

# Employing Activity Based Costing and Management Practices Within the Aerospace Industry: Sustaining the Drive for Lean

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## **Executive Summary**

### **A. Problem Statement**

The advent of continuously improving lean manufacturing practices has migrated from the manufacturing floor into the realm of financial management. Due to the shortcomings of current accounting policies in supporting strategic decisions, Activity Based Costing and Management (ABCM) has emerged as a tool used more and more extensively to tie operational performance to actual financial performance by using activities performed throughout manufacturing processes as a means of uncovering true product ownership costs and value addition versus non-value addition. Numerous companies, operating in various commercial sectors, and in different facets of industry, have adopted this business practice to align the cost management strategy with the overall strategy of the company. Within the aerospace and defense sector there has not been a widespread adoption of this business practice both amongst commercial and the military product lines. This thesis analyzes examples of pilot program implementations within the facility of a large aerospace company to understand how ABCM was used, what benefits were gained, and what the barriers and enablers to more widespread implementations in this industry sector really are.

### **B. Originality Requirement**

The case studies contained in the thesis offer textbook examples of approaches to ABCM implementations within the aerospace and defense sector. These implementations illustrate efforts to introduce ABCM as a tool used to support the cost management strategy of the company, and offer novel ways of looking at the financial performance of lean initiatives, make versus buy decisions, design for manufacturing processes, and multiple product variation configuration management.

### **C. Content and Conclusion**

The case studies contained in the thesis have illustrated several aspects of ABCM implementation within one of the largest facilities of the largest aerospace and defense sector company in the United States. What started as a tool to support the manufacturing environment by providing a link between manufacturing performance and financial benefits or losses, has the potential to migrate to a more strategic role, playing a central theme in the cost management strategy of the company. Barriers to implementation include poor upper management support, and continuous resistance in changing the culture of the employees affected by the implementations, especially those that belong to the finance and accounting departments. Enablers to widespread implementation are education, whereby the company's employees are exposed to the concepts of ABCM, understanding the benefits to be gained from widespread implementation, and communication. Continuous feedback provides a situation where the ABCM initiative does not get classified as another highly publicized and short-lived management optimization initiative. At the facility level, application of ABCM has shown an improvement in efficiency, and a reduction of the cost of quality.

## **D. System Design and Management Principles**

The case studies contained within the thesis offer evidence to support that ABCM is a tool that can be used effectively to enhance a company's lean initiatives both on the manufacturing floor and in other areas. Viewing operational data through activities enables management to make informed decisions about processes and practices that have been previously implemented based on a lean philosophy. ABCM has been shown to be an enabler of lean, by allowing management to more effectively channel resources towards activities that add value as opposed to those that do not.

## **E. Engineering and Management Systems Content**

The research contained in the thesis highlights how successful ABCM's implementations touch both the engineering and a managerial context. On the engineering side ABCM, through its core activity analysis, enables engineering managers to create a bridge between different engineering performance metrics, and their impact on bottom line costs. On the managerial side, ABCM represents a tool that can be used to augment the effectiveness of high level lean initiatives, and aid such decision making processes as make versus buy. The case studies presented in the thesis highlight examples in which a large company has begun to tackle the gaps existing between operational performance and strategic outlook by implementing a series of pilot ABCM programs designed to evidence how ABCM can close the gap between engineering performance and bottom line costs, and top level strategic outlook.

The work contained in the thesis is the author's and original.

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# Abstract

Activity Based Costing and Management (ABCM) is a new accounting methodology that links the cost of production or service provision based on activities and not on metrics such as labor hours and material cost. The outcome is a more accurate allocation of overhead charges, which in current business practices have increased substantially, and are being allocated to product costs in ways that hide true ownership costs. Although ABCM is a relatively new tool, it is proving to be a means by which companies can augment their lean initiatives, and introduce lean concepts in their financial and accounting practices, tying their cost strategies with their overall strategies. Uncovering true ownership costs assists managers in making critical decisions such as make versus buy, and understand how their decisions can impact bottom line cost, creating or destroying shareholder value. ABCM is increasingly becoming popular among those companies and industry sectors that serve commercial customers. However, within the aerospace and defense industry sector, adoption has been somewhat slower, especially for those companies, or divisions of companies that operate solely within the defense sector.

Data, gathered by means of a survey, was used to understand which types of facilities operating in the aerospace and defense sector are more likely to adopt ABCM practices. The results have shown that these facilities are usually first tier suppliers to larger OEMs, thus smaller in size, and producing multiple distinct products in a medium to high manufacturing volume. This suggests that there is a need to manage complex manufacturing environments and not necessarily complex products. Additionally, these facilities tend to be "brownfield", or older, than their counterparts that have not adopted ABCM, hinting at the fact the former are more prone to market instability and are adopting ABCM as a means to augment or retain their competitive advantage with respect to the latter, which might have lower manufacturing costs. When looking at some of the benefits that ABCM facilities have gained over non-ABCM enabled facilities, the data shows that ABCM enabled facilities report, among other things, higher profitability, productivity, and customer satisfaction. Also, ABCM enabled facilities adopt to a higher degree lean initiatives such as JIT and TQM, tend to partner up with their suppliers over long-term contracts, and invest more resources into the introduction of new manufacturing technology within their operations. This results in less exposure from supplier and technology business instability. However, ABCM enabled facilities are exposed more to organizational instability. The conclusion is that the introduction of ABCM in an organization does cause short-term organizational instability, as employees across the different layers of the organization get accustomed to the new business philosophy.

Within the aerospace and defense industry sector, the best examples of ABCM implementations have come from the BCAG Wichita Division of the Boeing Co. BCAG Wichita Division, a cost center, has introduced ABCM as a tool that supports a comprehensive lean production strategy that encompasses everything from asset management to design for manufacturability to cost of quality. BCAG Wichita Division does fall within the characteristics set by the survey data, being a first tier supplier handling multiple products with multiple configurations. The two case studies contained herein are examples of the flexibility of ABCM modeling and the benefits that can be gained through a correct implementation process. The overarching metric for both implementations is cost savings through activity analysis designed to uncover non-value added processes that depress value creation capabilities. The first implementation attempts to augment asset utilization, and thus ROA, while the second attempts to reduce product cost of quality through the reduction of rework activities. All ABCM initiatives have originated and been championed by the organization's middle management. The implementations have uncovered a number of barriers and enablers to widespread adoption of ABCM at the facility level. The most important barrier is slim upper management support. The most important enablers are education and communication. Education allows the organization to learn and understand the implications and benefits to be gained through the adoption of ABCM, while communication and constant feedback of the benefits gained through an implementation ensures that the ABCM movement does not get discounted as just another "in vogue" lean initiative.

BCAG Wichita Division is certainly at the forefront of ABCM adoption in the aerospace and defense industry sector, and is moving towards a Stage IV accounting system, where activities are associated with costs, and are fed directly into the legacy accounting systems that produce reports for the SEC, IRS, and investor community. The belief is that operating under a Stage IV cost accounting system will allow BCAG Wichita Division to be more efficient, passing its savings onto Boeing Co., and ultimately benefiting the shareholders.

Within the industry, companies or facilities of companies operating heavily in the defense sector have not shown a wide adoption of ABCM principles. The conclusion, arrived through discussions with various industry representatives of the defense contractor community, is that the acquisition process, which determines government and contractor relationships throughout the life of a program, is a real barrier to the adoption of novel accounting techniques. This is due mostly to the requirement to follow a strict set of accounting principles agreed upon prior to funding a defense program. In fact, it is evident that the contractors will only act upon initiatives that are proposed by the government, and are thus operating in ways that may not be in the best interest of shareholders. The conclusion is that widespread adoption of ABCM principles in a defense contract have to be delineated by both the government and the contractor so as to create a situation where program funding is cost effective, and at the same time creates value for the contractor's shareholders.

Within the labor environment, unions are receptive to the potential benefits of ABCM principles, but do not see them as a labor saving tool. In fact, there is the recognition that ABCM is a means by which all tiers of a company, labor included, can work together to mitigate instabilities, through better strategic decision making processes, thus reduce long-term labor turnover, and create values for shareholders, of which labor organizations are a part of.

ABCM is slowly moving out of academia into the world of everyday business. As a part of a wave of new business practices that are hitting the business world regularly, ABCM will require time and widespread adoption to gain wider recognition of its potential. To date, implementations have encompassed pilot programs, and have not migrated to widespread company adoption. Evidence supports the potential benefits of ABCM principles, but only time and more widespread adoption will determine ABCM's success as the mean by which lean principles can be introduced into a company's cost management strategy.

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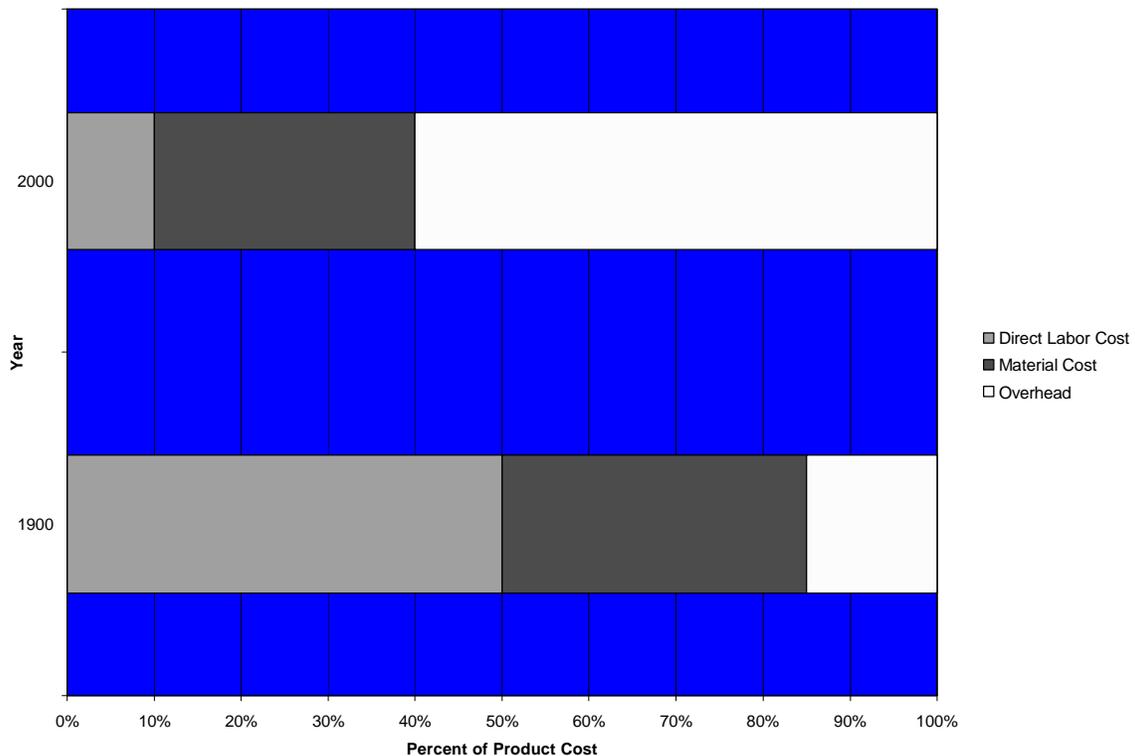
## List of Abbreviations

ABC	Activity Based Costing
ABCM	Activity Based Costing and Management
ABM	Activity Based Management
BCAG	Boeing Commercial Airplane Group
CAM-I	Consortium for Advanced Manufacturing-International
CASB	Cost Accounting Standards Board
CM	Cost Management
COGS	Costs Of Goods Sold
COTS	Commercial Off-The-Shelf
DCAA	Defense Contract Audit Agency
DCAC	Design and Control Airplane Configuration
DoD	Department of Defense
DSB	Defense Science Board
FY	Fiscal Year
GAAP	Generally Accepted Accounting Principles
HPWO	High-Performance Work Organization
IRS	Internal Revenue Service
JIT	Just-In-Time
JMAR	Journal of Management Accounting Research
KPI	Key Performance Indicator
LAI	Lean Aerospace Initiative
LARA	Labor Aerospace Research Agenda
MBU	Manufacturing Business Unit
MIT	Massachusetts Institute of Technology
MRM	Manufacturing Resource Management
MRP	Material Resource Planning
NPV	Net Present Value
OEM	Original Equipment Manufacturer
PC	Personal Computer
PROCAS	Process Oriented Contract Administration System
QA	Quality Assurance
RC	Responsibility Center
ROA	Return On Assets
ROE	Return On Equity
ROI	Return On Investments
RONA	Return On Net Assets
SEC	Securities and Exchange Commission
TBP	Team-Based Production
TPM	Total Productive Maintenance
TPS	Toyota Production System
TQM	Total Quality Management
USA	United States of America
WIP	Work-In-Process

# 1. Introduction

## 1.1. A Historical Perspective

Technological innovation and the breakdown of export barriers have, in the past 30 years, fueled incredible changes in the world business landscape. Numerous companies faced increased competition from both domestic and foreign markets, are increasingly pursuing best business practices to reduce production costs, maintain market share and profitable margins, trying to satisfy shareholder requirements. Among the famous best business practices are JIT, TPS, and Six-Sigma, which corporations have continuously used to improve operations by reducing waste (non-value added operations), and increasing value (value added operations).



**Figure 1.1: Changes in the cost structure of manufactured products between 1900 and 2000 [Pieper, 1999].**

Among the largest problems that have surfaced in recent years is the question of how to introduce the same type of operational efficiency philosophies to improve a company's "financial efficiency". The problem stems from widespread usage of a cost accounting system originally designed for the early 20<sup>th</sup> century companies. In essence, cost accounting systems have not evolved in parallel with the evolution of company operations. In fact, the cost structure of a typical manufacturing company

has changed dramatically; at the turn of the 20<sup>th</sup> century, direct labor accounted for approximately 50% of the total production cost, with material being 35%, and an overhead of 15% (refer to **Figure 1.1**), which reflects the advent of mass production, and Ford's famous Model T. Today, thanks to advances in automation, direct labor comprises less than 10% of the total production cost, with material being 30%, and overhead ballooning to 60% [Pieper, 1999, p. 3]. Since at the turn of the 20<sup>th</sup> century direct labor was the single largest contributor to cost, it made sense to use it as a basis of overhead allocation. The same statement does not hold true in today's business environment.

