606	0.2107	0.044631	0.151119	0.20087	0.175661	0.095916	0.148369	0.1452409	1.742891	0.055515462
20	0.069808	0.29233	0.068799	0.229199	0.059479	0.256067	0.088641	0.116924	0.15789	0.084503	0.229854	0.215837	0.1557776	1.869331	0.084488116
21	0.145136	0.164857	0.072845	0.084283	0.314381	0.111943	0.137569	0.111503	0.178146	0.102928	0.208433	0.110635	0.1452216	1.742659	0.066277678
22	0.209615	0.024003	0.219708	0.108301	0.113727	0.193538	0.221702	0.076605	0.178335	0.11332	0.136051	0.164733	0.1466364	1.759637	0.061931625
23	0.17019	0.077227	0.166059	0.097349	0.151925	0.235552	0.054686	0.154955	0.221461	0.237224	0.067861	0.110139	0.1453858	1.74463	0.064639437
24	0.207071	0.079832	0.05586	0.231653	0.194847	0.108667	0.146813	0.129861	0.109988	0.104999	0.243625	0.12567	0.1449071	1.738885	0.060691447
25	0.141138	0.139498	0.175744	0.058663	0.229906	0.127563	0.099811	0.167099	0.15601	0.233493	0.027077	0.246821	0.1502353	1.802823	0.067678916
26	0.145695	0.19738	0.065042	0.146393	0.167551	0.178388	0.03833	0.179088	0.12711	0.225524	0.111418	0.154436	0.1446963	1.736356	0.053362458
27	0.151814	0.105136	0.15713	0.128472	0.203702	0.016259	0.354987	0.040378	0.149021	0.312862	0.034788	0.127518	0.1485056	1.782067	0.103403664
28	0.16052	0.073862	0.151023	0.177741	0.152039	0.202231	0.055567	0.208164	0.078893	0.193022	0.133734	0.21939	0.1505156	1.806187	0.055345714
29	0.128555	0.148007	0.109877	0.170762	0.138736	0.08194	0.197659	0.236411	0.083747	0.180797	0.108314	0.113606	0.1415343	1.698412	0.04723465
30	0.117869	0.170529	0.232592	0.016533	0.220246	0.07692	0.138126	0.262687	0.131865	0.074709	0.184367	0.164258	0.1492251	1.790701	0.071718031
31	0.087185	0.23918	0.125675	0.048903	0.269263	0.144244	0.108234	0.155624	0.131193	0.204565	0.04886	0.239411	0.1501947	1.802337	0.074038109
32	0.224176	0.038236	0.178038	0.143894	0.119793	0.167195	0.09258	0.133641	0.117812	0.187522	0.137651	0.2181	0.1465531	1.758637	0.052812523
33	0.138162	0.132652	0.109311	0.167628	0.133379	0.159224	0.106705	0.12511	0.142617	0.22001	0.196464	0.09133	0.1435493	1.722591	0.037319866
34	0.12745	0.182127	0.151703	0.064872	0.170005	0.151159	0.165501	0.102778	0.119959	0.125044	0.128983	0.254884	0.1453721	1.744465	0.04707129
35	0.061947	0.290135	0.062193	0.20534	0.085212	0.1685	0.169508	0.097868	0.192583	0.103629	0.156603	0.184624	0.1481786	1.778143	0.068069442
Mean	0.144254	0.14745	0.133779	0.13311	0.155058	0.156739	0.127618	0.160457	0.131329	0.167823	0.130382	0.167762			
Std. Dev	0.043255	0.073219	0.063257	0.064416	0.056909	0.066754	0.071065	0.077699	0.052274	0.060717	0.066802	0.063556			

Net Profit Using the Throughput Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Dollars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	56832.86	157250.8	60035.7	65291.58	111553.8	90751.77	71596.79	87623.48	50124.26	98347.33	106624.2	128105.9	90344.867	1084138	32089.78253
2	59963.84	141692.9	79156.01	65477.55	64818.07	151612.2	61088.16	73247.8	65552.01	75379.56	123793.5	52666.45	84537.338	1014448	34150.94993
3	75476.16	93601.09	126858.4	88857.55	57397.21	135804.9	75922.35	153028.8	38503.9	85315.78	49935.57	134882.1	92965.32	1115584	37054.54679
4	83608.77	86823.95	66057.64	75762.84	87729.22	131559.8	65044.63	95146.89	73606.1	146788.9	42862.51	158911.8	92825.259	1113903	35132.53001
5	93619.9	73734.92	96251.17	58079.65	89656.51	101853.1	-5660.989	162702.9	105534.8	130616.9	40444.72	84471.3	85942.076	1031305	42738.89578
6	92171.55	78727.06	61992.15	85047.36	82986.14	117398.9	38178.23	107407.1	39476.94	86850.54	162150	50753.33	83594.95	1003139	35091.17416
7	51956.39	161354.7	12936.66	123279.6	91182.84	149591.8	46401.53	35045.14	124134.9	104187.4	19409.22	122883.5	86863.638	1042364	51673.23224
8	109451.3	49821.67	118504.5	5950.051	141016.1	72471.26	107342	48274.76	121776	99588.64	75348.78	147766.9	91442.667	1097312	42049.2672
9	92076.77	90739.4	87434.46	19370.27	105374.1	71097.41	116051.1	69894.85	58546.87	74004.06	138670.6	81082.52	83695.205	1004342	29989.48816
10	101314.2	39750.7	128908.8	35954.66	73443.59	102333.9	64247.7	135238.5	91266.73	42327.89	80317.9	129404.7	85375.781	1024509	35532.12487
11	86291.32	93806.94	74687.36	97100.02	74448.32	98342.14	88763.74	89325.57	99861.89	107324.1	99105.5	40154.26	87434.266	1049211	17869.36748
12	90503.19	70282.75	67334	98478.84	101629.1	52977.21	115735.1	122313.8	52670.71	100659.6	76544.63	83128.37	86021.45	1032257	22828.38437
13	105779.3	54733.66	90056	90599.73	69790.91	60475.49	111191.3	54654.58	28365.86	149561.6	37457.85	99654.16	79360.043	952320.5	34789.32511
14	66470.24	106178.2	64228.68	124279.6	69991.64	85652.23	50464.81	120928.5	80982.4	87408.18	52654.96	62649.16	80990.718	971888.6	24954.92048
15	87687.46	86944.07	55239.38	118125.1	81993.09	17352	98800.53	142086.5	40918.13	105346.6	115493.6	109781.7	88314.016	1059768	35416.97257
16	104250.4	82071.72	19454.59	99060.58	108957.1	36031.51	126770.7	62790.9	105288.9	112356.6	81562.67	46391.19	82082.245	984986.9	33902.62631
17	115606	38596.86	95405.16	113761.6	38141.36	73621.98	110108.5	43431.78	107785.7	68195.75	61588.61	111080	81443.617	977323.4	31023.5737
18	87082.67	35148.6	176219.3	32834.03	102111.4	121510	14712.37	177170.7	9362.765	85562.67	64094.62	126437.2	86020.528	1032246	57569.09228
19	73581.69	114791.5	61188.13	124664.2	70274.16	108828.1	29657.35	101303.9	118554.3	105659.9	64515.28	99737.22	89396.312	1072756	28965.52951
20	50897.63	156820.2	48708.54	121177	39218.41	132919.5	51813.58	74804.64	93821.49	62061.3	145428.1	114165.3	90986.298	1091836	41801.05138
21	89788.84	94798.73	50249.45	62381.5	174554.5	64097.7	81272.58	72999.87	106956.8	62118.17	113481.3	68708.76	86784.019	1041408	33705.99628
22	112064.1	15705.61	126472.3	73939.12	82636.97	113536.9	117628	49574.2	105281.4	70775.69	81310.18	97287.56	87184.329	1046212	31961.6106
23	101319.9	50796.47	109293.1	67566.03	106510	134660.3	38057.6	110208.6	132897.6	123521.2	39393.84	74791.04	90751.319	1089016	35243.94398
24	104304.3	44050.09	40478.94	136775.4	107857.4	64483.94	85757.92	71672.02	66301.57	71055.29	142974.1	70766.61	83873.129	1006478	32927.4392
25	86382.41	84292.45	103832.8	39755.18	130234.6	78829.24	63087.86	107597.5	95966.47	106779.3	16884.64	140242	87823.707	1053884	35251.72455
26	89986.86	100527.2	37593.56	89859.56	91532.77	86540.58	26147.02	108195.1	77306.2	129600	61265.4	86553.01	82092.272	985107.3	28756.54137
27	88666.98	63538.98	95299.45	85087.33	107583.3	12207.57	179386.2	27589.45	98945.31	163198.6	19395.74	80605.42	85125.352	1021504	51545.30219
28	93520.14	52308.62	101553.2	112226.6	89915.53	110803.9	37603.76	127198.5	52811.32	117224.5	86858.67	125684.4	92309.103	1107709	30099.64273
29	80958.31	87089.75	65797.29	100442.6	79355.48	60952.62	126208	128063.3	52296.2	101210.2	68895.11	69873.86	85095.219	1021143	24515.23753
30	82298.54	109834.3	114289.3	10839.22	127994	50908	100296.5	149583.2	72389.23	51103.57	117890.7	96105.97	90294.372	1083532	38816.83834
31	60289.12	140438.6	72528.57	33270.89	151600.4	83351.96	63400.67	91216.25	79420.71	110351.9	33705.64	130384.1	87496.572	1049959	39020.84145
32	109836.9	24227.07	101960.7	86381.42	71020.59	89662.89	58976.05	83156.99	73204.76	118203.7	91347.82	124445.4	86035.359	1032424	27506.34645
33	85972.91	80322.43	67482.18	104900	79858.63	103010.1	73919.56	88838.69	93808.02	143985	113223.4	56842.76	91013.639	1092164	23210.99724
34	84760.74	103040.1	86679.23	40857.19	107577.9	91406.01	94314.88	68017.54	76288.69	87026.36	95889.43	143625.5	89956.964	1079484	24389.9049
35	43521.9	158072.8	42577.99	120923	53010.15	102203.2	100399.5	63649.47	114725.6	71484.57	105529	111390.7	90623.98	1087488	35633.33067
Mean	85665.53	86340.42	80192.71	80238.77	92084.44	90252.58	76705.3	94399.48	80135.27	98719.47	80744.22	98897.55			
Std. Dev	18413.66	39373.15	34083.26	35702.01	29609.72	34336.49	37974.96	37593.65	30120.64	28834.1	38455.07	32210.01			