The implications of such practices are many, namely, the inability to report individual product cost within a reasonable level of accuracy (understanding the true product ownership cost), and the inability to use costing information to provide feedback to operations managers involved in operational control and strategy (plan and optimize an operations strategy such as deciding whether to produce a product "in-house as opposed to outsourcing it to a third party). The problem is further accentuated when looking at companies that produce numerous distinct products. In this case, the most popular practice is to allocate resource consumption based on the volume of product produced, employing cost drivers such as direct labor hours, machine hours, or material costs, without distinguishing that manufacturing one product might use a higher degree of automation, use less support time, or even be more complex than producing another product. This so called "peanut-butter" approach to spreading resource consumption masks true production costs, leaving operation managers unable to distinguish accurately which product is more profitable. Through time, these cost accounting systems have evolved to serve the financial community, especially through the advent of GAAP standards of objectivity, verifiability, and materiality for external control agencies such as the SEC, the IRS, and the creditor and investor community. This leaves operations managers with cost accounting data in a format that does not enhance an informed decision making process with regards to true cost and manufacturing strategy of the company's operations.

Recently, there have been numerous movements to rectify this "financial deficiency". Names like the Balanced Scorecard, and Target Costing are among the newest tools that have hit the industry with the promise of aiding upper management align the company's operations with the overall company strategy, and at the same time enhance shareholder value. Thus, the dramatic change in the cost structure of production, along with significant improvements in information processing technology, which

allows a reduction of measurement costs, and an increase in the competitiveness of the business environment, create the foundation for the development of a new type of cost accounting system. As described in more detail in the following sections, ABCM has shown to fulfill these requirements not only in a number of different industries, but also in a number of very diverse applications.

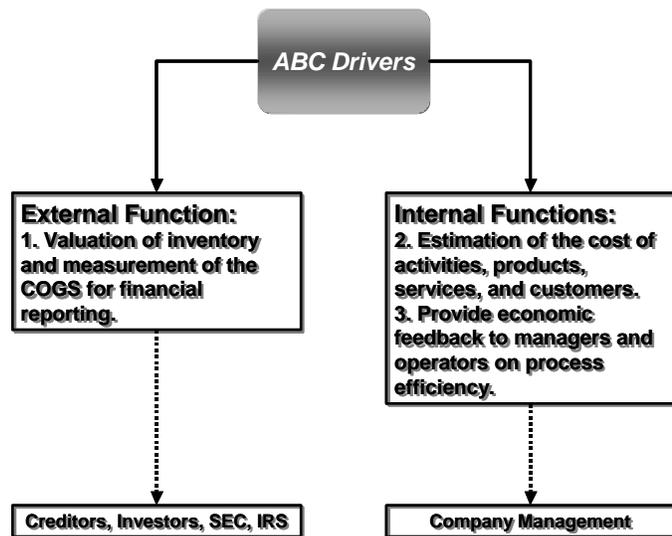
## 1.2. A Step in the Right Direction: ABC

While traditional cost accounting systems operate under the assumption that producing products is what drives cost, thus the employment of cost drivers such as direct labor and/or direct material costs, ABC works under the fundamental assumption that the activities performed to produce products are the real cost drivers [Bruns, 1992, p. 1]. Kaplan and Cooper first introduced the term ABC in the early 1980s, to refer to an activity driven cost allocation

system. The main drivers for such a development, apart from the more macroeconomic factors mentioned above, was the recognition on the part of Kaplan and Cooper that company cost systems needed to satisfy three major requirements, namely: “valuation of inventory and measurement of the COGS for financial reporting, estimation of the costs of activities, products, services, and customers, and provision of economic

feedback to managers and operators about process efficiency” [Kaplan et. al., 1998, p. 2]. While the first requirement is driven from external forces, such as investors, creditors, the IRS, and the SEC, internal forces, or the need for managers to understand and improve the economics of their operation, drives the last two (refer to **Figure 1.2**). Therefore, ABC can be defined as follows:

**“A management accounting system that assigns costs to products based on the amount of resources used (such as floor space, raw materials, machine hours, human effort, and power consumption), in order to design, order, or make a product.”** [Womack et. al., 1994, p. 305]



**Figure 1.2: ABC drivers and functions [Kaplan et. al., 1998].**

The power of ABC lies in trying to understand what drives the costs by identifying the reasons behind performing the actual activities needed to produce the product. This new way of thinking about cost drivers gives rise to an important set of questions that can be used to map activities to value adding and non-value adding categories. Effective ABC systems will aid a company's management in addressing the following set of questions:

1. What activities are the organizational resources performing?
2. How much does it cost to perform organizational activities and business processes?
3. Why does the organization need to perform activities and business processes?
4. How much of each activity is required for the organization's products, services, and customers? [Kaplan et. al., 1998, p. 79]

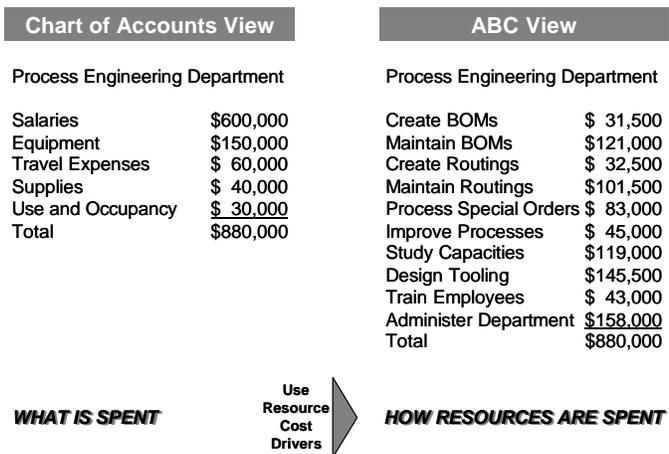


Figure 1.3: ABC usage of resource cost drivers [Pieper, 1999].

Therefore, an effective ABC system provides the organization with a clear view of the organization's expenses based on its activities. To illustrate this point further, Figure 1.3 [Pieper, 1999, p. 1] displays the example of the cost breakdown for an organization's process engineering department. The chart of accounts view, or traditional view, displays the cost information according to cost accounts. The ABC view displays the same information by breaking down the costs into a set of top-level activities

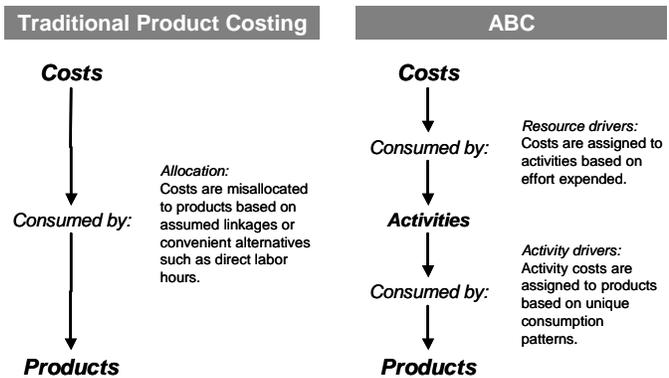


Figure 1.4: Traditional product costing versus ABC [Pieper, 1999].

that drive product cost. Through the ABC view, managers can identify activities that are absorbing more

money than expected and probe deeper into those activities, understanding what is driving the abnormal cost absorption, and subsequently formulate actions to reduce costs, as is shown by **Figure 1.4** [Pieper, 1999, p. 2].

In summary, traditional cost accounting systems limit a manager's ability to manage and allocate overhead costs in a correct manner, masking the true costs of products and services provided. ABC, on the other hand, enables managers to gain a clearer picture of the economics of their operation; understanding how indirect and support costs can be driven by a particular activity, and then by processes, products, services, and even customers.

### **1.3. The Correct Follow-Up: ABM**

Enabling managers to understand better the cost drivers of a particular production process, leads to the next natural step of ABCM, which is ABM. Consequently, ABM can be defined as follows:

**“The broad discipline that focuses on achieving customer value and company profit via the management of activities. It draws on ABC as a major source of information.”** [Player et. al., 1999, p. 4]

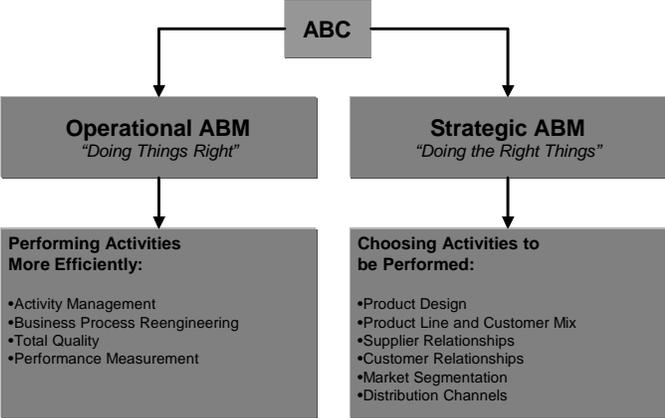
ABM covers a broad spectrum of management techniques used to manage operations based on activity cost data. The benefits gained through the use of ABM are:

- Identification of redundant costs.
- Analysis of value added and non-value added activities.
- Quantification of the cost of quality by element.
- Summarizing customer focused activities.
- Measuring the cost of complexity.
- Providing process cost and supporting process analysis.
- Tracking the impact of reengineering efforts.
- Better understanding the cost drivers.
- Evaluation of manufacturing flexibility investments.
- Activity Based Budgeting.

ABM ultimately enables the organization to achieve its operational goals by reducing the amount of overhead and support services required, thus achieving the same goals with lower costs. Therefore,

not only can ABM address operational issues, but its power can be extended and used to address very specific strategic issues as well. In fact, ABM can be subdivided into two very specific subsets: operational ABM, and strategic ABM. Operational ABM, “doing things right” focuses on three main objectives: enhance efficiency, lower costs, and enhance asset utilization. Strategic ABM, “doing the right things, attempts to alter the demand for activities to increase profitability while assuming, as a first approximation, that activity efficiency remains constant” [Kaplan et. al., 1998, pp. 4-5].

As is illustrated by **Figure 1.5** [Kaplan et. al., 1998, p. 4], operational ABM concentrates on improvements directly linked to the operations of the company. Operational ABM can support efforts geared towards increasing resource capacity, through the reduction of machine downtime, and improving or eliminating faulty activities. Therefore, the main goal of operational ABM is to take a company’s resource level as is and either



**Figure 1.5: Using ABM for operational and strategic improvements [Kaplan et. al., 1998].**

increase its capacity, or lower its cost. For those managers striving to achieve higher level of lean manufacturing in their operations, operational ABM is certainly a very powerful tool that can unhide inefficiencies in resource usage, previously unidentified. The benefits of operational ABM usage can be measured by a reduction in costs (improved asset utilization), and unnecessary cost avoidance (reduction of faulty or unnecessary activities). Both benefits lead to a more optimized and expanded capacity utilization of the company’s resources, leading to higher ROI and ROA.

Strategic ABM, on the other hand, is a more long-term tool used to steer the company’s strategy in the right direction through a better understanding of the economics of the business. Strategic ABM is used to identify the overall optimized allocation of resources. For example, through ABC, a company might find out that the revenues generated through the manufacturing of a certain product, or through providing a certain service, are less than the costs incurred for producing the product or providing the service. In this case, strategic ABM aids in identifying means to shift resources away from such

unprofitable activities, and channel them into more profitable ones, through a shift in the cost driver quantities demanded by the unprofitable activities. Strategic ABM can also be used beyond the manufacturing floor, by extending the same concept to the process of choosing a low-cost supplier instead of the low-price one. Further applications of strategic ABM include facilitating superior capital investment decisions (capital investment decisions not driven by distorted cost structures), lower product design and development costs, and increased capacity to serve and increment share in high profit market segments of particular products or services. “Obviously, operational ABM and strategic ABM are not mutually exclusive. Organizations will get the greatest impact when they reduce both the resources required to perform a given quantity of activities and, simultaneously, shift the activity mix to more profitable processes, products, services, and customers” [Kaplan et. al., 1998, pp. 5-6].

## 1.4. The Critical Link: ABCM

The previous sections presented a very concise overview of the major concepts that make up ABC and ABM. The purpose of this section is to expand further on the link between ABC and ABM to create a unified system (ABCM), and illustrate reasons why today’s business environment is mature for the adoption of such initiatives. As was mentioned above, it must be remembered that ABC is not in itself a measurement system. In essence, ABC enables the construct of a framework that enables the collection of different type of operational data

from the same sources. The key is to understand that ABC data exists, and is generated every day through normal operational activities. However, in the majority of cases, this data is lost due to the fact that the correct collection framework is not in place. Cokins, simplifies the explanation through this simple statement: “...the output of ABC can provide important input into performance measures. And the presence of ABC data can lead to actions and decision based measurements...” [Cokins, 1999 (2), p. 1].

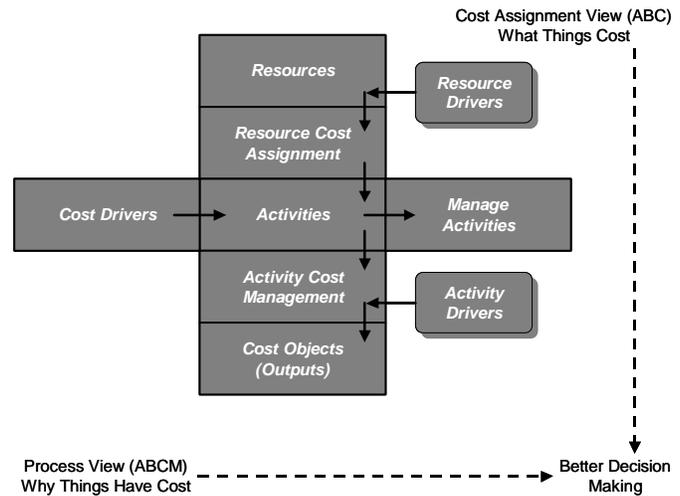


**Figure 1.6: Mission statements are ends, not means [Cokins, 1999 (2)].**

In essence, ABCM practitioners argue that there is a real discrepancy between many ambitious company mission statements, and the actual actions undertaken to achieve those mission statements. The manager's dilemma is the large disconnect between very high-level mission statements, and proper metrics that enable the organization to move in the right direction and actually achieve those mission statements (see **Figure 1.6**). Measurement techniques in place today do nothing to help close the gap between operational effectiveness and strategic visions, partly because these measurement techniques do not enable managers to fully understand the impact of their decisions. However, ABCM's foundation is based on linking operational effectiveness to organizational strategies and goals. The two main goals of ABCM are: "increase the emphasis on non-financial measurements, such as customer satisfaction and employee innovation, and channel a greater focus towards predictive measurements (leading indicators) in contrast to the after-the-fact historical results that are reported too late to change the outcomes (lagging indicators)" [Cokins, 1999 (2), p. 2]. Thus, as is illustrated by **Figure 1.6**, managers must find the answer to the following question: what must be done today in order to achieve the company's mission statement tomorrow?