Gross Profit Using the M-K Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Percent	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	0.050686	0.307323	0.089991	0.076032	0.200434	0.166939	0.101548	0.15197	0.04512	0.133487	0.130949	0.210527	0.138751	1.665006	0.075467
2	0.069492	0.25582	0.157998	0.096571	0.063954	0.273763	0.097013	0.122747	0.082895	0.085429	0.215624	0.029448	0.12923	1.550755	0.079318
3	0.091973	0.129479	0.185983	0.146422	0.065836	0.216535	0.077128	0.3383	0.061651	0.118848	0.02338	0.179913	0.136287	1.635448	0.085716
4	0.179462	0.148474	0.069899	0.112758	0.089006	0.230169	0.096927	0.108902	0.088094	0.282218	0.032457	0.300782	0.144929	1.739147	0.08575
5	0.159064	0.115364	0.172599	0.068439	0.138218	0.231594	-0.076881	0.186934	0.204512	0.29751	0.010229	0.070055	0.13147	1.577638	0.102077
6	0.19517	0.134807	0.059378	0.149604	0.139583	0.247085	0.010246	0.220665	0.026927	0.089801	0.312258	0.031314	0.134737	1.616839	0.09579
7	0.053962	0.341751	-0.025979	0.182078	0.115756	0.337122	0.062729	0.020021	0.196407	0.257195	-0.030397	0.220675	0.144277	1.73132	0.131244
8	0.206875	0.059662	0.223855	-0.031981	0.286777	0.080606	0.194467	0.026006	0.169055	0.16514	0.09147	0.325567	0.149792	1.7975	0.106892
9	0.15654	0.178866	0.165658	0.01574	0.176802	0.095379	0.222404	0.103046	0.072355	0.086706	0.230329	0.107827	0.134304	1.611651	0.064389
10	0.21058	0.047025	0.24593	0.049122	0.104064	0.170307	0.070267	0.254576	0.143231	0.051262	0.087828	0.23743	0.139302	1.671623	0.081687
11	0.117347	0.151569	0.131709	0.166519	0.076642	0.166413	0.110004	0.137307	0.15684	0.203165	0.200041	0.014884	0.136037	1.63244	0.052554
12	0.169171	0.099989	0.082531	0.157252	0.164694	0.064946	0.198623	0.221978	0.070479	0.16837	0.093741	0.116483	0.134022	1.608259	0.052531
13	0.196737	0.088527	0.128353	0.213502	0.10514	0.097837	0.239144	0.052285	-0.005598	0.350014	0.030247	0.161154	0.138112	1.657341	0.099854
14	0.095362	0.192201	0.092052	0.226016	0.112069	0.160373	0.058648	0.185832	0.162377	0.175213	0.045177	0.097225	0.133546	1.602546	0.057518
15	0.151845	0.134597	0.085575	0.221181	0.163891	-0.004776	0.135046	0.244591	0.041481	0.11584	0.24101	0.176392	0.142223	1.706671	0.076262
16	0.196369	0.181537	-0.007057	0.162973	0.213535	-0.004153	0.258143	0.058348	0.170687	0.203526	0.12304	0.042629	0.133298	1.599577	0.089481
17	0.242073	0.027404	0.162565	0.262041	0.030054	0.095125	0.220312	0.027342	0.224975	0.05847	0.071076	0.171472	0.132742	1.592909	0.090815
18	0.167143	0.012496	0.35405	0.008126	0.162484	0.340215	-0.043488	0.483044	-0.043369	0.146405	0.072803	0.253255	0.15943	1.913164	0.170192
19	0.092145	0.190867	0.079603	0.248373	0.083344	0.23293	-0.017179	0.159989	0.20596	0.175959	0.07261	0.112591	0.136433	1.637192	0.078627
20	0.047112	0.289374	0.065013	0.266291	0.038058	0.261721	0.069614	0.093535	0.167046	0.047235	0.254116	0.214011	0.151094	1.813124	0.100542
21	0.144846	0.138361	0.074652	0.066027	0.353074	0.109261	0.104711	0.101369	0.185066	0.087688	0.19729	0.072273	0.136218	1.634619	0.080519
22	0.222286	-0.010347	0.24407	0.084607	0.103327	0.196568	0.260081	0.028012	0.186226	0.091119	0.124543	0.143828	0.139527	1.674321	0.085044
23	0.184617	0.047064	0.170711	0.075216	0.116492	0.283038	0.027643	0.141167	0.216639	0.266384	0.054143	0.063333	0.137204	1.646448	0.087598
24	0.233954	0.058648	0.016319	0.272779	0.196708	0.103256	0.135249	0.11025	0.082551	0.097517	0.257817	0.113245	0.139858	1.678294	0.081769
25	0.140867	0.13869	0.19548	0.00992	0.246831	0.119498	0.087577	0.152611	0.152606	0.281435	-0.034646	0.243647	0.144543	1.734516	0.093372
26	0.166644	0.198478	0.043191	0.141234	0.174098	0.17951	-0.007024	0.18316	0.106898	0.254108	0.093017	0.145649	0.139914	1.678963	0.07139
27	0.152161	0.097255	0.138597	0.136443	0.225835	-0.029482	0.397467	0.002188	0.146137	0.337692	-0.011165	0.120155	0.142774	1.713283	0.129907
28	0.158423	0.052316	0.142206	0.17955	0.167936	0.224609	0.004041	0.227695	0.040361	0.198571	0.109335	0.225368	0.144201	1.730412	0.076921
29	0.120703	0.144933	0.107233	0.162353	0.139803	0.056243	0.192133	0.279157	0.064469	0.169994	0.071715	0.086605	0.132945	1.595342	0.063668
30	0.104625	0.174359	0.269854	-0.036529	0.246511	0.043252	0.11964	0.288495	0.127658	0.034862	0.188931	0.163899	0.143796	1.725557	0.098915
31	0.065772	0.272391	0.118869	0.008945	0.301707	0.145095	0.081582	0.169034	0.113146	0.201943	0.007692	0.257898	0.14534	1.744076	0.098494
32	0.261224	-0.008247	0.190653	0.137205	0.113189	0.188844	0.037137	0.144566	0.050865	0.236717	0.124579	0.223036	0.141647	1.699767	0.083857
33	0.135072	0.130645	0.082736	0.16787	0.150581	0.140414	0.086412	0.094827	0.102216	0.240339	0.227094	0.067723	0.135494	1.625931	0.054982
34	0.130009	0.181869	0.151884	0.046157	0.158321	0.141218	0.176059	0.077594	0.095718	0.122127	0.088377	0.220932	0.132522	1.590263	0.049687
35	0.040744	0.321136	0.050223	0.20147	0.058363	0.170861	0.17267	0.074055	0.201502	0.070563	0.129878	0.190868	0.140195	1.682335	0.084653
Mean	0.14603	0.143562	0.12904	0.127152	0.150946	0.158066	0.113146	0.150617	0.11752	0.168653	0.112474	0.154631			
Std. Dev	0.059076	0.092029	0.080785	0.086299	0.075436	0.091669	0.098923	0.10155	0.068302	0.087028	0.089732	0.080966			

Gross Profit Using the M-K Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Dollars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	37990.62	176874.3	53914.7	50901.18	114105.3	88603.16	61645.33	88948.49	31690.91	89536.16	92368.68	130529	84758.98	1017108	41767.6
2	50312.93	146155.5	92249.86	57605.42	45025.17	156636.2	53830.67	67725.84	49845.95	56772.96	133179.3	22976.51	77693.02	932316.3	44010.22
3	62482.37	96746.47	120949.4	90751.91	43066.2	139052.8	58647.98	158132.9	37257.87	69834.42	17107.81	107335.5	83447.13	1001366	42939.77
4	98666.46	87461.49	44124.24	70916.78	63737.71	145816.2	60467.21	70445.97	62691.28	160078.3	22647.52	170427.7	88123.41	1057481	46932.69
5	92867.92	68127.38	103798.5	41878.41	83281.23	123449.6	-60523.27	118103.2	124285.5	179004.5	7211.702	48703.44	77515.68	930188.2	62805.69
6	110357.5	72792.75	38319.06	89167.01	79201.89	133130	6384.065	123379.3	17107.1	64783.31	178639.5	19524.77	77732.19	932786.3	52597.71
7	35660.07	193013.9	-17866.05	128073.9	74442.77	175333.2	32302.92	13774.17	112318.4	128034	-20809.07	131289.1	82130.61	985567.3	72924.32
8	120380.2	34403.96	126022.4	-22923.09	165141.3	51616.1	118983.3	16895.02	107639.3	104732.7	63214.64	165312.8	87618.22	1051419	58942.67
9	93781.09	101356.4	81769.84	9957.836	104899.3	57500.91	126131	56968.74	46828.62	59637.56	138048.3	70071.04	78912.56	946950.7	36066.5
10	106360.6	30478.86	138833.6	26081.3	66503.48	102303.5	47873.6	151679.3	79981.34	31188.09	59594.61	128093.3	80747.63	968971.6	44180.12
11	76429.69	96298.52	80662.12	96348.95	52120.23	104423.2	70406.44	83670.13	101995.1	112480	101582.4	8995.287	82117.66	985411.9	28632.12
12	96610.88	64381.5	52370.75	96076.98	94429.12	42934.68	126406.9	123784.8	43378.59	99933.48	58510.53	73639.87	81038.18	972458.1	29267.17
13	111391.1	52218.69	79307.88	109929.9	61829.65	55732.02	124063.3	27454.02	-3818.127	174955.2	18716.06	96678.5	75704.85	908458.3	50569.23
14	60951.74	111063	59008.07	124312.5	67513.1	89514.98	37237.52	115923	84726.8	90573.43	25345.96	57137.48	76942.3	923307.6	31085.31
15	89210.36	75849.78	55727.57	125788.8	82384.7	-3152.702	93604.66	140707.3	28150.52	77476.27	139783.9	102592.1	84010.28	1008123	42815.27
16	110917	93230.54	-4410.202	100159.7	116465.9	-2987.58	151598.2	38838.77	103669.2	117393.2	67431.67	28913.67	76768.34	921220.1	50722.59
17	132289	17820.29	96432.84	131801.9	17525.16	60876.13	120493.1	16202.7	128960	34452.14	50311.68	110123.6	76440.71	917288.6	48280.47
18	90873.58	9684.605	198947.9	5488.25	95999.2	162296.9	-30770.33	212623.1	-25615.34	83963.66	48077.55	136036.4	82300.46	987605.5	83620.75
19	62181.28	112069.4	54207.88	144942.8	54429.48	120310.3	-11415.46	107249.7	121558.7	105839.5	48838.93	75686.5	82991.59	995899.1	43572.18
20	34349.66	155234.4	46028.21	140787.8	25094.21	135854.2	40691.49	59840.99	99262.12	34690.13	160778.6	113199.1	87150.9	1045811	52325.06
21	89609.11	79562.57	51496.39	48869.43	196038.2	62561.49	61861.15	66365.48	111111.4	52920.66	107414.9	44884.44	81057.93	972695.2	42459
22	118838	-6770.175	140496.1	57762.79	75080.31	115314.7	137990.8	18127.66	109940	56910.09	74432.13	84941.54	81921.98	983063.8	45820.6
23	109908.4	30956.77	112354.7	52204.16	81668.9	161806.9	19237.39	100402	130003.9	138704.5	31430.81	43007.41	84307.16	1011686	48028.49
24	117845.6	32360.81	11825.32	161057.8	108887.9	61273.51	79002.78	60848.46	49762.52	65991.63	151303.1	63770.17	80327.47	963929.6	45656.53
25	86216.45	83804.53	115493.3	6722.675	139821.9	73845.39	55354.58	98268	93872.41	128703.9	-21604.96	138438.6	83244.73	998936.7	49924.42
26	102925.5	101086.3	24964.11	86692.69	95109.57	87084.88	-4791.649	110654.8	65013.54	146026.3	51147.46	81628.16	78961.8	947541.7	40292.16
27	88869.22	58776.34	84059.41	90366.95	119272.3	-22135.81	200852.4	1495.173	97030.32	176150.4	-6225.235	75951	80371.88	964462.5	67675.61
28	92298.29	37049.78	95624.37	113368.8	99316.73	123065.3	2734.999	139133.2	27017.96	120594.3	71011.52	129109.1	87527.03	1050324	44020.19
29	76013.44	85280.79	64213.9	95496.55	79965.67	41837.17	122679.8	151218.5	40257.97	95162.7	45615.94	53266.65	79250.76	951009.1	33821.32
30	73051.07	112301.3	132598.4	-23949.32	143257.8	28625.68	86873.42	164278.9	70079.71	23846.51	120809.1	95896.24	85639.06	1027669	54973.44
31	45482.3	159939.1	68601	6085.885	169867.3	83844.17	47788.58	99076.22	68495.64	108937.8	5305.918	140452.1	83656.34	1003876	54531.34
32	127989	-5225.533	109185.1	82366.23	67105.45	101272.8	23657	89954.93	31606.02	149213.8	82673.05	127261.7	82254.96	987059.5	46346.97
33	84050.71	79107.42	51076.46	105051.8	90158.49	90840.73	59862.11	67334.88	67234.01	157289	130875.5	42150.29	85419.29	1025031	33129.34
34	86462.63	102894	86782.79	29070.08	100184	85394.66	100331.4	51351.02	60872.1	84996.23	65701.76	124493.6	81544.53	978534.3	25976.78
35	28625.28	174962.9	34382.87	118644.2	36307.23	103635.3	102272	48162.26	120038.9	48675.59	87520.43	115158.2	84865.44	1018385	45529.12
Mean	85778.54	83467.11	76672.94	75653.11	88835.34	89643.16	66393.3	87400.54	71264.3	97985.22	68799.76	90219.28			
Std. Dev	27976.09	51103.39	44624.36	49063.96	40118.64	48716.18	55781.14	50413.8	39989.9	44356.46	52600.87	42854.67			