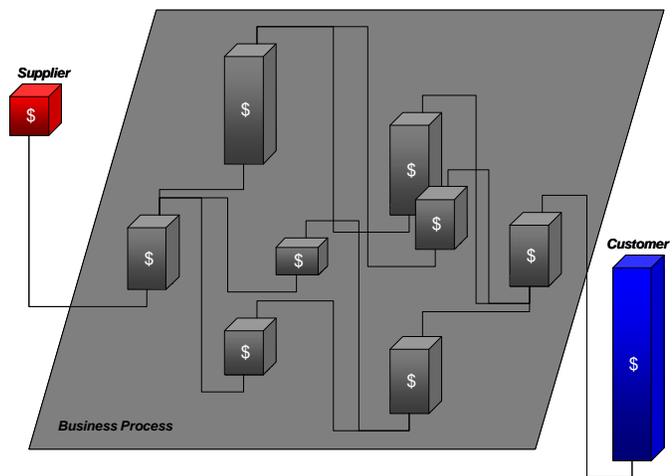
As simple as the vignette in **Figure 1.6** might seem, it captures the essence of ABCM. Empowered with the information systems and the technology to gather the data necessary to understand the true economics of a business, managers now struggle with understanding how best to access the data, what to do with it, and how to shape the data in a format that is usable by the organization. The majority of the research contained in this thesis will be dedicated to presenting and explaining different implementation examples of ABC, ABM, and ABCM both in the aerospace and defense sector environment and out. As the vignette in **Figure 1.6** correctly shows, the undecided management will realize that the options are many, as are the roads shown in the vignette. However, each road will lead down a different path that will require different ABC, ABM, or ABCM implementation levels, and will yield different results. In the end, successful ABCM implementations will pivot on whether the company's management successfully understood the trade-off between different types of implementations, and the benefits gained. In the end, it should be understood that "today's traditional managerial accounting is at best useless, and at worst dysfunctional and misleading" [Cokins, 1999 (2), p. 2], and that organizations must react to this and begin to employ methodologies that will rectify this critical managerial deficiency.

In the end, companies that adopt ABCM do so because there is a need to accomplish tasks in both the operational and strategic scenarios of ABM. The approach, however, should be structured, meaning that from past experiences it is easier for companies to pursue the “ABC comes first, ABM second approach” [Cokins, 1998, p. 2]. A very commonly used framework, which highlights how ABC and ABM can be bridged together, is the CAM-I cross shown in **Figure 1.7**. In the CAM-I cross, activities lie at the center since they are the key to answering two critical questions: why things have cost, and what things cost. The optimal approach is to first traverse the cross vertically, with the goal to calculate the costs of outputs, products, service lines, channels and customers, based on their differences.



**Figure 1.7: The ABCM framework (the CAM-I cross) [Cokins, 1998].**

The “ABC comes first” approach allows the ABCM team to build a database that enables to extract information in a format that can be tied into the second step; “ABM comes second.” Now the ABCM implementation team has two choices: “either disaggregate the activity costs and their outputs to allow for more detail and granularity, or calculate the business process costs” [Cokins, 1998, pp. 3-4]. The first choice obviously enables the ABCM team to increase the level of detail, increasing the number of

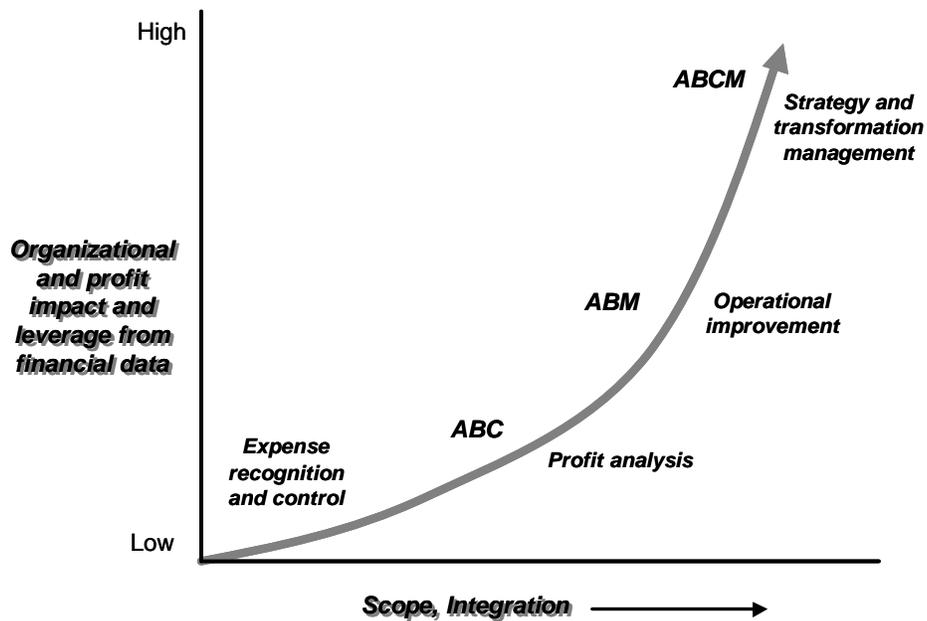


**Figure 1.8: Business process cost visualization [Cokins, 1998].**

opportunities to calculate intermediate output costs. The first option enables the ABCM implementation team to employ ABM for productivity improvements (operational ABM as mentioned previously). The advantage to this approach is that it enables the company’s management to understand how the

individual process can be streamlined, and aid root-cause analysis and performance type issues. The latter choice enables the ABM team to map the business process, and aggregate the costs per business process as sequenced in time, as is shown in **Figure 1.8** [Cokins, 1998, p. 5]. In this case, the business process cost visualization is more geared towards a strategic analysis that questions the business process as a whole (strategic ABM as mentioned previously). Now the company's management can also question the feasibility of performing certain tasks, and answer questions such as what is the optimum make versus buy ratio, and how the business process can be modified to enhance value added activities and modify the non-value added ones.

Thus, the numbers of options available to the ABCM implementation team to bridge the gap between ABC and ABM and migrate towards an ABCM environment are numerous. In the end, the main driver is to try and understand the true cost of work. Now the key question is what is the level of difficulty



**Figure 1.9: The evolution of ABC [Cokins, 1998].**

in achieving an ABCM status. As the organization moves through the CAM-I cross (**Figure 1.7**), the natural evolution will be to go from ABC to ABM to ABCM. Due to the fact that the scope of integration increases as the company moves from ABC to ABCM, so does the level of complexity of the system. **Figure 1.9** [Cokins, 1998, p. 13] displays graphically exactly this point.

## 1.5. Research Structure

Now that a quick overview of ABC, ABM, and ABCM has been presented, this section will briefly explain the structure of the thesis. The objectives of the thesis are:

1. Present an overview of the current extent and successfulness of ABCM implementation.
2. Understand how ABCM can be used successfully in the aerospace and defense sector and identify enablers and barriers to widespread usage.
3. Present supporting data on ABCM implementations in the aerospace and defense sector through case studies of actual implementations.

The thesis will be subdivided into four major sections: Introduction to ABCM, aerospace and defense sector practices (see peripheral data explanation below), case studies, analysis and conclusion. Appendix A contains background research done to provide a view of the different types of companies outside the aerospace and defense industry sector that have implemented ABCM, and the different types of applications attempted.

Peripheral data will come from survey data gathered from MIT's LARA. This data enables to determine, with a certain degree of certainty, which types of companies within the aerospace and defense industry sector are more prone to using ABCM practices, and why.

The following is the hypothesis put forth at the beginning of the research, and the overarching questions that will be used to gather the data to either prove or disprove the hypothesis:

**“Aerospace and defense industry sector companies can benefit from the use of ABCM practices through the introduction of activity analysis for enhanced cost management and more efficient allocation of overhead costs.”**

- What are the barriers and enablers to widespread adoption of ABCM practices in the aerospace and defense industry sector?
- What are the lessons learned from the various implementation examples?
- Is investment in ABCM implementations offset by the benefits reaped from the implementation?
- What kind of operational decisions were made differently due in part from the implementation of ABCM practices for a particular product or process?

- During the ABCM implementations, what kind of data was sought and why?
- How does ABCM fit in the overall strategy of the organization?
- Can the aerospace and defense industry sector benefit from ABCM usage?
- Are aerospace and defense industry sector companies truly lean without the adoption of ABCM?

The data collected from the case studies contained below will show that there is evidence to support the hypothesis. Additionally, the data is useful in identifying the most important barriers and enablers to widespread ABCM adoption, and various lessons learned and benefits gained through different implementations. Most importantly, the data shows how an aerospace and defense industry sector facility was able to lay the groundwork that enables ABCM to be part of the facility's overall lean strategy, supporting the notion that without ABCM implementations, the facility does not consider itself a truly lean operation.

## **2. ABCM in the Aerospace and Defense**

### **Industry Sector**

## 2.1. A Typical ABCM Facility Profile

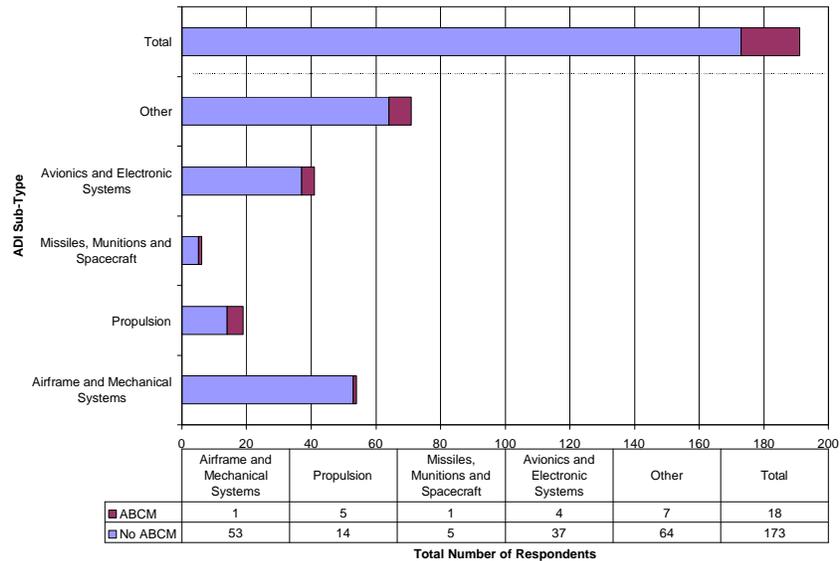
Although ABCM is not widely adopted within the aerospace and defense sector, it is useful to note that, to some extent, there exists data on those aerospace and defense industry sector companies that have adopted ABCM.

The data presented herein is an integral part of a more comprehensive survey conducted by MIT's LARA, through the National Aerospace Industry Survey. The survey's goal was to measure the impact of changes in the aerospace

industry, at the facility level, with regards to changes in

work practices, technology, employment, funding, and organization. Amongst the many issues it addresses, the National Aerospace Industry Survey also queried the use of ABCM through a pair of binary questions where the facility was asked to identify whether there were any significant ABCM efforts in place. The existence of this type of data allows the cross tabulation of a "no" or "yes" answer to the usage of ABCM with other facility characteristics parameters, and observe if there are trends among those aerospace and defense industry sector facilities that have adopted ABCM, as opposed to those that have not.

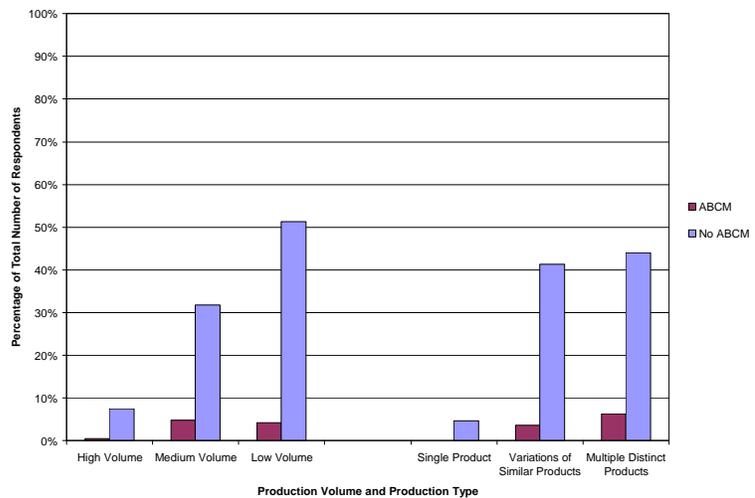
It is useful to begin with a cross tabulation of ABCM usage over the whole sample of respondents. **Figure 2.1** collects this data and displays the breakdown of ABCM usage by industry sector sub-type. In the National Aerospace Industry Survey, the industry sector sub-types were airframe and mechanical systems, propulsion, missiles, munitions and spacecraft, avionics and electronic systems, and other. The top-most bar on the graph in **Figure 2.1** represents the total percentage of facilities using



**Figure 2.1: Breakdown of the total number of respondents as a function of aerospace and defense sector sub-type.**

ABCM, as opposed to those that did not use ABCM. From the data gathered through the National Aerospace Industry Survey, 90.6% of the facilities responded that ABCM was not currently being adopted, while the remaining 9.4% reported that ABCM practices were in place. From the table in **Figure 2.1**, the reader can infer what is the relative concentration of ABCM usage within each of the sub-industries. In summary, of the total 9.4% representing those facilities that have adopted ABCM, 5.6% of the total 9.6% belong to the airframe and mechanical systems sector sub-type, 27.8% belong to the propulsion sector sub-type, 5.6% belong to the missiles, munitions, and spacecraft sector sub-type, 22.2% of them belong to the avionics and electronic systems sector sub-type, and the remaining 38.9% of the facilities belong to the other category. From the information provided in the survey responses, the other category is mostly comprised of facilities that produce unique products and provide unique services to larger OEMs. These products and services include everything from software development to special mechanical tool production. Even

though companies that have adopted ABCM tend to operate in all facets of industry, there is evidence that ABCM is mostly used by companies having higher product mixes, where the overall manufacturing process might not be complex due to the complexity of the product, but due to the diversity of the products being produced. If the facilities in the other



**Figure 2.2: Facility characteristics with respect to different production volume and type categories.**

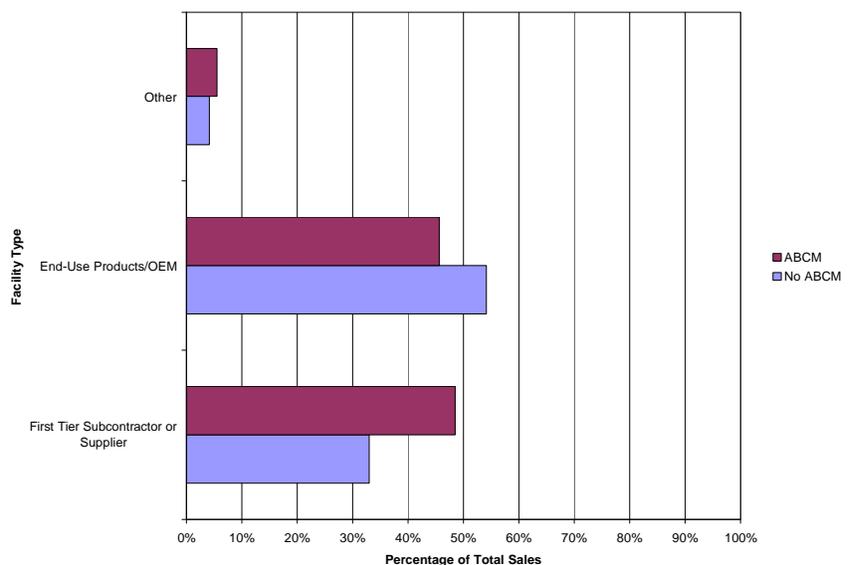
category are omitted, for simplicity reasons, one should expect that the sector sub-type that is more prone to a high product mix is the avionics and electronics sector. The fact that the propulsion sector shows higher ABCM usage percentages might be in line not with a high product mix, but a high number of uniquely complex manufacturing stages that involve a high number of small part integration efforts.