Net Profit Using the M-K Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Percent	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	0.032739	0.281459	0.066702	0.057409	0.177717	0.142807	0.083052	0.133453	0.032611	0.120803	0.120393	0.197939	0.1205905	1.447085	0.073575819
2	0.050475	0.229669	0.133768	0.074212	0.047763	0.252242	0.075629	0.102377	0.066265	0.07251	0.201905	0.021909	0.1107271	1.328726	0.076618166
3	0.07093	0.11231	0.166197	0.126086	0.047509	0.198664	0.064864	0.313013	0.045159	0.102674	0.013637	0.166816	0.1189883	1.42786	0.082994454
4	0.150603	0.123455	0.048389	0.092171	0.073316	0.211899	0.079241	0.09329	0.075915	0.265052	0.021654	0.285856	0.1267368	1.520842	0.084997276
5	0.132613	0.090446	0.149426	0.047008	0.11731	0.207606	-0.088394	0.171977	0.188878	0.282094	-4.61E-06	0.060385	0.1132785	1.359342	0.099758734
6	0.167458	0.106435	0.038618	0.127236	0.116616	0.223488	-0.007485	0.200713	0.011824	0.078854	0.296467	0.019035	0.1149381	1.379258	0.093915829
7	0.031989	0.315134	-0.044733	0.164958	0.096916	0.312243	0.038765	0.006049	0.178619	0.235947	-0.041626	0.207042	0.1251087	1.501305	0.128742706
8	0.180292	0.033917	0.19829	-0.048557	0.264313	0.062657	0.176183	0.010512	0.154188	0.151038	0.080459	0.307539	0.1309026	1.570831	0.105436406
9	0.131061	0.152412	0.134854	-0.004649	0.155368	0.075556	0.201743	0.082735	0.057751	0.07463	0.215791	0.096373	0.1144688	1.373625	0.062905641
10	0.178127	0.025383	0.22048	0.022552	0.085025	0.150384	0.055084	0.236591	0.124419	0.036047	0.076374	0.22118	0.1193039	1.431647	0.080385368
11	0.094875	0.129287	0.10919	0.14311	0.059475	0.147846	0.093065	0.120301	0.142364	0.185243	0.180722	0.001655	0.1172612	1.407134	0.051249967
12	0.141841	0.07813	0.061206	0.135726	0.142104	0.047948	0.181508	0.201936	0.054508	0.152462	0.080247	0.104369	0.1151653	1.381984	0.051343854
13	0.169082	0.063585	0.106134	0.185697	0.083412	0.07616	0.215432	0.030271	-0.018817	0.328914	0.016544	0.147731	0.1170121	1.404145	0.097607404
14	0.07223	0.166482	0.071067	0.200773	0.091132	0.137997	0.041469	0.169187	0.141382	0.155185	0.028831	0.083297	0.1132528	1.359034	0.055524562
15	0.125627	0.108247	0.065106	0.197159	0.136422	-0.021833	0.120314	0.225536	0.028105	0.103351	0.225584	0.162192	0.1229842	1.47581	0.075199063
16	0.168628	0.151094	-0.028898	0.141637	0.189168	-0.018809	0.238925	0.043505	0.154341	0.186808	0.106017	0.032144	0.1137132	1.364559	0.08691665
17	0.212982	0.005889	0.138911	0.233295	0.008031	0.077156	0.198452	0.009276	0.206925	0.042378	0.060615	0.159739	0.112804	1.353648	0.088272897
18	0.137857	-0.003626	0.329321	-0.010201	0.141196	0.311995	-0.05765	0.455055	-0.060513	0.129527	0.060714	0.236872	0.1392124	1.670549	0.165946953
19	0.070876	0.165791	0.060544	0.22538	0.064981	0.207814	-0.033042	0.14533	0.188804	0.160417	0.06096	0.101915	0.1183142	1.419771	0.076335398
20	0.028318	0.260951	0.047151	0.239718	0.019979	0.236766	0.049933	0.077611	0.150072	0.036691	0.240985	0.197191	0.1321138	1.585366	0.09767117
21	0.120536	0.112466	0.055998	0.050659	0.329495	0.087775	0.085371	0.086075	0.168377	0.072233	0.180077	0.05973	0.1173994	1.408793	0.078636608
22	0.192287	-0.031644	0.219339	0.0666	0.088529	0.176367	0.237154	0.012399	0.169237	0.076605	0.109937	0.13001	0.1205682	1.446819	0.082526527
23	0.15889	0.025916	0.150577	0.057877	0.100352	0.261484	0.013028	0.128052	0.19995	0.24657	0.038742	0.052885	0.1195269	1.434323	0.085592399
24	0.201387	0.031134	-0.000797	0.25008	0.17295	0.082927	0.115551	0.089885	0.06599	0.085043	0.242706	0.098175	0.1195859	1.435031	0.080231908
25	0.116186	0.1146	0.171664	-0.008222	0.223961	0.100458	0.070255	0.136866	0.136619	0.257219	-0.048146	0.228812	0.1250226	1.500272	0.091462001
26	0.142288	0.167683	0.018602	0.119851	0.149783	0.151981	-0.022183	0.165588	0.090594	0.237285	0.076092	0.130442	0.1190004	1.428004	0.07000097
27	0.12572	0.073193	0.115837	0.117508	0.200295	-0.043023	0.372877	-0.011953	0.132209	0.317969	-0.027689	0.108047	0.1234157	1.480988	0.127131001
28	0.131891	0.033551	0.122781	0.159366	0.146398	0.201586	-0.01132	0.210472	0.026642	0.183311	0.09685	0.210757	0.1260238	1.512285	0.075688642
29	0.097049	0.119883	0.083913	0.139531	0.117137	0.042453	0.175514	0.258161	0.048884	0.152412	0.05872	0.073838	0.1139578	1.367494	0.061760869
30	0.084468	0.152833	0.238813	-0.055772	0.224383	0.026268	0.106133	0.270039	0.108409	0.022658	0.176046	0.149836	0.1253428	1.504113	0.096783271
31	0.045306	0.247266	0.094204	-0.009151	0.278468	0.123907	0.061967	0.150536	0.096696	0.183241	-0.00335	0.241911	0.1259167	1.511001	0.096647901
32	0.227385	-0.03063	0.165714	0.115086	0.091727	0.165072	0.020449	0.12801	0.035472	0.222443	0.112596	0.208331	0.1218047	1.461656	0.082350593
33	0.110982	0.106634	0.060476	0.147143	0.129648	0.122766	0.071675	0.08193	0.088408	0.227124	0.211489	0.055227	0.1177918	1.413501	0.055108146
34	0.108228	0.155758	0.126886	0.025634	0.138973	0.121554	0.155567	0.062608	0.080758	0.110313	0.078978	0.206208	0.1142887	1.371464	0.048286865
35	0.020788	0.293138	0.031333	0.178672	0.038471	0.151487	0.153388	0.058585	0.184597	0.058549	0.118593	0.17759	0.1220993	1.465192	0.082497237
Mean	0.120914	0.119092	0.106487	0.105874	0.129952	0.137533	0.095215	0.133028	0.10159	0.15296	0.099083	0.141228			
Std. Dev	0.055319	0.090165	0.078857	0.084272	0.073682	0.088972	0.096768	0.09935	0.067463	0.084755	0.088719	0.079331			