After identifying the sector sub-types where ABCM is more prevalent, it is useful to look at some of the physical characteristics of the facilities that have adopted ABCM as opposed to the ones that have

not. **Figure 2.2** displays two important differences amongst these two types of facilities. The first half of the bar chart displays the percentage of product volume subdivided in high, medium, and low production categories. For example, a high volume wafer manufacturers contrasted to low volume airframe manufacturers. From the bars, the reader can infer the total breakdown amongst the different respondents, or the relative concentration of ABCM enabled facilities for each of the product volume and type categories. Of the total number of respondents, 57% reported low volume production, 35% reported medium volume production, and 8% reported high volume production, totaling 100% of the respondents. The bars also show the relative concentration of facilities employing ABCM as opposed to those that do not. Of the total number of respondents, ABCM enabled facilities tend to operate in medium production volume environments. In fact, the highest concentration of ABCM enabled facilities fall under the medium production volume category. Through the same analysis, from the second half of the same graph, the highest concentrations of facilities that employ ABCM tend produce multiple distinct products, suggesting the need to manage multiple complex manufacturing lines. These findings supports the comments made above, where manufacturing facilities that have to manage complex manufacturing processes, and not complex products, are the ones that tend to migrate most towards ABCM practices.

Additionally, the National Aerospace Industry Survey data offers insights into the type of tiers that

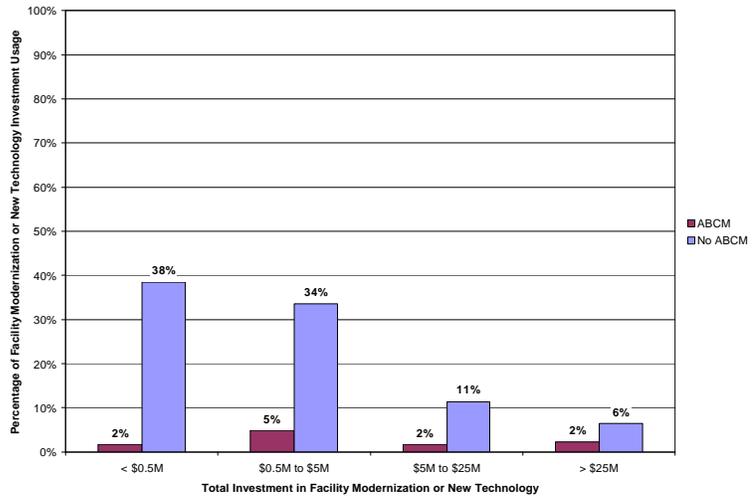
ABCM facilities tend to service and operate in as opposed to those facilities that have not adopted ABCM. This information is displayed in **Figure 2.3**. Facilities that have adopted ABCM tend to be first tier subcontractors as opposed to OEMs. This finding follows in line with the findings from the previous charts. First tier subcontractors tend to have



**Figure 2.3: Average portion of total sales breakdown by facility type.**

more numerous products, and higher production volumes as opposed to OEMs. Additionally, first tier subcontractors have a higher probability of manufacturing systems that have smaller parts, thus accentuating integration efforts.

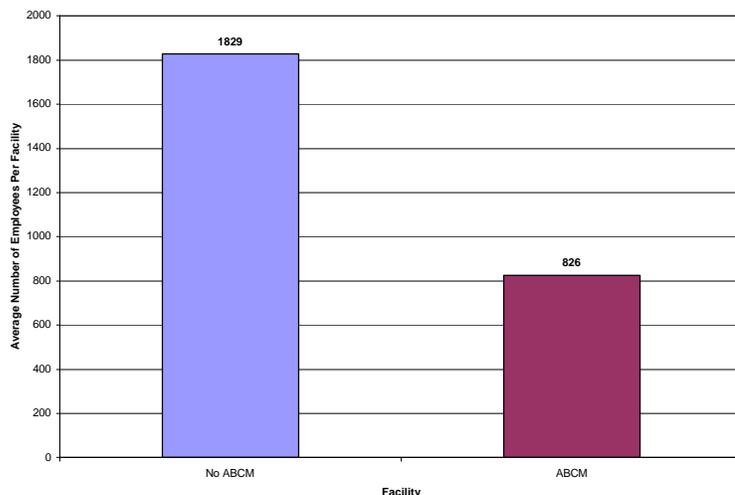
Another interesting statistic is the total investment in modernization and new technologies that ABCM enabled facilities have implemented versus facilities that are not ABCM enabled. **Figure 2.4** displays the differences in investment levels in modernization and new technology at the facility level between these two types of facilities. Of the respondents to the survey that have adopted



**Figure 2.4: Facility modernization and new technology investments differences between facilities that adopted ABCM and facilities that did not.**

ABCM, the majority of the facilities have invested between \$0.5 and \$5 million in modernization and new technology. By contrast, the majority of facilities that did not adopt ABCM have invested less than \$0.5 million in modernization and new technology for their facilities. **Figure 2.4** illustrates this by displaying the

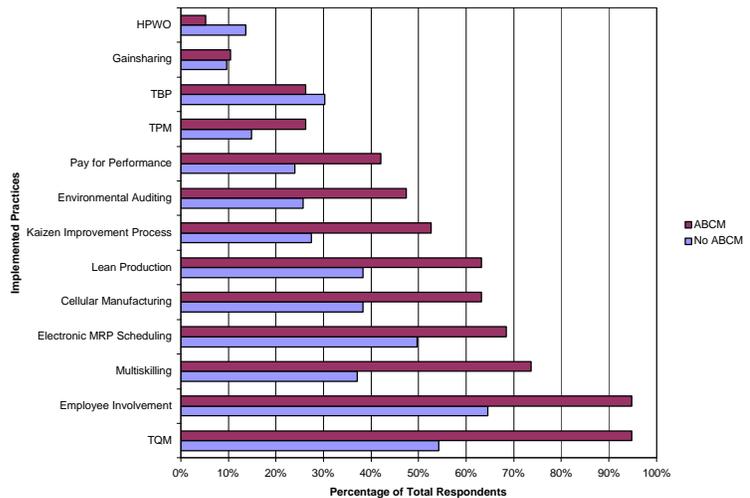
concentration of facilities that adopted ABCM versus those that did not. The reader should keep in mind that apart from the higher number of facilities that do not employ ABCM practices, these facilities tend to be larger in size, have lower production rates, and tend to produce less distinct products. Therefore, the assumption is that there is less investment in modernization and new technology



**Figure 2.5: Average facility size by employee number.**

due to the relatively low need to manage complex production systems, or numerous production lines. An airframe integrator might not require the same level of modernization investment as compared to a facility that produces numerous types of specialized avionics equipment.

To associate this illustration with the relative size of the facilities that have adopted ABCM versus those that did not, **Figure 2.5** displays the average number of employees at facilities that have implemented ABCM and those that do not. As is shown in **Figure 2.5**, facilities that have adopted ABCM tend to be somewhat smaller (826 average employees), versus facilities that did not adopt ABCM (1829 average employees). Again, this follows in line with the findings from the above charts, where facilities that have adopted ABCM tend to be first tier suppliers, thus the assumption is that their operations are somewhat smaller than the OEMs they tend to serve and supply.



**Figure 2.6: Comparison of implemented practices amongst ABCM enabled facilities and facilities that did not adopt ABCM practices.**

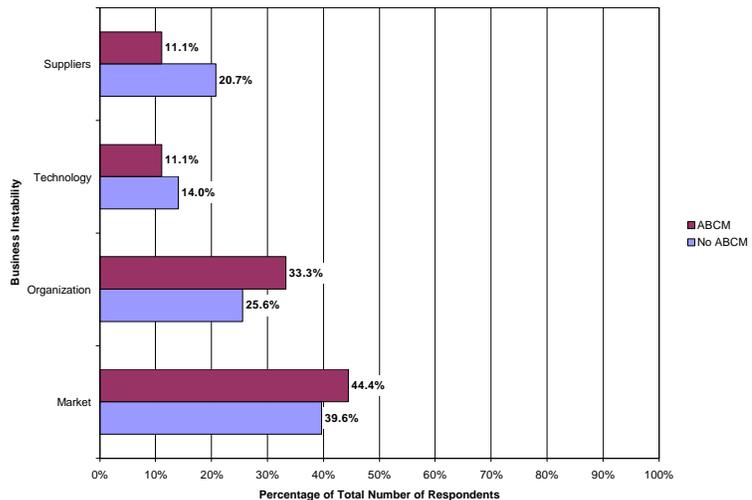
Therefore, in summary, the

basic characteristics of an aerospace and defense sector facility that has adopted ABCM are as follows:

- Industry – aerospace and defense sector.
  - Industry sub-type – Propulsion or avionics and electronic systems.
- Production volume – Medium.
- Production type – Multiple distinct products.
- Facility type – First tier subcontractor or supplier.
- Investment in modernization or new technology – Between \$0.5 and \$5 million.
- Average facility size – 826 employees.

However, thanks to the breadth of the National Aerospace Industry Survey, there are many other factors that go beyond the basic physical demographic of the ABCM enabled facility. Implemented

practices, business environment factors, management practices, effects of business instability, and overall economic performance are also useful in refining the picture of a typical aerospace and defense sector facility that is ABCM enabled. First off, **Figure 2.6** displays a list of practices that are usually implemented by companies or facilities that are striving to migrate towards a more lean manufacturing environment, and the relative popularity of the practice among the different facilities, ABCM enabled and not. As can be seen from the graph, for ABCM enabled facilities, the top 5 implemented practices are: TQM, employee involvement, multiskilling, electronic MRP scheduling, and cellular manufacturing. Although these practices also represent the top 5 implementations for facilities that are not ABCM enabled, it is useful to notice that the level of usage amongst ABCM enabled facilities is much higher. For example, for TQM, while approximately 95% of ABCM facilities have stated that it is currently being used, the number drops to approximately 53% for facilities that are not ABCM enabled. Similarly, of the facilities that employ ABCM practices, 95% also employ employee involvement practices, as opposed to the 65% of the facilities that do not have ABCM practices. 74% of the ABCM enabled facilities also use multiskilling, in contrast to the 37% of facilities that are not ABCM enabled. Lastly, electronic MRP scheduling and cellular manufacturing are employed by 68% and 63%, respectively, by ABCM enabled facilities, as opposed to the 50%, and 38%, respectively of the non-ABCM enabled facilities.



**Figure 2.7: Business instability effects on ABCM enabled facilities as opposed to facilities that are not ABCM enabled.**

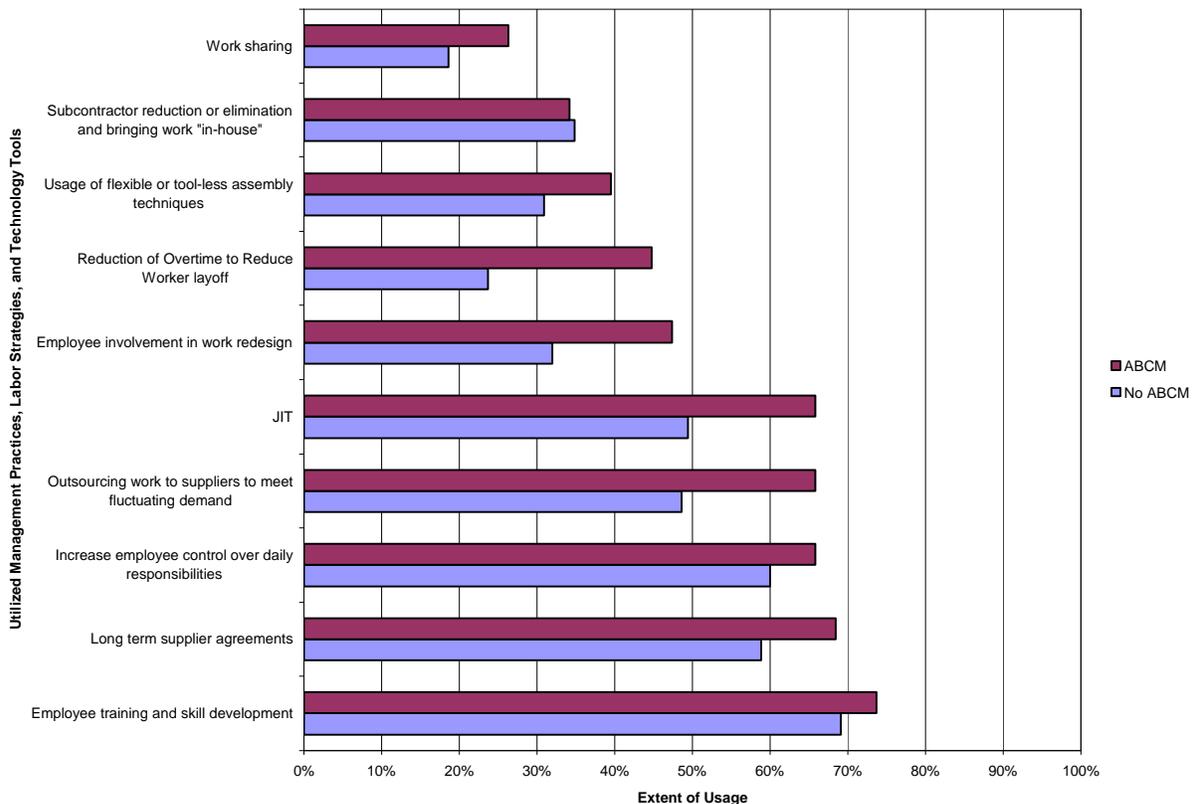
It should be noted that when asked about HPWO, a very important component of lean practices, ABCM enabled facilities stated a lower usage as opposed to those facilities that are not ABCM enabled; 5% for ABCM enabled facilities versus 13% for non-ABCM enabled facilities. This is contrast with the responses to other lean practices, may suggest that those facilities that adopted ABCM, HPWO might not be a distinct lean initiative. In fact, HPWO practices can surface after ABCM implementations, where teams

are composed of employees from diverse business backgrounds. The graph in **Figure 2.6** clearly shows, that ABCM enabled facilities are more likely to use other lean practices as opposed to those facilities that are not ABCM enabled.