Net Profit Using the M-K Costing Method
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Dollars	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Sum	Std. Dev.
Series (yr)															
1	24539.07	161988.8	39961.66	38433.58	101173.1	75795.02	50416.82	78110.73	22905.35	81028.83	84922.66	122724.2	73499.988	881999.9	41644.68396
2	36543.94	131214.9	78102.74	44268.18	33626.47	144322.7	41964.94	56486.94	39846.18	48187.67	124706	17094.57	66363.771	796365.3	43093.89218
3	48186.43	83917.81	108082.1	78148.1	31077.82	127576.5	49322.42	146312.8	27291.44	60330.71	9978.678	99522.24	72478.923	869747.1	42195.72244
4	82800.16	72723.4	30545.79	57969.39	52502.57	134242.1	49433.45	60347.08	54024.38	150341.9	15109.6	161970.3	76834.17	922010	47139.10848
5	77424.33	53412.2	89862.34	28764.59	70683.2	110663	-69587.36	108653.2	114784.6	169729.5	-3.246634	41980.61	66363.909	796366.9	62184.69957
6	94687.99	57472.25	24921.49	75835.08	66169.8	120415.6	-4663.85	112223.6	7511.772	56886.11	169605.1	11868.7	66077.805	792933.7	52170.23397
7	21139.66	177981.3	-30763.35	116032	62326.32	162394.2	19962.56	4161.834	102146.3	117456.6	-28496.43	123178.3	70626.61	847519.3	72339.95257
8	104911.9	19558.42	111630.4	-34805.12	152205.2	40122.45	107796.7	6829.412	98172.88	95789.07	55604.69	156158.8	76164.571	913974.9	58916.90009
9	78516.78	86365.76	66565.18	-2941.322	92182.46	45550	114413.7	45739.99	37376.61	51331.29	129335.2	62628.01	67255.309	807063.7	35955.80852
10	89968.97	16451.86	124466.4	11973.67	54336.36	90336.26	37529.44	140963.1	69476.37	21931.14	51822.78	119326.8	69048.606	828583.3	44120.08535
11	61793.59	82141.68	66871.1	82804.37	40445.66	92773.06	59564.75	73307.35	92581.07	102557.6	91772.2	1000.44	70634.407	847612.9	28123.83932
12	81003.09	50306.38	38838.65	82925.25	81476.52	31697.17	115514.4	112608.4	33548.84	90491.4	50087.79	65981.25	69539.932	834479.2	29063.48178
13	95732.83	37506.5	65579.46	95613.27	49052.12	43383.86	111762.1	15895.13	-12833.59	164408.4	10236.69	88625.82	63746.882	764962.6	49941.72258
14	46166.83	96201.47	45555.81	110428.5	54900.37	77025.42	26330.14	105539.8	73772.03	80220.3	16175.23	48952.16	65105.676	781268.1	30309.55314
15	73807.13	61000.51	42398.28	112127	68576.52	-14411.74	83393.49	129745.5	19073.53	69123.53	130837	94333.25	72500.335	870004	42980.76209
16	95247.59	77596.02	-18059.38	87046.76	103175.7	-13529.34	140311.8	28959.14	93741.32	107750.3	58102.16	21801.97	65178.675	782144.1	50109.39727
17	116391.2	3829.421	82401.4	117343.1	4682.935	49377.03	108537	5496.843	118613.4	24970.27	42906.61	102588.3	64761.471	777137.7	47788.29298
18	74951.16	-2809.95	185052.4	-6889.19	83421.98	148834.6	-40791.22	200303.2	-35740.66	74284.17	40094.54	127235.8	70662.229	847946.7	82840.42942
19	47828.72	97345.8	41229.05	131524.8	42437.15	107337.8	-21956.13	97422.91	111433.1	96490.79	41002.85	68509.73	71717.217	860606.6	43106.98113
20	20647.04	139986.9	33382.41	126738.4	13173.74	122900.8	29187.5	49653.13	89175.77	26946.89	152470.8	104302.2	75713.795	908565.5	52056.72425
21	74569.91	64671.68	38628.1	37495.03	182946.4	50259.14	50435.1	56352.16	101091.6	43593.87	98043.01	37094.95	69598.417	835181	41927.29619
22	102800	-20705.78	126259.9	45469.03	64327.46	103463.5	125826.6	8023.732	99910.08	47844.85	65702.96	76781.31	70475.301	845703.6	45354.3356
23	94592.29	17046.64	99103.58	40169.93	70353.6	149484.8	9066.383	91074.64	119988.8	128387.6	22490.13	35911.97	73139.19	877670.3	47510.38267
24	101441.3	17179	-577.7052	147655.4	95736.3	49209.86	67496.93	49608.51	39779.2	57550.77	142434.9	55284.11	68566.547	822798.6	45541.03697
25	71110.54	69247.95	101422.1	-5571.978	126866.7	62079.37	44406.19	88129.82	84038.46	117629.4	-30023.51	130009.7	71612.064	859344.8	49562.52546
26	87882.25	85402.18	10751.67	73566.96	81826.31	73729.99	-15132.31	100038.7	55097.72	136358.5	41840.58	73105.59	67039.012	804468.1	40120.97168
27	73426.66	44234.27	70255.02	77825.97	105783.8	-32303.05	188426.2	-8167.547	87782.43	165862.6	-15437.81	68297.33	68832.151	825985.8	67021.19185
28	76840.68	23760.47	82562.36	100624.4	86579.09	110450.4	-7660.344	128608.8	17834.54	111326.5	62902.99	120738.7	76214.051	914568.6	43950.69934
29	61117.14	70540.8	50249.26	82072.31	67001.07	31579.79	112067.9	139844.8	30525.48	85320.26	37350.12	45414.24	67756.934	813083.2	33236.32693
30	58977.06	98436.76	117345.8	-36565.95	130398.6	17385.33	77065.58	153769.4	59512.72	15498.59	112569.6	87667.95	74338.443	892061.3	54764.32781
31	31329.3	145186.4	54366.14	-6226.045	156783.2	71600.56	36298.75	88234.27	58537.15	98848.93	-2310.926	131745.4	72032.756	864393.1	54071.35281
32	111409.2	-19407.52	94903.15	69088.07	54381.7	88524.29	13026.62	79653.35	22041.01	140216.4	74720.71	118871.3	70619.022	847428.3	46604.87587
33	69060.05	64568.15	37334	92080.88	77624.94	79423.26	49653.01	58177.4	58151.64	148640.3	121882.1	34372.54	74247.358	890968.3	33513.91248
34	71977.24	88121.77	72499.14	16144.39	87940.88	73503.62	88653.76	41433.35	51358.23	76774.44	58714.57	116196.6	70276.501	843318	25921.43231
35	14604.89	159708.8	21450.6	105218.6	23932.76	91883.87	90851.53	38101.46	109968.3	40388.1	79915.66	107146.7	73597.604	883171.2	45291.26804
Mean	70669.34	68919.51	62947.92	62639.64	76288.83	77630.89	55397.84	76904.09	61500.52	88699.93	60487.6	82240.63			
Std. Dev	27267.81	50768.86	44311.41	48684.54	39788.36	48167.8	55303.18	50075.73	39814.02	43898.95	52356.63	42413.6			

Finished Goods Inventory Trends
Inventory Reduction Policy 2: 50% Reduction Over 12 Months

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean	Std. Dev.	Var
Series (yr)															
1	896770	992366.9	930203	831173.4	862142.9	853876.1	748567.1	722517.3	585704	567155.3	496401.5	520320.1	750599.8	170814.9	29177734195
2	917932.6	996044.2	943141.7	889149	759913.3	820896.5	791048.9	749260	666651.6	572353.2	564881.5	392129.4	755283.5	179069.8	32065995944
3	953062.5	855244	857820.4	840253.5	799225.1	765085.3	621704.1	788008.9	664428.4	633580.4	475275.7	520881.6	731214.1	146860	21567869224
4	1057753	982538.8	905229.8	863159.4	749009.2	771612	735584.4	673259.2	577793.7	649090	502528.3	563829.8	752615.7	172655.8	29810013191
5	1029572	981012.3	929077.2	874254.5	839868.5	852438.8	604272.6	630000.9	633399	618338.1	480996.6	448188.3	743451.6	197048.9	38828252799
6	1044636	1021367	893171.3	888794.7	868805.5	847633	736527.7	743710	639688.4	526479.7	602288.5	510404.6	776958.9	180079.2	32428526818
7	968027	1002169	859819.6	802790.4	807763.7	862603.4	822690.5	640822.1	678145	705160.3	512490.7	540720.1	766933.5	154664.9	23921243764
8	1031223	989702.6	959466.2	792135.8	862403.9	766243.8	745776.6	671040.8	631095.3	596241.6	507329.9	610262.7	763576.8	169311.3	28666321122
9	1017621	999376.3	1013644	859943.9	847788.3	796727.6	781155.1	748583.4	630134.2	553751.3	580873.2	496202	777150	182203	33197918329
10	1092774	935132.9	957813.4	940508.5	811141.3	797815.5	689610.6	714410.1	700331.2	617130	518122.1	584431.7	779935.1	173921.2	30248594359
11	975740	943789.8	919401.2	902972.2	778304.8	776677.5	722779.5	690851.9	627598.5	661488.8	654009.9	532989.8	765550.3	142249.7	20234976147
12	1040519	938341.2	902140.1	876781.8	863506.3	749167.1	726168.3	745091.3	655316.9	629472.2	561516	510575	766549.6	161139.7	25965993154
13	1043887	980813	915228	954442.6	851834.9	823210.8	820077.8	770592.9	601030.7	703123.8	565291.4	536845.3	797198.2	167064.4	27910527742
14	985660.1	990771.7	896817.5	925597.4	840848.7	832637.1	727159	692213	730317.8	690208.7	611382	545687.6	789108.4	145041.5	21037026857
15	1026882	989950.8	888618.8	910787.5	920545.6	750602.5	680744.2	730787.7	605132.5	556849.1	596461.4	550591.1	767329.5	173621.3	30144343895
16	1044624	1042301	909944.9	874196.5	886007.4	702783.9	752430.8	658642.1	661859.2	642861.2	621967.1	474113.4	772644.3	177848.3	31630027163
17	1059853	932724.3	935429.1	963918.8	856148.6	766606.9	797071.8	713723.8	689770.3	632124.7	493671.3	502350.8	778616.1	180742.8	32667958591
18	1061495	832970.3	926368.6	825162.7	838481.1	897487.1	668059.7	821327.9	675021.8	645299.5	532200.7	586707.1	775881.8	155124.1	24063488630
19	956837.2	981573	865255.4	894532	799488.5	864832.7	702711.7	655120.2	675041.6	623247.9	522405.8	478451.5	751624.8	166418.4	27695077604
20	913508.6	1016502	843052.9	936627.1	794697.7	863558.4	766932.3	679191	672422.9	516215.7	553850.5	593126.5	762473.8	160491	25757369925
21	1002614	992725.8	857885.8	758293	872782.2	820156.8	761737	667554.7	667985.3	621785.8	624795.2	519299	763967.8	151085	22826664388
22	1069197	929040.6	949079.7	819583.6	716856.2	790080	810945.5	673595	668661.6	604349	581944.1	544015.1	763112.2	161558.7	26101203451
23	1021071	927341.8	883410.5	802281.8	754352.9	821479.9	678066.9	621826	667675.4	687794.4	596045.4	473029.3	744531.3	154594.9	23899584757
24	1093624	1012121	826868.7	893494	876774.3	804242.9	767056.5	749329.9	665554.7	562723.6	591213	565736.8	784061.6	170570.4	29094260872
25	1007061	970438.6	938075.8	819643.5	863681.8	784401.2	729892.5	675878.5	655597.1	738300.7	561236.5	561922.7	775510.8	149892.5	22467762024
26	1002880	1045606	947496	875048.2	885551	890326.1	689377.1	707743.7	661055.1	644520.1	620458.9	568171.6	794852.8	163550.8	26748867722
27	1029504	969471	920292.8	836065.1	899236.1	677816.4	828416.9	644181.4	616526	685855.3	614171.5	510244.6	769315.1	165395	27355497694
28	1030508	885953.8	870800.9	849627.9	849176	840992.2	693022.9	701624.2	612227.6	617856.6	540568.3	558023.8	754198.5	154430.5	23848793959
29	993086.7	982666	930975.5	894949.1	864306.3	683825.4	707459.6	758246.1	648832.5	656162.2	551054.6	523493.9	766254.8	163224.3	26642158242
30	938267.2	924301.4	1016840	841108.5	857280.2	749356.6	653856.3	700633.5	704466.1	556527.9	549304.4	548552.4	753374.6	162018	26249827620
31	943533.4	983516.3	948990.3	820795.3	872272.9	816241.1	765988.3	722796.7	663899.4	672592.5	507789.6	580448.5	774905.4	150847.2	22754892348
32	1105320	945466	952131.5	885210.3	848250.1	849899.9	708691.7	686771.8	637667.9	599823.8	530155.9	559362	775729.2	181117.1	32803394829
33	999377.4	969284.7	916164.6	864729.4	835570.2	761164.3	680606.6	610498.4	605491.3	576580.2	599559.5	518516.4	744795.2	167771.6	28147322084
34	965692.4	984818.1	952243.2	861712.6	816208	792736	778509.2	661178.2	634258.5	548119.5	465812.5	553132.8	751201.7	176740.8	31237308895
35	934692.7	1016944	862151.2	895042.7	824964.4	783430.2	761363.4	670720	671372.7	552498.7	506985.2	534103.8	751189.1	165961.9	27543357371
Mean	1007280	969839.6	915001.4	867564.8	836433.9	800818.4	733030.4	699763.8	650918.7	619018.9	554144	531910.3			
Std. Dev.	53711.18	47003.52	43785.43	47480.44	45598.08	53568.08	55353.09	48750.26	33893.9	55288.63	49372.96	43976.29			
Var	2.88E+09	2.21E+09	1.92E+09	2.25E+09	2.08E+09	2.87E+09	3.06E+09	2.38E+09	1.15E+09	3.06E+09	2.44E+09	1.93E+09			