When asked to identify business instability factors that affect the facility, the differences between ABCM enabled facilities and facilities that are not adopting ABCM are also noticeable. This information is captured in **Figure 2.7**. Business instabilities are subdivided into 4 major categories: market, organization, technology, and suppliers. Market instability would include changes in budget allocations for government contracts, changes in internal company budgets, and/or changes in product demand. Organization instability includes such things as mergers and acquisitions involving the parent company, changes in leadership visions, staffing turnover rates, and/or restructuring of operations. Technology instability includes factors such as changes in equipment or other technology, and/or changes in customer requirements, technical design or materials. Lastly, supplier instability includes changes in supplier performance, changing government acquisition practices (for those facilities shifted more heavily into military contracting), outsourcing manufacturing capability, and changing in the number of suppliers to the facility. **Figure 2.7** clearly shows that ABCM enabled facilities identified market instability as the major source of influence to operations (44.4%), followed by organizational instability (33.3%). On the other hand, even though facilities that are not ABCM enabled identified the market and the organization instabilities as major sources of influence their operations, the graph clearly shows that the numbers are more spread out, and that facilities that are not ABCM enabled seem to receive significant influence from technological and supplier issues as well. ABCM enabled facilities, to a certain degree, seem to be less susceptible to supplier and technology issues. This notion follows in line with information presented above. ABCM enabled facilities have been shown to invest more resources into modernization and manufacturing technology improvements, as well as employing TQM, and JIT techniques that preclude a higher degree of cooperation with their supply chain. With this in mind, ABCM enabled facilities will receive less business instability influence from technology and supply chain disruption as opposed to their non-ABCM enabled counterparts. This enables these facilities to channel more resources in trying to mitigate market instabilities, which are notoriously harder to predict and manage. Organizationally, ABCM facilities tend to experience more instability than non-ABCM enabled facilities. A plausible explanation for

this can be that the introduction of ABCM practices does cause a certain amount of organizational instability as the system is put in place and accepted by all levels of the organization.

In an effort to gauge the reaction of the different facilities to the different types of instabilities mentioned above, the facilities were asked to state to what degree they engaged in using certain



**Figure 2.8: Extent of utilization of management practices, labor strategies, and technology tools to mitigate business instabilities between ABCM and non-ABCM facilities.**

management practices, labor strategies, and/or technology tools to mitigate the effects of business instabilities. **Figure 2.8** displays the pertaining information. ABCM enabled facilities tend to invest more resources in employee training, long term supplier contracts and higher degree of supplier integration, and JIT. ABCM enabled facilities also tend to push the decision making process to the lower levels of the organization by increasing employee control over daily activities, and employing more employees in work redesign processes. Additionally, ABCM enabled facilities seem to have a more flexible work force that is able to utilize work sharing capabilities to greater extents, as well as trying to reduce the overall number of suppliers by bringing more outsourced work "in-house". However, by contrast, ABCM enabled facilities

tend to make more extensive use of supplier capacity to mitigate instabilities in product demand. Not surprisingly, ABCM enabled facilities tend to invest more resources into reducing overtime to avoid worker layoffs, which is one of the problems that ABCM was originally designed to resolve. Overtime, which arises mainly from unpredictable product demand fluctuations, can add significant strain to the facility's cost structure if the facility has to make use of overtime policies to maintain a manufacturing level that will enable it to meet spikes in product demand. Fluctuations of this sort create distortions in the budgeted resources for product manufacturing that can have negative repercussions once demand has subsided to normal levels, or fallen to below average values, usually rectified through worked layoffs. Investing in trying to stabilize product manufacturing with fluctuating product demand, can help mitigate the need to layoff workers during periods of slower demand that following unpredictable spikes.

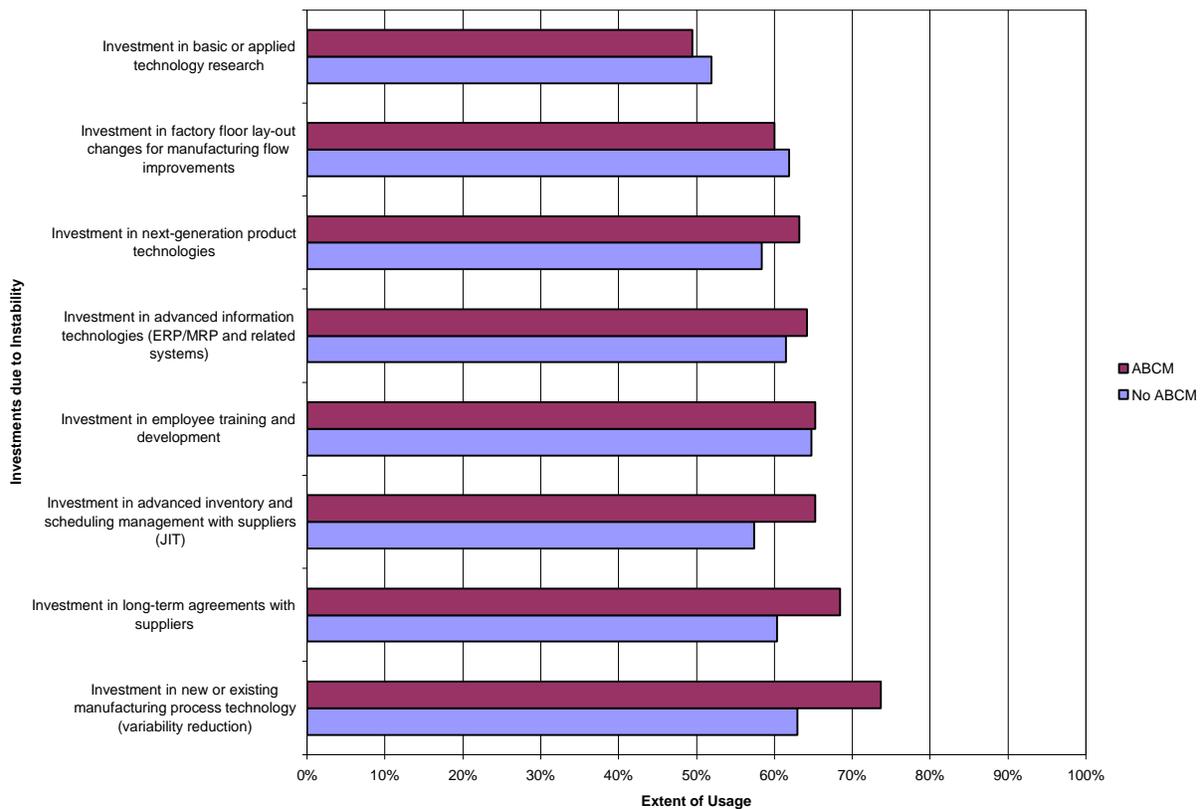
Additionally, to the extent of use of various management practices, labor strategies, and technology tools used to cope with business environment instabilities, as presented in **Figure 2.8**, it is useful to look at the actual changes in investment levels for facilities that are ABCM enabled, as opposed to facilities that are not. Investments can be regarded as pledging various resources, capital, both human and financial, to help reduce the facility's susceptibility to business instabilities. As can be see from **Figure 2.9**, facilities that have adopted ABCM tend to invest more resources in the following 3 areas:

- Investing in new or existing manufacturing technology in order to reduce manufacturing variability due to fluctuating demand.
- Investments in long-term agreements with suppliers.
- Investment in advanced inventory and scheduling management with suppliers (JIT).

These findings follow in line with information presented in the above charts. ABCM enabled facilities strive to reduce variability through the introduction of new manufacturing technologies, and the adoption of JIT techniques coupled with long-term supplier integration. It is also helpful to notice that investment in ERP and MRP based systems does not differ greatly between ABCM enabled and non-ABCM enabled facilities. In fact, ERP and MRP systems are sometimes viewed as risky due to the fact that their inflexibility, as product manufacturing techniques change, will cause additional investments into changing the system in order to keep up with these changes. By contrast, facilities that are not ABCM enabled invest more resources into new products (in the form of research and development), and factory floor

layout. Although it is somewhat hard to interpret these results, a plausible explanation for the higher degree of investment in new products is the need for non-ABCM enabled facilities to develop newer products that will enable them to achieve higher margins through market sales. ABCM enabled facilities might be experiencing a higher degree of profitability from their current lineup of products, thus are in less of a need to develop new products to substantiate their.

**Figure 2.10** is very useful in portraying additional differences between ABCM enabled facilities



**Figure 2.9: Extent of investments due to business instability.**

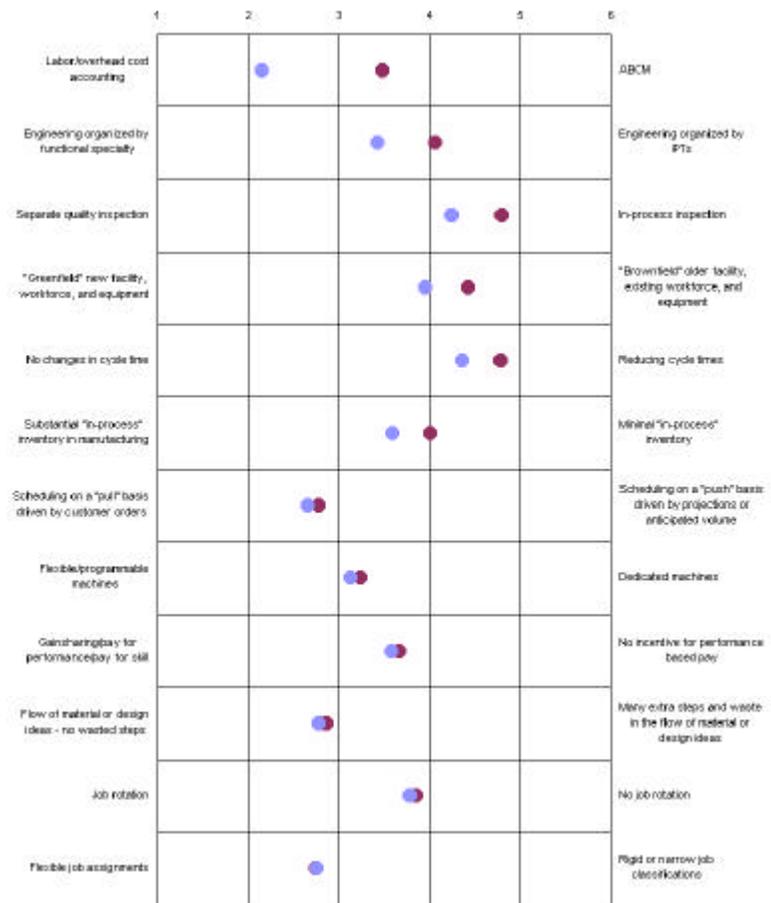
and non-ABCM enabled facilities. The figure displays two extremes separated by a scale of 1 to 6. To illustrate, the first category that appears on the left hand side is labor/overhead cost accounting, which can be interpreted as the classic method of allocating resources consumed in the normal operations of the facility. On the same line, on the right hand side, appears ABCM, which is the newer method of allocating the consumption of resources from the normal operations of the facility. Using the same color code as was used for the other charts that appear in this section of the research, the reader can see how

ABCM enabled facilities view themselves as opposed to non-ABCM enabled facilities. It is useful to note the largest differences between these two different types of facilities. ABCM enabled facilities are inclined to use more ABCM type cost accounting methodologies. The reader should be aware that facilities may use ABCM without having ABCM as an integral part of the cost accounting system. In fact, in many instances, ABCM is used as a “surgical” optimization tool that is employed to optimize a process, but is not necessarily migrated to the legacy cost accounting systems. ABCM enabled facilities tend to organize their engineering teams in IPTs, and use in-process inspection. This is very supportive of the information that was presented above, since these are characteristics of TPS and JIT type manufacturing environments, where multiskilling, and employee involvement are prevalent. Additionally, ABCM enabled facilities also experience reduced cycle times, and lower in-process inventories. Again, the plausible explanation for these differences are the investments that ABCM enabled facilities tend to make in newer manufacturing technology, coupled with the longer term relationships that are stricken with suppliers, and all lead towards the facility’s effort to try and mitigate market type instabilities (i.e.: product demand). It is also very interesting to notice that older, so called “brownfield” facilities, tend to employ ABCM more than newer or “greenfield” facilities. There could be a number of reasons for this difference, but the most plausible one is that older facilities are more susceptible to cost cutting efforts, and are thus more prone to exploring alternative methods of rendering their businesses more profitable in order to survive. In addition to the largest differences between ABCM enabled facilities and non-ABCM enabled facilities. For example, whether or not ABCM is employed in a facility should not influence the fact that the facility is employing a “pull” versus a “push” manufacturing system, or that the facility has dedicated versus flexible machines. ABCM usage is probably unlikely to give any insight into the facility’s usage of gainsharing or pay for performance, extent of job rotation, and rigid versus flexible job classifications.

Lastly, it is useful to whether or not ABCM enabled facilities have experienced any improvements in economic performance. The information is displayed in **Figure 2.11**. Commencing with the bottom-most portion of the graph, approximately 80% of the facilities that have implemented ABCM have stated an improvement in productivity. By contrast, less than 75% of the non-ABCM enabled facilities have reported the same improvement. Although this difference is not substantial, the higher response rate

suggests that there might be a relationship between facilities that employ ABCM practices and productivity improvements.