APPENDIX B

Visual Basic for Applications Data Bridge Code

Visual Basic Data Bridge Utility

This utility provides the interface between the Pro Model factory simulation software and the Excel production planning and control (PP&C) tool. This Visual Basic (VB) code extracts the completed production information for the previous production cycle (month) from a file, pm.csv, created by the Pro Model "export data" function. It then enters that information into the appropriate page of the PP&C tool. This initiates the schedule generation for the coming month based on previous sales demand, sales forecast data and current inventory position. The newly generated production schedule is extracted by the VB code and saved in an external file, schedule.wk1, which becomes the "arrivals" data, or production schedule, for the next cycle of the Pro Model simulation.

Program:

```
Public sched_month As Integer, prod_month As Integer, month As Integer, policy As
Integer, replication As Integer, clear As Integer

Sub main()
Dim years As Integer, start As Integer, inv_policy As Integer, s As Integer, i As
Integer, j As Integer, k As Integer
Application.DisplayAlerts = False
Workbooks.Open ("c:\dmeade\data1.xls")
Workbooks.Open ("c:\dmeade\data2.xls")
Workbooks.Open ("c:\dmeade\data3.xls")
Workbooks.Open ("c:\dmeade\policy 1 sales & inventory.xls")
Workbooks.Open ("c:\dmeade\policy 2 sales & inventory.xls")
Workbooks.Open ("c:\dmeade\policy 3 sales & inventory.xls")

Windows("P&L PP&C vb.xls").Activate

start = Worksheets("control_sheet").Range("d12")
years = Worksheets("control_sheet").Range("d13")
clear = Worksheets("control_sheet").Range("d14")
Worksheets("control_sheet").Range("d23") = years

If clear = 1 Then
Call clear_data
Windows("P&L PP&C vb.xls").Activate
Worksheets("control_sheet").Range("d14") = 0
End If

For s = 1 To start
Call sales_update
```

```
Next s

'Debug.Print years

   For i = start To years
   Worksheets("control_sheet").Range("d20") = i
   Call sales_update
      For j = 1 To 3
      Worksheets("control_sheet").Range("d22") = j
      inv_policy = j
      Worksheets("control_sheet").Range("d15") = inv_policy
      Call clear_past_prod
         For k = 1 To 12
         Worksheets("control_sheet").Range("d21") = k
         month = k - 1
         Call update_next_month_schedule
         ans = MsgBox("Run ProModel simulation, export Entity Activity data to file:
pm, select OK when complete", vbSystemModal + vbOKCancel)
         If ans = vbCancel Then Exit Sub
         Call update_last_month_production
         'Call showform
         Debug.Print "month ="; k, "policy ="; j, "year ="; i, "of"; years
         Next k
         policy = j
         replication = i
         Call save_data
      Next j
   Next i

End Sub

Sub clear_data()
Dim i As Integer

If clear = 1 Then

   Windows("data1.xls").Activate
   Worksheets("P&L FA gross").Select
   Range("b4:m38").clear
   Worksheets("P&L FA net").Select
   Range("b4:m38").clear
   Worksheets("P&L d gross").Select
   Range("b4:m38").clear
   Worksheets("P&L d net").Select
```

```
Range("b4:m38").clear
Worksheets("P&L abc gross").Select
Range("b4:m38").clear
Worksheets("P&L abc net").Select
Range("b4:m38").clear
Worksheets("P&L tpc gross").Select
Range("b4:m38").clear
Worksheets("P&L tpc net").Select
Range("b4:m38").clear
Worksheets("P&L m-k gross").Select
Range("b4:m38").clear
Worksheets("P&L m-k net").Select
Range("b4:m38").clear
Worksheets("Inventory").Select
Range("b4:m38").clear

Windows("data2.xls").Activate
Worksheets("P&L FA gross").Select
Range("b4:m38").clear
Worksheets("P&L FA net").Select
Range("b4:m38").clear
Worksheets("P&L d gross").Select
Range("b4:m38").clear
Worksheets("P&L d net").Select
Range("b4:m38").clear
Worksheets("P&L abc gross").Select
Range("b4:m38").clear
Worksheets("P&L abc net").Select
Range("b4:m38").clear
Worksheets("P&L tpc gross").Select
Range("b4:m38").clear
Worksheets("P&L tpc net").Select
Range("b4:m38").clear
Worksheets("P&L m-k gross").Select
Range("b4:m38").clear
Worksheets("P&L m-k net").Select
Range("b4:m38").clear
Worksheets("Inventory").Select
Range("b4:m38").clear

Windows("data3.xls").Activate
Worksheets("P&L FA gross").Select
Range("b4:m38").clear
Worksheets("P&L FA net").Select
```

```
    Range("b4:m38").clear
    Worksheets("P&L d gross").Select
    Range("b4:m38").clear
    Worksheets("P&L d net").Select
    Range("b4:m38").clear
    Worksheets("P&L abc gross").Select
    Range("b4:m38").clear
    Worksheets("P&L abc net").Select
    Range("b4:m38").clear
    Worksheets("P&L tpc gross").Select
    Range("b4:m38").clear
    Worksheets("P&L tpc net").Select
    Range("b4:m38").clear
    Worksheets("P&L m-k gross").Select
    Range("b4:m38").clear
    Worksheets("P&L m-k net").Select
    Range("b4:m38").clear
    Worksheets("inventory").Select
    Range("b4:m38").clear

    For i = 1 To 35
    Windows("policy 1 sales & inventory.xls").Activate
    Worksheets(i).Select
    Range("c4:o65").clear
    Range("d70:o102").clear
    Windows("policy 2 sales & inventory.xls").Activate
    Worksheets(i).Select
    Range("c4:o65").clear
    Range("d70:o102").clear
    Windows("policy 3 sales & inventory.xls").Activate
    Worksheets(i).Select
    Range("c4:o65").clear
    Range("d70:o102").clear
    Next i

End If
End Sub

Sub save_data()

If policy = 1 Then
    Windows("P&L PP&C vb.xls").Activate
    Sheets("P&L FA").Range("d13:o13").Copy
    Windows("data1.xls").Activate
```

```
Sheets("P&L FA gross").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d19:o19").Copy
Windows("data1.xls").Activate
Sheets("P&L FA net").Select
Range("b3").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L FA").Range("d12:o12").Copy
Windows("data1.xls").Activate
Worksheets("P&L FA gross").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d18:o18").Copy
Windows("data1.xls").Activate
Sheets("P&L FA net").Select
Range("b44").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d4:o4").Copy

Windows("data1.xls").Activate
Sheets("P&L FAIS").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d7:o7").Copy

Windows("data1.xls").Activate
Sheets("P&L FAIS").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
```

```
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d10:o10").Copy

Windows("data1.xls").Activate
Sheets("P&L FAIS").Select
Range("b85").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d15:o15").Copy

Windows("data1.xls").Activate
Sheets("P&L FAIS").Select
Range("b208").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L d").Range("d13:o13").Copy
Windows("data1.xls").Activate
Worksheets("P&L d gross").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d20:o20").Copy
Windows("data1.xls").Activate
Sheets("P&L d net").Select
Range("b3").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L d").Range("d12:o12").Copy
Windows("data1.xls").Activate
Worksheets("P&L d gross").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d19:o19").Copy
Windows("data1.xls").Activate
```

```
Sheets("P&L d net").Select
Range("b44").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d4:o4").Copy

Windows("data1.xls").Activate
Sheets("P&L dIS").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d7:o7").Copy

Windows("data1.xls").Activate
Sheets("P&L dIS").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d10:o10").Copy

Windows("data1.xls").Activate
Sheets("P&L dIS").Select
Range("b85").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d15:o15").Copy

Windows("data1.xls").Activate
Sheets("P&L dIS").Select
Range("b167").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d16:o16").Copy
```

```
Windows("data1.xls").Activate
Sheets("P&L dIS").Select
Range("b208").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L abc").Range("d13:o13").Copy
Windows("data1.xls").Activate
Worksheets("P&L abc gross").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d19:o19").Copy
Windows("data1.xls").Activate
Sheets("P&L abc net").Select
Range("b3").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L abc").Range("d12:o12").Copy
Windows("data1.xls").Activate
Worksheets("P&L abc gross").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d18:o18").Copy
Windows("data1.xls").Activate
Sheets("P&L abc net").Select
Range("b44").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d4:o4").Copy

Windows("data1.xls").Activate
Sheets("P&L abcIS").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
```

```
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d7:o7").Copy

Windows("data1.xls").Activate
Sheets("P&L abcIS").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d10:o10").Copy

Windows("data1.xls").Activate
Sheets("P&L abcIS").Select
Range("b85").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d15:o15").Copy

Windows("data1.xls").Activate
Sheets("P&L abcIS").Select
Range("b208").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L tpc").Range("d13:o13").Copy
Windows("data1.xls").Activate
Worksheets("P&L tpc gross").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d23:o23").Copy
Windows("data1.xls").Activate
Sheets("P&L tpc net").Select
Range("b3").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
```

```
Worksheets("P&L tpc").Range("d12:o12").Copy
Windows("data1.xls").Activate
Worksheets("P&L tpc gross").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d22:o22").Copy
Windows("data1.xls").Activate
Sheets("P&L tpc net").Select
Range("b44").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d4:o4").Copy

Windows("data1.xls").Activate
Sheets("P&L tpcIS").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d7:o7").Copy

Windows("data1.xls").Activate
Sheets("P&L tpcIS").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d10:o10").Copy

Windows("data1.xls").Activate
Sheets("P&L tpcIS").Select
Range("b85").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d16:o16").Copy
```

```
Windows("data1.xls").Activate
Sheets("P&L tpcIS").Select
Range("b126").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d17:o17").Copy

Windows("data1.xls").Activate
Sheets("P&L tpcIS").Select
Range("b167").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d19:o19").Copy

Windows("data1.xls").Activate
Sheets("P&L tpcIS").Select
Range("b208").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L m-k").Range("d13:o13").Copy
Windows("data1.xls").Activate
Worksheets("P&L m-k gross").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d19:o19").Copy
Windows("data1.xls").Activate
Sheets("P&L m-k net").Select
Range("b3").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L m-k").Range("d12:o12").Copy
Windows("data1.xls").Activate
Worksheets("P&L m-k gross").Select
Range("b44").Select
```

```
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d18:o18").Copy
Windows("data1.xls").Activate
Sheets("P&L m-k net").Select
Range("b44").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d4:o4").Copy

Windows("data1.xls").Activate
Sheets("P&L m-kIS").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d7:o7").Copy

Windows("data1.xls").Activate
Sheets("P&L m-kIS").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d10:o10").Copy

Windows("data1.xls").Activate
Sheets("P&L m-kIS").Select
Range("b85").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d15:o15").Copy

Windows("data1.xls").Activate
Sheets("P&L m-kIS").Select
Range("b208").Select
ActiveCell.Offset(replication, 0).Select
```

```
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("inventory_cost_$'s").Range("d68:o68").Copy
Windows("data1.xls").Activate
Worksheets("inventory").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("inventory_units").Select
Range("a1:o65").Select
Selection.Copy
Windows("policy 1 sales & inventory.xls").Activate
Worksheets(replication).Select
Range("a1").Activate
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("sales").Select
Range("a1:o36").Select
Selection.Copy
Windows("policy 1 sales & inventory.xls").Activate
Worksheets(replication).Select
Range("a67").Activate
Selection.PasteSpecial Paste:=xlValues

End If

If policy = 2 Then
Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L FA").Range("d13:o13").Copy
Windows("data2.xls").Activate
Worksheets("P&L FA gross").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d19:o19").Copy
Windows("data2.xls").Activate
Sheets("P&L FA net").Select
Range("b3").Activate
```

```
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L FA").Range("d12:o12").Copy
Windows("data2.xls").Activate
Worksheets("P&L FA gross").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d18:o18").Copy
Windows("data2.xls").Activate
Sheets("P&L FA net").Select
Range("b44").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d4:o4").Copy

Windows("data2.xls").Activate
Sheets("P&L FAIS").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d7:o7").Copy

Windows("data2.xls").Activate
Sheets("P&L FAIS").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d10:o10").Copy

Windows("data2.xls").Activate
Sheets("P&L FAIS").Select
Range("b85").Select
ActiveCell.Offset(replication, 0).Select
```

```
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d15:o15").Copy

Windows("data2.xls").Activate
Sheets("P&L FAIS").Select
Range("b208").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L d").Range("d13:o13").Copy
Windows("data2.xls").Activate
Worksheets("P&L d gross").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d20:o20").Copy
Windows("data2.xls").Activate
Sheets("P&L d net").Select
Range("b3").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L d").Range("d12:o12").Copy
Windows("data2.xls").Activate
Worksheets("P&L d gross").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d19:o19").Copy
Windows("data2.xls").Activate
Sheets("P&L d net").Select
Range("b44").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d4:o4").Copy
```

```
Windows("data2.xls").Activate
Sheets("P&L dIS").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d7:o7").Copy

Windows("data2.xls").Activate
Sheets("P&L dIS").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d10:o10").Copy

Windows("data2.xls").Activate
Sheets("P&L dIS").Select
Range("b85").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d15:o15").Copy

Windows("data2.xls").Activate
Sheets("P&L dIS").Select
Range("b167").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d16:o16").Copy

Windows("data2.xls").Activate
Sheets("P&L dIS").Select
Range("b208").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L abc").Range("d13:o13").Copy
```

```
Windows("data2.xls").Activate
Worksheets("P&L abc gross").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d19:o19").Copy
Windows("data2.xls").Activate
Sheets("P&L abc net").Select
Range("b3").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L abc").Range("d12:o12").Copy
Windows("data2.xls").Activate
Worksheets("P&L abc gross").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d18:o18").Copy
Windows("data2.xls").Activate
Sheets("P&L abc net").Select
Range("b44").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d4:o4").Copy

Windows("data2.xls").Activate
Sheets("P&L abcIS").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d7:o7").Copy

Windows("data2.xls").Activate
Sheets("P&L abcIS").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
```

```
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d10:o10").Copy

Windows("data2.xls").Activate
Sheets("P&L abcIS").Select
Range("b85").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d15:o15").Copy

Windows("data2.xls").Activate
Sheets("P&L abcIS").Select
Range("b208").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L tpc").Range("d13:o13").Copy
Windows("data2.xls").Activate
Worksheets("P&L tpc gross").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d23:o23").Copy
Windows("data2.xls").Activate
Sheets("P&L tpc net").Select
Range("b3").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L tpc").Range("d12:o12").Copy
Windows("data2.xls").Activate
Worksheets("P&L tpc gross").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d22:o22").Copy
```

```
Windows("data2.xls").Activate
Sheets("P&L tpc net").Select
Range("b44").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d4:o4").Copy

Windows("data2.xls").Activate
Sheets("P&L tpcIS").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d7:o7").Copy

Windows("data2.xls").Activate
Sheets("P&L tpcIS").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d10:o10").Copy

Windows("data2.xls").Activate
Sheets("P&L tpcIS").Select
Range("b85").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d16:o16").Copy

Windows("data2.xls").Activate
Sheets("P&L tpcIS").Select
Range("b126").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d17:o17").Copy
```

```
Windows("data2.xls").Activate
Sheets("P&L tpcIS").Select
Range("b167").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d19:o19").Copy

Windows("data2.xls").Activate
Sheets("P&L tpcIS").Select
Range("b208").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L m-k").Range("d13:o13").Copy
Windows("data2.xls").Activate
Worksheets("P&L m-k gross").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d19:o19").Copy
Windows("data2.xls").Activate
Sheets("P&L m-k net").Select
Range("b3").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L m-k").Range("d12:o12").Copy
Windows("data2.xls").Activate
Worksheets("P&L m-k gross").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d18:o18").Copy
Windows("data2.xls").Activate
Sheets("P&L m-k net").Select
Range("b44").Activate
ActiveCell.Offset(replication, 0).Select
```

```
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d4:o4").Copy

Windows("data2.xls").Activate
Sheets("P&L m-kIS").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d7:o7").Copy

Windows("data2.xls").Activate
Sheets("P&L m-kIS").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d10:o10").Copy

Windows("data2.xls").Activate
Sheets("P&L m-kIS").Select
Range("b85").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d15:o15").Copy

Windows("data2.xls").Activate
Sheets("P&L m-kIS").Select
Range("b208").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("inventory_cost_$'s").Range("d68:o68").Copy
Windows("data2.xls").Activate
Worksheets("inventory").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
```

```
    Selection.PasteSpecial Paste:=xlValues

    Windows("P&L PP&C vb.xls").Activate
    Worksheets("inventory_units").Select
    Range("a1:o65").Select
    Selection.Copy
    Windows("policy 2 sales & inventory.xls").Activate
    Worksheets(replication).Select
    Range("a1").Activate
    Selection.PasteSpecial Paste:=xlValues

    Windows("P&L PP&C vb.xls").Activate
    Worksheets("sales").Select
    Range("a1:o36").Select
    Selection.Copy
    Windows("policy 2 sales & inventory.xls").Activate
    Worksheets(replication).Select
    Range("a67").Activate
    Selection.PasteSpecial Paste:=xlValues

    End If

If policy = 3 Then
    Windows("P&L PP&C vb.xls").Activate
    Worksheets("P&L FA").Range("d13:o13").Copy
    Windows("data3.xls").Activate
    Worksheets("P&L FA gross").Select
    Range("b3").Select
    ActiveCell.Offset(replication, 0).Select
    Selection.PasteSpecial Paste:=xlValues
    Windows("P&L PP&C vb.xls").Activate
    Sheets("P&L FA").Range("d19:o19").Copy
    Windows("data3.xls").Activate
    Sheets("P&L FA net").Select
    Range("b3").Activate
    ActiveCell.Offset(replication, 0).Select
    Selection.PasteSpecial Paste:=xlValues

    Windows("P&L PP&C vb.xls").Activate
    Worksheets("P&L FA").Range("d12:o12").Copy
    Windows("data3.xls").Activate
    Worksheets("P&L FA gross").Select
    Range("b44").Select
    ActiveCell.Offset(replication, 0).Select
```

```
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d18:o18").Copy
Windows("data3.xls").Activate
Sheets("P&L FA net").Select
Range("b44").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d4:o4").Copy

Windows("data3.xls").Activate
Sheets("P&L FAIS").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d7:o7").Copy

Windows("data3.xls").Activate
Sheets("P&L FAIS").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d10:o10").Copy

Windows("data3.xls").Activate
Sheets("P&L FAIS").Select
Range("b85").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L FA").Range("d15:o15").Copy

Windows("data3.xls").Activate
Sheets("P&L FAIS").Select
Range("b208").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
```

```
Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L d").Range("d13:o13").Copy
Windows("data3.xls").Activate
Worksheets("P&L d gross").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d20:o20").Copy
Windows("data3.xls").Activate
Sheets("P&L d net").Select
Range("b3").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L d").Range("d12:o12").Copy
Windows("data3.xls").Activate
Worksheets("P&L d gross").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d19:o19").Copy
Windows("data3.xls").Activate
Sheets("P&L d net").Select
Range("b44").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d4:o4").Copy

Windows("data3.xls").Activate
Sheets("P&L dIS").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d7:o7").Copy

Windows("data3.xls").Activate
```

```
Sheets("P&L dIS").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d10:o10").Copy

Windows("data3.xls").Activate
Sheets("P&L dIS").Select
Range("b85").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d15:o15").Copy

Windows("data3.xls").Activate
Sheets("P&L dIS").Select
Range("b167").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L d").Range("d16:o16").Copy

Windows("data3.xls").Activate
Sheets("P&L dIS").Select
Range("b208").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L abc").Range("d13:o13").Copy
Windows("data3.xls").Activate
Worksheets("P&L abc gross").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d19:o19").Copy
Windows("data3.xls").Activate
Sheets("P&L abc net").Select
Range("b3").Activate
```

```
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L abc").Range("d12:o12").Copy
Windows("data3.xls").Activate
Worksheets("P&L abc gross").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d18:o18").Copy
Windows("data3.xls").Activate
Sheets("P&L abc net").Select
Range("b44").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d4:o4").Copy

Windows("data3.xls").Activate
Sheets("P&L abcIS").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d7:o7").Copy

Windows("data3.xls").Activate
Sheets("P&L abcIS").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d10:o10").Copy

Windows("data3.xls").Activate
Sheets("P&L abcIS").Select
Range("b85").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
```

```
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L abc").Range("d15:o15").Copy

Windows("data3.xls").Activate
Sheets("P&L abcIS").Select
Range("b208").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L tpc").Range("d13:o13").Copy
Windows("data3.xls").Activate
Worksheets("P&L tpc gross").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d23:o23").Copy
Windows("data3.xls").Activate
Sheets("P&L tpc net").Select
Range("b3").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L tpc").Range("d12:o12").Copy
Windows("data3.xls").Activate
Worksheets("P&L tpc gross").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d22:o22").Copy
Windows("data3.xls").Activate
Sheets("P&L tpc net").Select
Range("b44").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d4:o4").Copy

Windows("data3.xls").Activate
```

```
Sheets("P&L tpcIS").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d7:o7").Copy

Windows("data3.xls").Activate
Sheets("P&L tpcIS").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d10:o10").Copy

Windows("data3.xls").Activate
Sheets("P&L tpcIS").Select
Range("b85").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d16:o16").Copy

Windows("data3.xls").Activate
Sheets("P&L tpcIS").Select
Range("b126").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d17:o17").Copy

Windows("data3.xls").Activate
Sheets("P&L tpcIS").Select
Range("b167").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L tpc").Range("d19:o19").Copy
```

```
Windows("data3.xls").Activate
Sheets("P&L tpcIS").Select
Range("b208").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L m-k").Range("d13:o13").Copy
Windows("data3.xls").Activate
Worksheets("P&L m-k gross").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d19:o19").Copy
Windows("data3.xls").Activate
Sheets("P&L m-k net").Select
Range("b3").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("P&L m-k").Range("d12:o12").Copy
Windows("data3.xls").Activate
Worksheets("P&L m-k gross").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d18:o18").Copy
Windows("data3.xls").Activate
Sheets("P&L m-k net").Select
Range("b44").Activate
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d4:o4").Copy

Windows("data3.xls").Activate
Sheets("P&L m-kIS").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues
```

```
Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d7:o7").Copy

Windows("data3.xls").Activate
Sheets("P&L m-kIS").Select
Range("b44").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d10:o10").Copy

Windows("data3.xls").Activate
Sheets("P&L m-kIS").Select
Range("b85").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Sheets("P&L m-k").Range("d15:o15").Copy

Windows("data3.xls").Activate
Sheets("P&L m-kIS").Select
Range("b208").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("inventory_cost_$'s").Range("d68:o68").Copy
Windows("data3.xls").Activate
Worksheets("inventory").Select
Range("b3").Select
ActiveCell.Offset(replication, 0).Select
Selection.PasteSpecial Paste:=xlValues

Windows("P&L PP&C vb.xls").Activate
Worksheets("inventory_units").Select
Range("a1:o65").Select
Selection.Copy
Windows("policy 3 sales & inventory.xls").Activate
Worksheets(replication).Select
Range("a1").Activate
Selection.PasteSpecial Paste:=xlValues
```

```
    Windows("P&L PP&C vb.xls").Activate
    Worksheets("sales").Select
    Range("a1:o36").Select
    Selection.Copy
    Windows("policy 3 sales & inventory.xls").Activate
    Worksheets(replication).Select
    Range("a67").Activate
    Selection.PasteSpecial Paste:=xlValues

    End If

    Windows("P&L PP&C vb.xls").Activate

End Sub


Sub clear_past_prod()
'
' clear_past_prod Macro
' Macro recorded 6/16/2004 by dja
'
    Worksheets("from_ProModel").Activate
    Range("B4:M73").Select
    Selection.ClearContents
End Sub

Sub sales_update()
'
' sales_update Macro
' Macro recorded 6/16/2004 by dja
'
    Sheets("sales_simulation").Select
    Calculate
    Range("d39:o73").Select
    Selection.Copy
    Sheets("sales").Select
    Range("D2").Select
    Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, SkipBlanks:= _
        False, Transpose:=False
End Sub

Sub update_next_month_schedule()
'
```

```
' update_month_production Macro
' Macro recorded 6/16/2004 by dja
'
'Dim month As Integer
'month = 1

    Sheets("to_ProModel").Select
    Range("B4").Activate
    ActiveCell.Offset(0, month).Range("A1:a73").Select
    Application.CutCopyMode = False
    Selection.Copy
    Workbooks.Open ("C:\dmeade\schedule.wk1")
    'Workbooks.Open ("h:\research\dissertation\schedule.wk1")

    Windows("schedule.wk1").Activate
    Sheets("schedule").Select
    Range("c2").Activate
    Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, SkipBlanks:= _
        False, Transpose:=False
    ActiveWorkbook.SaveAs Filename:= _
        "C:\dmeade\schedule.wk1" _
        , FileFormat:=xlWK1, Password:="", CreateBackup:=False
    'ActiveWorkbook.SaveAs Filename:= _
        "h:\research\dissertation\schedule.wk1" _
        , FileFormat:=xlWK1, Password:="", CreateBackup:=False

    ActiveWorkbook.Close

End Sub

Sub update_last_month_production()
'
' update_last_month_production Macro
' Macro recorded 6/16/2004 by dja
'
'Dim month As Integer
'month = 1

    Workbooks.Open ("c:\dmeade\pm.csv")
    'Workbooks.Open ("h:\research\dissertation\pm.csv")

    Windows("pm.csv").Activate
    Range("B3:B72").Select
    Selection.Copy
```

```
    Windows("P&L PP&C vb.xls").Activate
    Sheets("from_ProModel").Select
    Range("B4").Select
    ActiveCell.Offset(0, month).Select
    Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, SkipBlanks:= _
        False, Transpose:=False
    Windows("pm.csv").Activate
    ActiveWorkbook.Close
End Sub
```