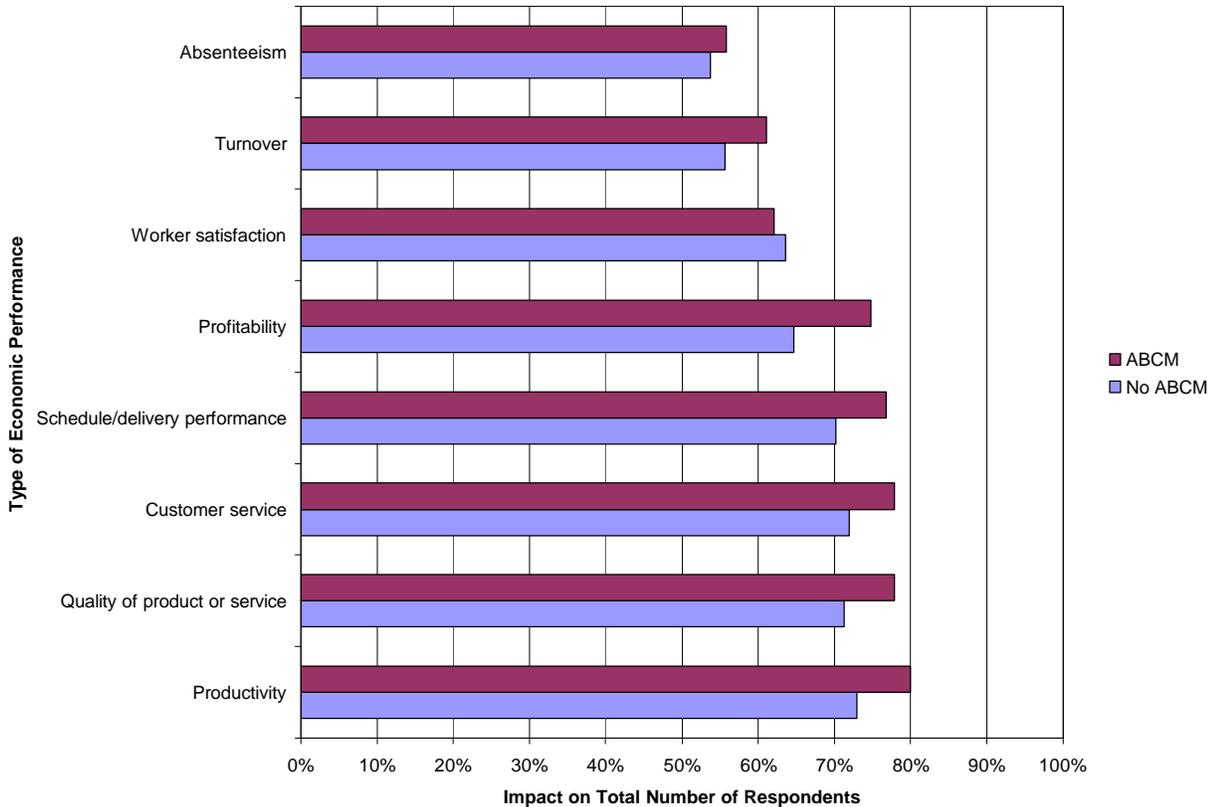
Additionally, other areas of economic profitability show that ABCM enabled facilities tend to benefit more than non-ABCM enabled facilities. Profitability, customer service, product and/or service quality, and schedule and/or delivery performance improvements are all more prevalent amongst those facilities that employed ABCM practices. It is useful to mention the differences between the different types of economic performance. The largest difference between these two types of facilities is in profitability with a difference of 10.1%. Productivity follows with 7.1%, schedule and/or delivery performance with 6.7%, product and/or service quality with 6.6%, and customer service with 6.0%. However, the reader should notice that ABCM enabled facilities have reported higher degrees of absenteeism and turnover. This follows in line with the lower degree of worker satisfaction that ABCM enabled facilities reported in contrast to non-ABCM enabled facilities. This can be explained along the same lines as the data presented in **Figure 2.7**. Organizational instability is prevalent in facilities introducing implementations such as ABCM. There will be a period of time where the organization of the facility will be adjusting to the new work practices, and thus higher absenteeism and turnover, and lower worker satisfaction are plausible short-term setbacks of an ABCM type implementation.



**Figure 2.10: Comparison of work system elements between ABCM enabled facilities and facilities that have not yet adopted ABCM practices.**

However, the reader should notice that ABCM enabled facilities have reported higher degrees of absenteeism and turnover. This follows in line with the lower degree of worker satisfaction that ABCM enabled facilities reported in contrast to non-ABCM enabled facilities. This can be explained along the same lines as the data presented in **Figure 2.7**. Organizational instability is prevalent in facilities introducing implementations such as ABCM. There will be a period of time where the organization of the facility will be adjusting to the new work practices, and thus higher absenteeism and turnover, and lower worker satisfaction are plausible short-term setbacks of an ABCM type implementation.

In conclusion, the data gathered through the National Aerospace Industry Survey does evidence that there are differences between facilities that have implemented ABCM practices versus those facilities



**Figure 2.11: Economic performance impact on ABCM enabled and non-ABCM enabled facilities.**

that have not. ABCM enabled facilities seem to be first tier suppliers, and thus smaller by number of employees with respect to the OEMs they furnish their products and services to. ABCM enabled facilities also tend to deal with multiple distinct products in medium to high production volumes, suggesting that ABCM is adopted by those facilities that have to deal with complex manufacturing processes, by means of numbers, and not necessarily with complex products. Additionally, these facilities tend to be older or “brownfield”, as opposed to younger or “greenfield”, suggesting that ABCM enabled facilities might be in the position of having to increase their productivity and profitability in order retain their competitiveness. This is further supported by the fact that ABCM enabled facilities invest more in new manufacturing technologies, and in long-term supplier relations, reducing the sources of instability to organizational and changing market conditions. Instability within the organization can certainly be explained by the

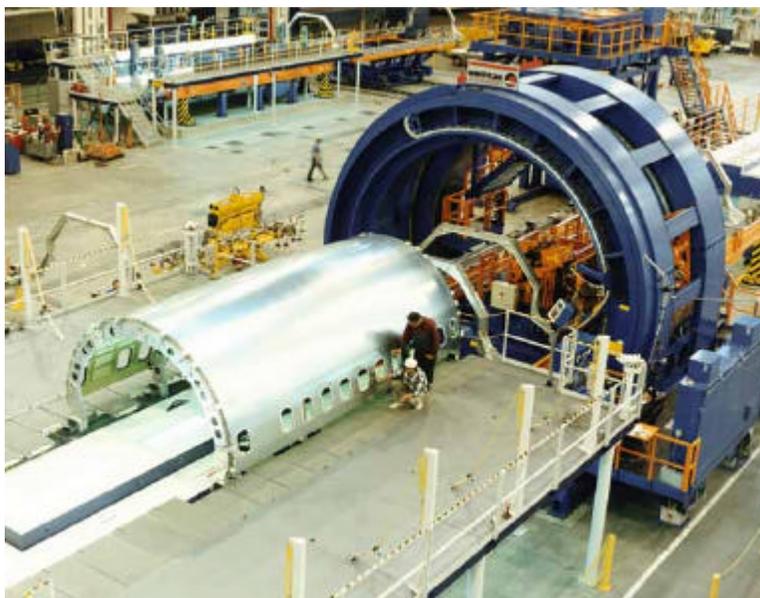
adjustment that the various tiers of the organizational structure have to make to ABCM implementations, suggested by higher degrees of employee absenteeism and turnover, and lower levels of employee satisfaction. Overall, economic performance measures suggest that ABCM enabled facilities experience increases in profitability, productivity, customer satisfaction, and improved product and/or service delivery times.

## **3. The BCAG Case Studies**

### 3.1. BCAG Wichita Division: The CM Strategy

A note to the reader: please keep in mind that the majority of the information contained within this chapter was obtained through a number of different interviews and discussions with BCAG employees, as well as information that is contained in Boeing internal briefings and presentations not available to the public, thus, the references have been omitted from the bibliographical list due to their unavailability. The information contained herein was gathered through a number of different interview sessions with various members of the BCAG Finance Department. These different members ranged from managers to business analysts. BCAG is the world's largest manufacturer of commercial airplanes, and comprises approximately 60% of the total revenues recognized by the Boeing Co., the largest aerospace company in the USA. Within BCAG there are numerous plants in various locations in the states of Washington, California, and Kansas, USA. BCAG Wichita Division, located in Wichita, Kansas, is a cost center manufacturing plant producing the 737-NG fuselage (as is shown in

**Figure 3.1**), Section 41, commonly know as the nose, the struts, the nacelles (which encase the airplane's jet engines), and thrust reversers for the 737, 747, 757, 767, and 777 families of products, along with approximately 18 other minor models. The plant also engages in passenger-to-freight modifications on 747, 757, MD-11, and DC-10 platforms. As of May 1999, the plant employed approximately 16,835 employees



**Figure 3.1: A multitask, high-precision gantry riveting system used in the assembly of a 737-700 fuselage (courtesy of the Boeing Co.).**

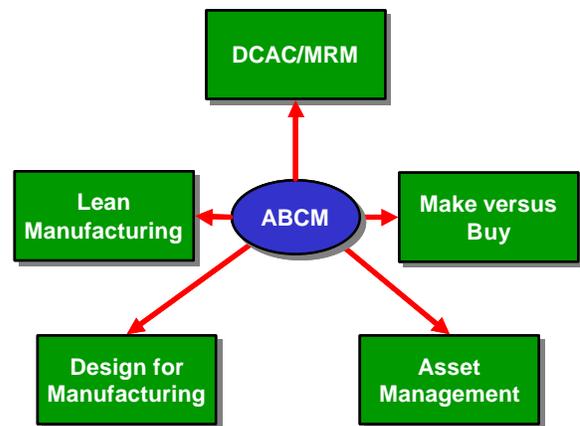
directly, and 53,100 indirectly within the state of Kansas. It averaged \$1.1 billion in annual payroll, purchased \$900 million yearly in raw materials and purchased parts, boasted 100,000+ part numbers, occupied an area equivalent to 1,300 acres, and its manufacturing facility contained 13.4 million square

feet of covered area. BCAG Wichita Division is subdivided into 4 RCs, 5 MBUs, and 17 Support Organizations that include engineering, materiel, and finance. As part of its overall strategy to become and retain the status of a world-class aerospace manufacturer, BCAG Wichita Division as a whole is focused on developing a lean, efficient design and production system that is supported by its CM Strategy.

The CM Strategy is supports of 5 strategic initiatives designed to link the manufacturing process and the support activities in such a way as to simplify the whole production process, and gain benefits from the use of lean business practices. As is illustrated in **Figure 3.2**, the CM Strategy's 5 strategic production initiatives are: DCAC/MRM (simplifies configuration, definition, production and support processes in use during customization of an airplane platform for a particular customer), Lean Manufacturing (used to shorten both flow and cycle times, as well as increase quality and inventory turnover), Make versus Buy (used to identify core products and processes, and helps to keep items that provide a competitive advantage that can be produced efficiently and cost effectively "in-house"), Asset Management (provides the analysis required to obtain an efficient use of assets, increasing ROA), and Design for Manufacturing (linking the design and manufacturing process so as to decrease product time-to-market).

These initiatives are linked and supported by ABCM, which acts as the financial tool used to unveil the process and activity views of costs. In particular, ABCM supports each of the initiatives differently. For DCAC/MRM, ABCM provides information used to tailor business streams and material management, thus providing the information to potentially reduce the cost of complexity and configuration changes.

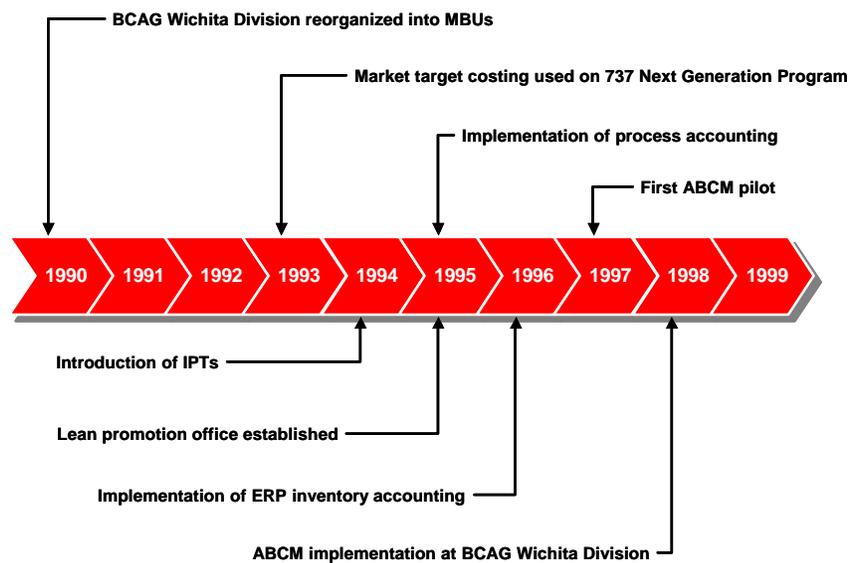
For Lean Manufacturing, ABCM provides information pertaining to costs of activity and processes, cost of quality, value added versus non-value added analysis, and performance measurements along with the appropriate metrics. In Make versus Buy, ABCM is used to provide profitability analysis used to decide whether a product should be produced "in-house" as opposed to



**Figure 3.2: The BCAG CM Strategy supports the Division's strategic initiatives.**

being outsourced, thus improving the decision making process. For Asset Management, ABCM provides analysis of set-up and run costs, costs of scheduled and unscheduled maintenance, costs of asset failure, and costs of manufacturing capacity, thereby allowing manufacturing managers to manage the assets under their control more effectively. Lastly, in Design for Manufacturing, ABCM provides analysis on the costs of products and processes, costs of design changes in configuration as impacted on the manufacturing floor, costs of incorporating complexity into a configuration design, and the costs of quality. The biggest hurdle in achieving this type of architecture is trying to move the financial community from the role of a scorekeeper/policeman, as is the classical accounting role, to a role of business partner, where strategic decisions, relevant to the company's pursuance of continued competitive advantage, are supported by the financial community through the provision of financial data that highlights the impacts of these decisions. In essence, BCAG Wichita Division views a successful implementation of ABCM as fulfilling 3 major roles: address the size, complexity and diversity of the manufacturing process, change the role of the financial community from scorekeeper/policeman to business partner, and successfully support the 5 strategic initiatives highlighted in the CM Strategy. Although ABCM supports the strategic initiatives outlined in BCAG Wichita's CM Strategy, it should be pointed out that ABCM is not, presently, part of the facility's CM System. The CM System is the collection of legacy tools and software that are normally used to aggregate operational data into financial accounting data as per GAAP, and issue accounting reports as per SEC specifications.

At BCAG Wichita Division, the introduction of ABCM began without full upper management backing.