APPENDIX C

Sample Income Statements – Inventory Reduction Policy 2, 50% Reduction in Inventory Over 12 Months

Income Statement (full absorption)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
COGM												
cogm	502028.3	484128.3	494366.4	518001.4	569893.9	488371.8	483273.5	522279.4	467729.3	488675.3	490691.6	491769.7
COGS												
+/- fgi	-70118.05	-67829.52	-90849.05	-58007.52	-156882.4	4675.383	2756.6	999.95	36200.68	-39600.12	620.2833	-401.2667
cogs	572146.3	551957.9	585215.5	576008.9	726776.2	483696.4	480516.9	521279.5	431528.6	528275.4	490071.3	492171
Sales	625491.4	604169.4	616223.8	644838.4	710633.1	607925.3	602543.5	650371.8	582555.8	608614.3	611010.8	613225.7
less COGS	572146.3	551957.9	585215.5	576008.9	726776.2	483696.4	480516.9	521279.5	431528.6	528275.4	490071.3	492171
GP	53345.08	52211.57	31008.3	68829.52	-16143.13	124228.9	122026.5	129092.3	151027.1	80338.95	120939.5	121054.7
GP%	0.0853	0.0864	0.0503	0.1067	-0.0227	0.2043	0.2025	0.1985	0.2592	0.1320	0.1979	0.1974
Interest Expense	14289.87	13247.51	11786.18	10116.67	8032.437	7941.655	7745.004	7433.041	8251.292	7858.713	7906.858	7890.686
Net Profit	39055.2	38964.06	19222.12	58712.86	-24175.57	116287.2	114281.5	121659.3	142775.8	72480.23	113032.7	113164
NP%	0.062439	0.064492	0.031193	0.09105	-0.03402	0.191285	0.189665	0.187061	0.245085	0.119091	0.184993	0.184539

Income Statement (direct)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
COGM												
cogm	376409.4	361089.4	371308.8	385707.1	429044.6	365120.6	361314.5	393746.5	346796.4	366635.1	369520.5	369736.6
COGS												
+/- fgi	-54249.35	-49016.51	-70846.35	-42445.84	-121200.8	5855.128	2212.2	-3766.683	33533.56	-32706.71	-1406.572	426.2444
cogs	430658.8	410106	442155.2	428153	550245.4	359265.5	359102.3	397513.2	313262.9	399341.8	370927.1	369310.3
Sales	625491.4	604169.4	616223.8	644838.4	710633.1	607925.3	602543.5	650371.8	582555.8	608614.3	611010.8	613225.7
less COGS	430658.8	410106	442155.2	428153	550245.4	359265.5	359102.3	397513.2	313262.9	399341.8	370927.1	369310.3
GP	194832.6	194063.5	174068.6	216685.5	160387.7	248659.8	243441.2	252858.6	269292.9	209272.5	240083.7	243915.3
GP%	0.3115	0.3212	0.2825	0.3360	0.2257	0.4090	0.4040	0.3888	0.4623	0.3439	0.3929	0.3978
Fixed	125398.3	125398.3	125398.3	125398.3	125398.3	125398.3	125398.3	125398.3	125398.3	125398.3	125398.3	125398.3
Interest Expense	14289.87	13247.51	11786.18	10116.67	8032.437	7941.655	7745.004	7433.041	8251.292	7858.713	7906.858	7890.686
Net Profit	55144.47	55417.7	36884.16	81170.53	26956.98	115319.9	110297.9	120027.3	135643.3	76015.55	106778.6	110626.4
NP%	0.088162	0.091725	0.059855	0.125877	0.037934	0.189694	0.183054	0.184552	0.232842	0.124899	0.174757	0.180401

Income Statement (ABC)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
COGM												
cogm	502028.3	484128.3	494366.4	518001.4	569893.9	488371.8	483273.5	522279.4	467729.3	488675.3	490691.6	491769.7
COGS												
+/- fgi	-71566.5	-64280.74	-92180.57	-57481.96	-156517.7	5420.336	4033.478	-7096.586	49378.76	-46812.3	-3168.003	3079.286
cogs	573594.8	548409.1	586547	575483.4	726411.5	482951.4	479240	529376	418350.5	535487.6	493859.6	488690.4
Sales	625491.4	604169.4	616223.8	644838.4	710633.1	607925.3	602543.5	650371.8	582555.8	608614.3	611010.8	613225.7
less COGS	573594.8	548409.1	586547	575483.4	726411.5	482951.4	479240	529376	418350.5	535487.6	493859.6	488690.4
GP	51896.62	55760.34	29676.78	69355.07	-15778.46	124973.8	123303.4	120995.8	164205.2	73126.76	117151.3	124535.2
GP%	0.082969	0.092293	0.048159	0.107554	-0.022203	0.205574	0.204638	0.186041	0.28187	0.120153	0.191734	0.203082
Interest Expense	14289.87	13247.51	11786.18	10116.67	8032.437	7941.655	7745.004	7433.041	8251.292	7858.713	7906.858	7890.686
Net Profit	37606.75	42512.84	17890.6	59238.41	-23810.89	117032.2	115558.4	113562.7	155953.9	65268.05	109244.4	116644.5
NP%	0.060124	0.070366	0.029033	0.091866	-0.033507	0.192511	0.191784	0.174612	0.267706	0.10724	0.178793	0.190215

Income Statement Throughput

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
COGM												
cogm	313600	299570	309780	319560	358620	303495	300335	329480	286330	305615	308935	308720
COGS												
+/- fgi	-46315	-39610	-60845	-34665	-103360	6445	1940	-6150	32200	-29260	-2420	840
cogs	359915	339180	370625	354225	461980	297050	298395	335630	254130	334875	311355	307880
Sales	625491.4	604169.4	616223.8	644838.4	710633.1	607925.3	602543.5	650371.8	582555.8	608614.3	611010.8	613225.7
less COGS	359915	339180	370625	354225	461980	297050	298395	335630	254130	334875	311355	307880
GP	265576.4	264989.4	245598.8	290613.4	248653.1	310875.3	304148.5	314741.8	328425.8	273739.3	299655.8	305345.7
GP%	0.424588	0.438601	0.398555	0.450676	0.349904	0.511371	0.504774	0.483941	0.563767	0.449775	0.490426	0.497934
Fixed Costs												
Labor	62809.42	61519.44	61528.8	66147.13	70424.62	61625.59	60979.51	64266.47	60466.43	61020.08	60585.52	61016.58
Other OH	125618.8	123038.9	123057.6	132294.3	140849.2	123251.2	121959	128532.9	120932.9	122040.2	121171	122033.2
Interest Expense	14289.87	13247.51	11786.18	10116.67	8032.437	7941.655	7745.004	7433.041	8251.292	7858.713	7906.858	7890.686
Net Profit	62858.25	67183.58	49226.17	82055.37	29346.78	118056.9	113464.9	114509.3	138775.2	82820.35	109992.4	114405.2
NP%	0.100494	0.1112	0.079884	0.12725	0.041297	0.194196	0.18831	0.176067	0.238218	0.13608	0.180017	0.186563

Income Statement (M-K)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
COGM												
cogm	502028.3	484128.3	494366.4	518001.4	569893.9	488371.8	483273.5	522279.4	467729.3	488675.3	490691.6	491769.7
COGS												
+/- fgi	-85400.21	-65813.14	-90242.26	-71977.94	-149397.1	-17165.24	-15023.52	8800.001	36853.41	-27768.12	-5473.922	2599.831
cogs	587428.5	549941.5	584608.7	589979.3	719291	505537	498297	513479.4	430875.9	516443.4	496165.5	489169.9
Sales	625491.4	604169.4	616223.8	644838.4	710633.1	607925.3	602543.5	650371.8	582555.8	608614.3	611010.8	613225.7
less COGS	587428.5	549941.5	584608.7	589979.3	719291	505537	498297	513479.4	430875.9	516443.4	496165.5	489169.9
GP	38062.92	54227.94	31615.09	54859.1	-8657.924	102388.3	104246.4	136892.4	151679.9	92170.94	114845.3	124055.8
GP%	0.0609	0.0898	0.0513	0.0851	-0.0122	0.1684	0.1730	0.2105	0.2604	0.1514	0.1880	0.2023
Interest Expense	14289.87	13247.51	11786.18	10116.67	8032.437	7941.655	7745.004	7433.041	8251.292	7858.713	7906.858	7890.686
Net Profit	23773.05	40980.43	19828.92	44742.44	-16690.36	94446.61	96501.42	129459.3	143428.6	84312.23	106938.5	116165.1
NP%	0.038007	0.067829	0.032178	0.069385	-0.023487	0.155359	0.160157	0.199054	0.246206	0.138531	0.175019	0.189433

BIBLIOGRAPHY

Boyd, L. H. (1999). Production Planning and Control and Cost Accounting Systems: Effects on Management Decision Making and Firm Performance. *Doctoral Dissertation*, Ann Arbor, MI: UMI Co.

Chandler, A. (1977). *The Visible Hand: The Management Revolution in American Business*. Cambridge, Mass.: Harvard University Press.

Cooper, R. & Kaplan, R. S. (April 1988). How Cost Accounting Distorts Product Costs. *Management Accounting,* vol 69, No. 10, pp. 20-27.

Cunningham, J. & Fiume, O. (2003). *Real Numbers: Management Accounting in a Lean Organization*. Durham, NC: Managing Times Press.

Drury, C., & Tayles, M. (1997). Evidence on the Financial Accounting Mentality Debate: A Research Note. *British Accounting Review*, vol 29, pp. 263-276

Elnicki, R. A. (April 1971). The Genesis of Management Accounting. *Management Accounting*, pp.16

Fullerton, R. R., & McWatters, C. S. (2001). The production performance benefits from JIT implementation. *Journal of Operations Management*, vol. 19, pp. 81-96.

Garrison, R. H., & Noreen, E. W. (1994). *Managerial Accounting*. Burr Ridge, IL: Irwin, Inc.

Goldratt, E. M. & Cox, J. (1982). *The Goal*, Second Revised Ed., New York, NY: McGraw Hill.

Hartley, R. V. (1983). *Cost and Managerial Accounting.* Newton, MA: Allyn and Bacon, Inc.

Hicks, C. R. (1993). *Fundamental Concepts in the Design of Experiments,* Fourth Edition. New York: Oxford University Press.

Hillier, F. S. & Lieberman, G. J. (2001). *Introduction to Operations Research*, Seventh Ed. New York, NY: McGraw Hill.

Hoffer, C. W. (Winter 1994). MAN Class Handout, The University of Georgia.

Horngren, C. T. (1995). Management accounting: this century and beyond. *Management Accounting Research*, vol. 6, pp. 281-286.

Hsu, J.C. (1996). *Multiple Comparisons, Theory and Methods.* New York: Chapman & Hall.

Hsu, J.C. (1984). Constrained Two-Sided Simultaneous Confidence Intervals for Multiple Comparisons With the Best. *Annals of Statistics*, vol.12, pp.1136–1144.

Johnson, H. T., Kaplan, R. S. (1987). *Relevance Lost: The Rise and Fall of Management Accounting.* Boston, MA: Harvard Business School Press.

Kaplan, R. S. (1994). Management Accounting (1984-1994): Development of New Practice and Theory. *Management Accounting Research*, vol. 5, pp. 247-260.

Kinsinger, K. (Spring 2004). Allocation Schemes in Cost Accounting. Personal Interviews.

Krajewski, King, Ritzman & Wong.(1987). Kanban, MRP, and Shaping the Manufacturing Environment. *Management Science*, vol. 33, No. 1, pp. 39-57.

Law, A. M. & Kelton, W. D. (2000). *Simulation Modeling and Analysis,* Third Ed. New York, NY: McGraw Hill.

Lapin, L. L. (1997). *Modern Engineering Statistics*. Belmont, CA: Duxbury Press.

Lea, Bih-Ru (1998). The Impact of Management Accounting Alternatives in Different Manufacturing Environments. *Doctoral Dissertation*, Ann Arbor, MI: UMI Co.

Lere, J. C. (2001). Your Product-costing System Seems to Be Broken: Now What? *Industrial Marketing Management*, vol. 30, pp. 587-598.

Levene, H. (1960). *Contributions to Probability and Statistics*. Stanford CA: Stanford University Press.

Little, T.M. (1981). Interpretation and Presentation of Result, *HortScience*, vol 19, pp.637-640.

Martin-Vega, L. A.(2001). *Maynard's Industrial Engineering Handbook*, Fifth Ed. New York, NY: McGraw Hill.

Nachtmann, H. & Needy, K. (2003) Methods for Handling Uncertainty in Activity Based Costing Systems. *The Engineering Economist*, vol. 48, No. 3, pp. 259-282.

Pine, B. J. (1993). *Mass Customization: The New Frontier in Business Competition.* Boston, MA: Harvard Business School Press.

Ramasesh, R. (1990). Dynamic Job Scheduling: A Survey of Simulation Research. *Omega*, vol. 18, No. 1.

Schonberger, R. J. (1982). *Japanese Manufacturing Techniques: Nine Hidden Lessons in Simplicity*. New York, NY: The Free Press.

Schonberger, R. J. (1982). Some Observations on the Advantages and Implementation Issues of Just-in-Time Production Systems. *Journal of Operations Management*, vol.3, No. 1.

Scott, D.R. (1931). *The Cultural Significance of Accounts*. New York, NY: Henry Holt.

Shah, R. & Ward, P. T. (2003). Lean Manufacturing: Context, Practice Bundles, and Performance. *Journal of Operations Management*, vol. 21, 129-149.

Soloman, J. M. (2003). *Who's Counting?* Fort Wayne, IN: WCM Associates.

Sugimori, Y., Kusunoki, F., Cho, F, & Uchikawa, S. (1977). Toyota Production and Kanban System: Materialization of Just-in-Time and Respect for Human Systems. *International Journal of Production Research*, vol 15, pp. 553 – 564.

Vollmann, T.E., Berry, W. L. & Whybark, D. C. (1992). *Manufacturing Planning and Control Systems*, Third Edition. Chicago, IL: Irwin, Inc.

Wantuck, K. A. (1989). *Just in Time for America: A common sense production strategy*. Southfield, MI: KWA Media.

Womak, J. & Jones, D. (2003). *Lean Thinking: Banish Waste and Create Wealth in Your Corporation.* New York, NY: The Free Press.

Monden, Y. (2002). The Relationship Between Mini Profit-Center and JIT System. *International Journal of Production Economics*, vol 80, 145-154.

Morrison, D. (1967). *Multivariate Statistical Methods.* New York, NY: McGraw-Hill.

Neter, J., Wasserman, W. & Kutner, M.H. (1985). *Applied Linear Statistical Models*, Second Edition. Chicago, IL: Irwin, Inc.

Ott, E.R. & Schilling, E.G. (1990). *Process Quality Control – Troubleshooting and Interpretation of Data*, 2nd Edition. New York, NY: McGraw-Hill.

Turney, P. (1993). *Common Cents: The ABC Performance Breakthrough.* Hillsboro, OR: Cost Technology.