**Figure 3.3: BCAG Wichita Division ABCM implementation milestone chart.**

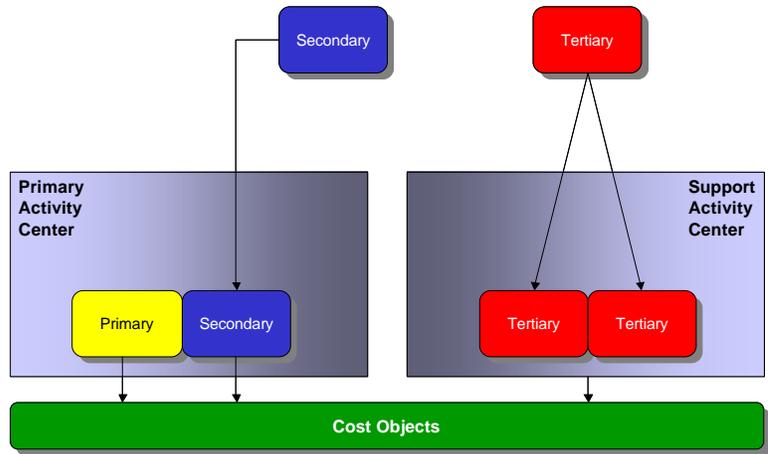
However, throughout the different implementation stages, the finance and operations departments, the offices that championed the introduction of ABCM practices, contracted outside consulting services both from management consulting firms (Klynveld Peat Marwick Goerdeler LLP, and Marakon Associates) and academicians (Dr. R. Cooper) possessing know-how on ABCM implementations and value based management. As is shown in **Figure 3.3**, the effort began in 1990 with the facility being organized in MBUs. Right from the onset, the vision was clear, and activity analysis was seen as the only viable analysis methodology to pursue in order to support and achieve the goals set by the CM Strategy. The steps that preceded the implementation of ABCM practices within BCAG Wichita Division, aided in laying the foundation necessary for a cultural change that enabled BCAG Wichita Division to shift from a product focus, where delivery schedules were the important metric by which performance was measured, to a more process oriented focus, where cost management and activity analysis were equally as important. Evidence of positive reactions on the part of shareholders is substantiated, in part, by the comments made by R.J. Glasebrook II, Managing Director, Senior Equity Portfolio Manager, and Analyst at Oppenheimer Capital, Boeing Co.'s largest investor, and responsible for tax-exempt portfolios and several investment companies advised by Oppenheimer Capital:

**“On the factory floor, it’s been clear for several years that [Boeing Co.] was handicapped in not having robust and sufficient ABC systems. I understand now [that] those are being deployed, hopefully rapidly, and will give [Boeing Co.] a huge leg up because it’s crucial to know where [the company is] making money. [Boeing Co. has] got to eliminate the bleeders; [the company has] got to pump assets and money where [it’s] best opportunities are, but first [it] need[s] to identify where value is created or lost.”** [R.J. Glasebrook, Boeing Co. Senior Manager’s Meeting, May 4<sup>th</sup>, 1999]

Like the examples that are presented in the Appendix section of this research, BCAG Wichita Division designed an ABCM system that met its unique requirements. The ABCM model is based on the premise that it must “provide a basis which is consistent with business issues and needs.” The ABCM model groups activities in terms of their relationships to final cost objects (i.e.: the different products produced at BCAG Wichita Division). This is accomplished through a system that breaks down activities costs into 3 categories, and links these activity costs to cost objects. The different activity cost categories are named and defined as follows:

- Primary costs – Activity has a direct relationship, and the activity’s cost can be assigned directly to the cost object.

- Secondary costs – Activity has cause and effect relationships to the cost object, even though there might not be a direct relationship with the cost object. These secondary activities are first driven to the primary activity center through location drivers, and subsequently to the cost object through activity drivers.
- Tertiary costs – These activities have little or no cause and effect relationship to the cost object, and costs are driven to the cost object using volume drivers such as labor hours or labor dollars.



**Figure 3.4: BCAG Wichita Division ABCM model cost categories.**

Figure 3.4 provides an illustration of the different activity cost categories, and how they map to the cost objects.

The ABCM model is designed to encompass each of the MBUs, which include support, engineering, tooling,

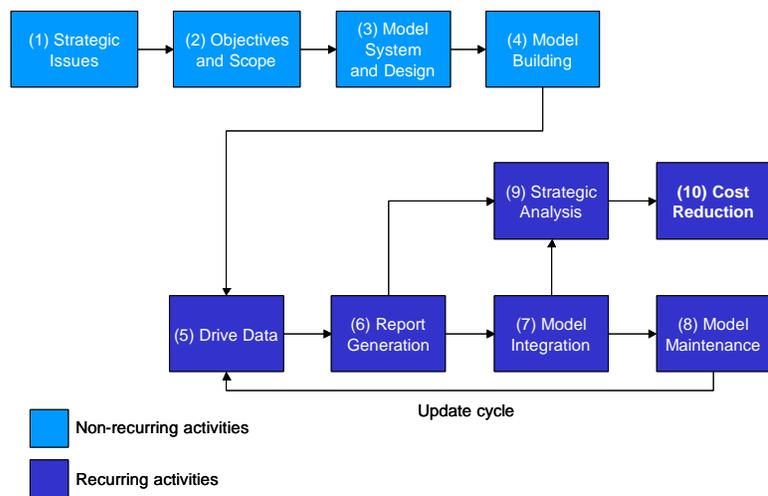
fabrication, and assembly. Resources will map to activities via the primary, secondary, or tertiary activity costs, which subsequently will map to

end items or parts produced in each of the MBUs. BCAG Wichita Division

has also developed guidelines for implementing, maintaining, and updating the ABCM model. There are

10 unique steps divided into recurring and non-recurring activities, as is illustrated in Figure 3.5. Throughout

the implementation, maintenance, and update of the model, the ABCM



**Figure 3.5: ABCM model implementation, maintenance, and update process used at BCAG Wichita Division.**

implementation team focuses on a set of guidelines as shown:

- Understand the strategic nature of the business.
- Obtain top management support.
- Clearly define goals and objectives.
- Form cross-functional teams.
- Build internal expertise, and do not rely exclusively on complex software and external consultants.
- Empower team members.
- Focus on changing behavior.
- Focus on long term continuous improvements.

To illustrate the differences in the way costs are viewed between a traditional accounting system, and an ABCM system, consider information pertaining to one of the manufacturing processes making up the total manufacturing cost of the Section 41 portion of a 767, which, as mentioned before, is the front portion of the airplane spanning from the nose to well within the first class cabin. The data contained in **Table 3.1** illustrates the traditional view of one of the manufacturing costs; the most common question that manufacturing managers pose themselves, when observing costs in such a layout is “where are the opportunities for cost reduction and improvement actually embedded?”

**Table 3.1: Traditional view of cost for the Twin Aisle manufacturing of the 767 Section 41.**

<i>Sum of Dollars</i>			
<b>Site</b>	<b>Resource</b>	<b>FY99, 4<sup>th</sup> Quarter (Percent of Total)</b>	
Twin Aisle	Labor expense	91.0%	
	Perishable tools	4.3%	
	Computing	2.3%	
	Travel	1.2%	
	Shop supplies	0.7%	
	Assignment allowance	0.3%	
	Tools and shop equipment	0.1%	
	Resource support	0.1%	
	Miscellaneous	0.0%	
<b>Twin Aisle Total</b>			<b>100.0%</b>

However, through ABCM and the development of a map that links activities with the actual value stream, manufacturing managers can use the information contained in **Table 3.1**, and organize it

differently painting a completely different picture. The different components of labor, overtime, and support can now be subdivided according to the activities that they support. In turn, the activities that absorb the labor, overtime, and support can be categorized as value added or non-value added. In essence, it is pointless for a manufacturing manager to reduce his/her cost by reducing the workforce (the largest contributor to the illustrative data displayed in **Table 3.1**), if the root of the problem lies in the growth of non-value added activities such as rework. To illustrate this point further, **Table 3.2** re-organizes the information displayed in **Table 3.1** according to macro-processes developed to analyze this particular portion of the 767 Section 41 manufacturing process.

**Table 3.2: Macro-process view of activity cost for the Twin Aisle manufacturing of the 767 Section 41.**

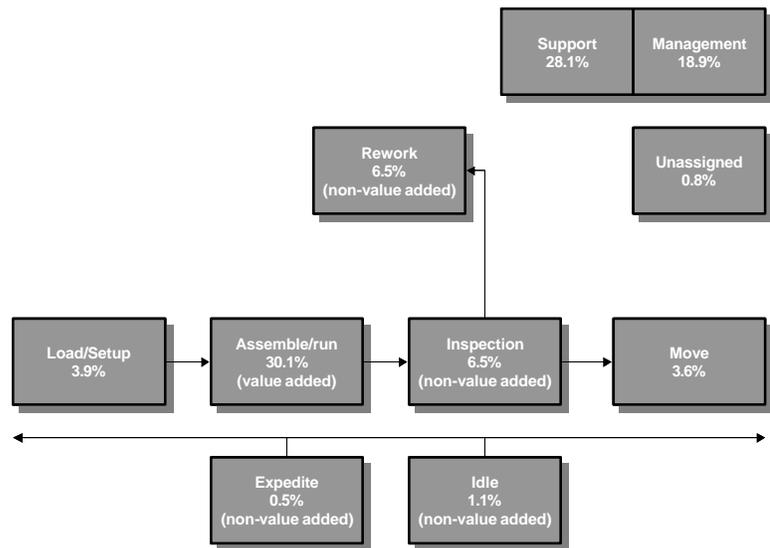
<i>Sum of Dollars</i>			
Site	Macro-process	FY99, 4 <sup>th</sup> Quarter (Percent of Total)	
Twin Aisle	Assemble/run	30.1%	
	Support	28.1%	
	Management	18.9%	
	Inspection	6.5%	
	Rework	6.5%	
	Load/setup	3.9%	
	Move	3.6%	
	Idle	1.1%	
	Unassigned	0.8%	
	Expedite	0.5%	
<b>Twin Aisle Total</b>		<b>100.0%</b>	

The manufacturing manager now has the power of identifying which macro-processes should be targeted for elimination or improvement. Lean principles can now be used more effectively in trying to streamline a macro-process, such as idle time, because the activity was identified, and a cost was assigned to it. As is shown in **Figure 3.6**, the macro-process view subdivides the activities into value added and non-value added. The manufacturing manager is thus in the position to target specific activities with lean initiatives designed to reduce the cost of the non-value added activity, or ultimately eliminate it directly.

BCAG Wichita Division leverages the power of the information contained within the simple schematic shown in **Figure 3.6** by being able to generalize the information for all the Twin Aisle manufacturing processes for all the different airplane platforms produced within the MBU (i.e.: 747, 767, and 777). Therefore, the information contained in **Figure 3.6** will encompass the cumulative cost data for

Twin Aisle manufacturing for the MBU. With this information, and the desire to reduce the cost of a non-value added activity such as rework, BCAG Wichita Division’s management can drill down further and add additional layers to the non-value added macro-process activity. For example, rework can be divided further to encompass more details highlighting the sub-activities that make up the rework macro-process (i.e.: fasten parts, load/locate, remove/replace, drill, and support). Furthermore, these sub-activities can be mapped to the different organizations to find out which one of the products has a disproportionate amount of non-value added rework being performed, and investigate the situation further.

The approach undertaken by BCAG Wichita Division in designing the ABCM model has its foundations closely tied to the CAM-I cross illustrated in **Figure 1.7**. As was mentioned above, the CAM-I cross proposes a flow of information that tries to answer two critical questions in order: why things have cost, and what things cost. Using this approach, and as is shown in **Figure 3.7**, BCAG Wichita Division has devised its own



**Figure 3.6: Macro-process view of the Twin Aisle manufacturing of the 767 Section 41.**

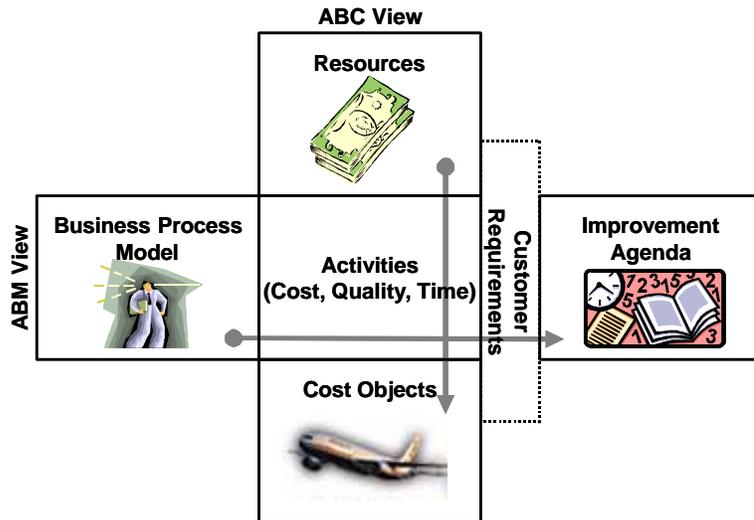
version of the CAM-I cross, which it uses to outline the flow of events during each new ABCM implementation. With this approach, BCAG Wichita Division identifies and describes the activities of its organization, understands the judgments that are made about the activity, maps how resources are actually consumed, and thus can highlight where value is created or destroyed. The overarching steps taken in order to build the CAM-I cross are the following:

- Determining what activities are done within a specific department.
- Understanding how many people perform the activities.
- Understanding how much time these people expend in performing the activities.
- Mapping the activities to the correct amount of resources they consume.

- Asking the question of whether or not the activity adds value to the organization as a whole.

In addition to the above, activity analysis is accomplished by conducting interviews, formulating surveys, gathering data from questionnaires, studying work records, and reviewing any other work related data that can shed light onto how to associate a cost to a set of activities.

The first pass, vertically, allows the organization to subdivide the cost structure into its primary, secondary, and tertiary costs, as is illustrated by **Figure 3.4**. Ultimately, ABCM should tie together the whole organization and begin to nurture a culture based on waste elimination, response time reduction, product and process design simplification, and quality



**Figure 3.7: The BCAG Wichita Division version of the CAM-I cross.**

improvement, as well as “emphasizing a structured approach to selecting and examining key work processes that are paramount to the success of the whole organization.” The ultimate goal that BCAG Wichita Division hopes to achieve through widespread implementation of ABCM practices is best summarized by the quote below:

**“Identify, reduce, or eliminate non-value added costs (including those activities that are essential, but non-value added) without deterioration to product quality value, or performance.”**

The reasons why Boeing Wichita Division believes that the above goal is achievable is because it firmly believes that ABCM enables the facility to accomplish the following:

- “Allows that understanding of the cause and effect relationship between cost and behavior.”
- “Creates a cost effective means of identifying opportunities for improvement.”

- “Establishes priorities, provides cost benefit analysis, and tracks the progress of continuous improvement initiatives.”
- “Facilitates what-if and sensitivity analysis related to business processes.”
- “Estimates future activity and process costs after reducing inefficiencies.”
- “Presents a cost view that influences product design and development decisions.”
- “Eliminates waste, reduces response time, simplifies the design of both products and processes, and improves quality.”
- “Increases capacity.”

Additionally, BCAG Wichita Division feels that the implementation of ABCM will enhance its ability to be competitive for future Boeing Co. work, its ability to meet future accounting and economic profit goals, and its ability to return value to shareholders and Boeing Co. as a whole, all through the ability to manage better the products’ unit costs. One of the ways that BCAG Wichita Division identified the above potential accomplishments that it hopes to achieve with a widespread implementation of ABCM is by understanding the limitations of its own process accounting system, which are identified below:

- Many costs are not allocated based on a cause and effect relationship – The system overemphasizes direct labor costs, and does not account for the impact of manufacturing volume and product complexity. ABCM would introduce activities as metrics for determining the true ownership cost of a product by determining the amount of resources absorbed by particular production activities.
- System is limited to production costs – The system does not account for General and Administrative costs, as well as making it very difficult to understand a specific product’s costs of quality. Additionally, customer and supplier costs are not readily understood from the information contained within the process accounting system. ABCM enables production managers to quantify the true ownership costs by taking into account costs incurred in offloading parts to vendors, through the introduction of potential delays and quality issues.
- System makes it difficult to act upon information – The system does not contain the granularity and information required to undertake improvement processes, and additional

special studies are required every time there is the need to uncover information necessary act upon an improvement process. The information contained in the process accounting system is designed to satisfy the needs and requirements of outside customers (i.e.: shareholders, SEC, IRS, etc.), and the focus are the collection of data that may not be suitable for operational analysis. ABCM rectifies this problem by providing cost data that is provided on a timely basis, and is useful for operational decision making purposes.

The best way to illustrate how BCAG Wichita Division performs ABCM implementations is through examples. The following sections provide documentation of actual ABCM implementations in different parts of the BCAG Wichita Division manufacturing process, with specific goals to be achieved for each implementation.

## **3.2. Case Study 1: MPF Phase I – Light Structures**

MPF Phase I, or Light Structures, represents the first stage in a manufacturing process designed to transport and process fuselage parts, being both outside panels, also know as skins, and brackets through a series of chemical treatment baths designed to treat the parts prior to assembly. The parts being processes can be divided into two categories: large and small. Parts falling in the large category are the outer panels, or skins, which will eventually make up the outside of the airplane's fuselage. Large parts also include large support brackets, used in the assembly of the fuselage, that, due to design requirements, have to go through the same chemical treatment processes as the skins. Both large and small parts get mounted onto hoods. Hoods are devices designed specifically to support these parts as they get dipped into the various treatment tanks. MPF Phase I, which is designed to handle the smaller parts, namely the smaller brackets, was an ABCM case study designed to analyze capacity through the process. Referring back to **Figure 3.2**, the case study touches upon the Lean Manufacturing, the Make versus Buy, and the Asset Management strategic production initiatives.

MPF Phase I represents a value added activity to the overall fuselage manufacturing process. Daily production rates showed that 30 hoods were going through the line every day. Factoring out any delays or unscheduled stops due to personnel or machinery, the existing equipment was designed to handle 60 hoods per day. The ABCM implementation team calculated that by factoring in normal delays,

such as personnel shift changes, and lunch breaks, 54 fully loaded hoods could pass through the tank line every day. Thus, at 30 hoods per day, there was only a 55% utilization rate of existing assets. The remaining 45% of the potential work that could pass through the facility's existing assets were being offloaded to external contractors. The ABCM implementation team estimated that by bringing asset utilization back up to 100% would mean that BCAG Wichita Division could process an additional 175,500 parts currently being outsourced to third party contractors. Even if the asset utilization level was only 80%, BCAG Wichita Division could bring back into the facility 135,000 parts currently being offloaded.

In order to accurately analyze the impact of bringing an additional 135,000 parts back into the manufacturing plant, the ABCM implementation team came up with the correct cost of undertaking this action. The total cost to BCAG Wichita Division can be broken down as follows:

- The initial cost of offloading the part to outside vendors.
- The cost of idle labor while outside vendors process the order.
- Any "in-house" rework that has to be done on offloaded parts coming back into the facility.
- Cost of facility fixed and variable assets associated with vendor procurement, contract, and other negotiations, in addition to any offload expenses paid to vendors.
- Cost of available capacity labor that could be processing parts (i.e.: foregone ROA).

With the above components, the ABCM implementation team formulated following metric:

$$\frac{\text{Offload Cost}}{\text{Part}} = \text{Vendor Costs} + \text{Fixed and Variable Costs} + \text{Capacity Costs}$$

**Vendor Costs = Initial cost of offload + any "in - house" rework on defective offloaded parts**

**Fixed and Variable Costs = Cost of idle labor + "in - house" vendor support costs**

**Capacity Costs = Maintenance cost of machinery that could be processing parts**

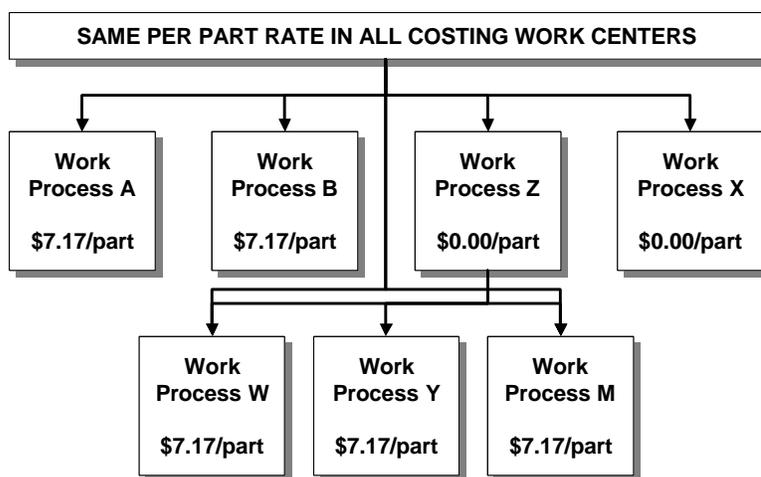
Taking a sample process batch of 12,000 parts, the ABCM implementation team came up with the cost of processing the batch through an outside vendor, and doing the same internally. An outside vendor would charge BCAG Wichita Division \$4.00 per part for the 12,000 part batch, as opposed to the \$7.00 per part that it would cost BCAG Wichita Division to process the parts "in-house". However, since the facility was working under capacity, and could theoretically increase the parts processed by approximately 50%, BCAG Wichita could process 24,000 parts, or 2 batches, without any increase in the

cost per part. Therefore, doing the work internally would cost BCAG Wichita Division \$3.50 per part as opposed to \$7.00, and would represent a \$0.50 savings per part. The ABCM implementation team did not feel that the significant increase in capacity would require additional staffing. Further analysis attempted to estimate the monthly savings that could be incurred by reversing the cycle of offloading parts to vendors and under utilizing the facility's assets. By breaking down the facility's average monthly output by product line, the ABCM implementation team could essentially estimate which product line would contribute the most to the savings, and which one did not. **Table 3.3** displays the typical product work breakdown for the facility. Additionally, as displayed in **Table 3.3**, over the subsequent 12 months from the ABCM implementation date, BCAG Wichita Division forecasted the total number of products that would be produced for each line.

**Table 3.3: Offload savings for 12-month production period on BCAG Wichita Division product line.**

Product Line	Number	Aircraft	Offload Savings (\$)
		Percentage of Total Production	
737	360	45%	\$710,775
747	108	14%	\$213,233
757	72	9%	\$142,155
767	108	14%	\$213,233
777	144	18%	\$248,310
<b>Total</b>	<b>792</b>	<b>100%</b>	<b>\$1,579,500</b>

Therefore, in conclusion, the ABCM implementation team argued that just by using under utilized asset capacity, the facility could stand to save approximately \$1,579,500 over a period of 12 months, and increase its ROA for MPF Phase I significantly without increasing operational cost. Once this preliminary analysis was completed, the ABCM implementation



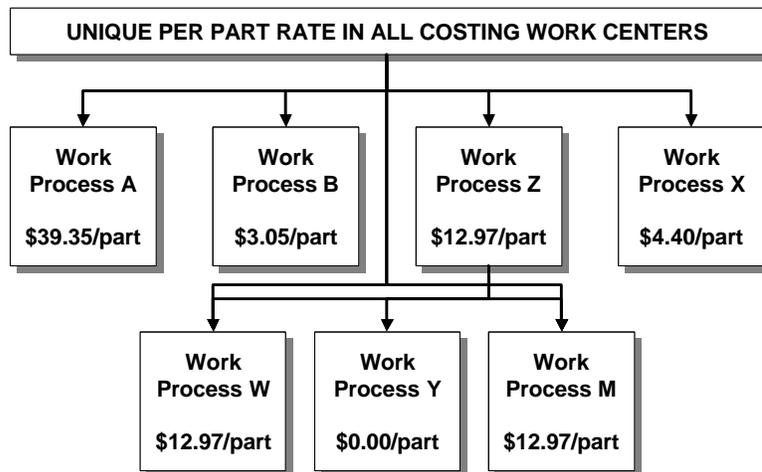
**Figure 3.8: MPF Phase I used costing methodology.**

team journeyed further into the activity analysis of MPF Phase I by beginning to study the activities associated with each of the work processes performed in MPF Phase I. The reason behind the activity

analysis was to enhance the granularity of the information presented above. The ABCM implementation team was interested in understanding if the asset utilization argument was valid for each of the work processes contained within MPF Phase I.

To better understand this next stage of the analysis carried out by the ABCM implementation team, it is helpful to realize that MPF Phase I is a manufacturing process where the metal parts (i.e.: fuselage panels, and brackets) are treated through different work processes. These work processes can

either be automated or manual, and can either handle large parts or small parts. By extracting the existing costing methodology, the one used to make strategic decisions such as offloading versus “in-house” processing, the ABCM implementation team found that BCAG Wichita Division used the information as is presented in **Figure 3.8**. The different



**Figure 3.9: MPF Phase I proposed costing methodology.**

work processes had the same rates despite of the fact that they processed very different parts, and that they could either be automated or manual.

By gathering activity information to more accurately map work process rates to their true cost, the ABCM implementation team proposed a different costing methodology as is shown in **Figure 3.9**. The information uncovered by the study is particularly interesting when looking at Work Process B. Not only is the rate approximately \$4.12 cheaper than offloading the part to outside vendors, but these parts were the ones that were being offloaded with greater frequency. The information presented in **Figure 3.9** paints a completely different picture from the costing methodology presented in **Figure 3.8**. Placing this information into the hands of decision makers greatly enhances their ability to decide what is the best course of action based on the true cost of the work process.

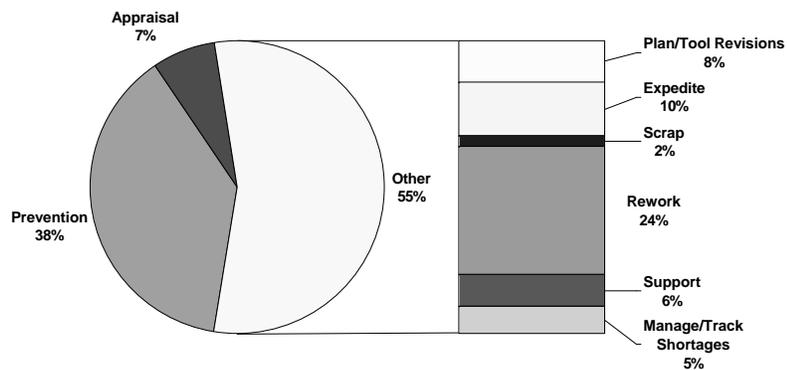
Despite the finding, what is useful about the study is that the ABCM implementation team encountered a number of different cultural barriers to overcome before being able to fully sell the notion

that under utilization of MPF Phase I capacity was costing the facility more money than previously expected. Although various members of manufacturing support, such as QA, were on board with the notion of increasing the number of parts that could be processed “in-house”, other support organizations were not so keen on the idea. Specifically, several organizations fought back on the notion that the amount of paper work that needed to be cleared in order to bring the offloaded parts back into the facility was great. Additionally, capacity planners were not fully convinced that the offloaded parts could be brought back into the plant without an impact on MPF Phase I labor.

### 3.3. Case Study 2: MPF Phase II – Structural Bond

Following MPF Phase I is MPF Phase II, or a process within the Structural Bond MBU. MPF Phase II consists of a continuation of the activities that take place in MPF Phase I;

namely chemical processing, anodizing, and painting large fuselage skin panels and brackets that will make up the fuselages of the different airplane models. By contrast to MPF Phase I, the MPF Phase II case study is an example of how BCAG



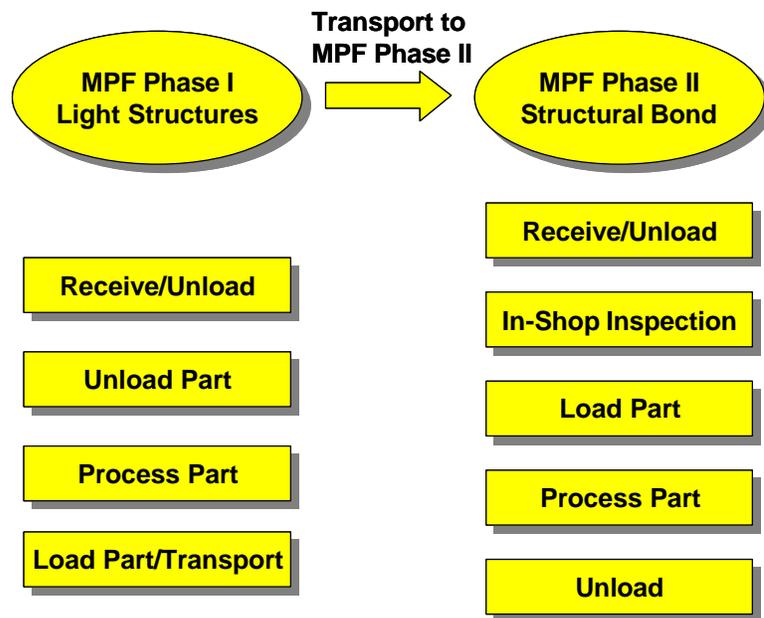
**Figure 3.10: Cause and effect model of failure cost drivers for MPF Phase II.**

Wichita Division used ABCM to control its cost of quality, thereby, mapping the ABCM implementation to the Lean Manufacturing strategic initiative as is shown in **Figure 3.2**. For this particular manufacturing process, cost of quality is defined as the total cost of prevention, appraisal and failures. At the time that the case study was carried out, total cost of quality represented 16% of the total expenses incurred in MPF Phase II, where the remaining 84% were costs associated with the regular processing of non-defective parts. The ABCM implementation team analyzed cost of quality data by first attempting to understand its breakdown. **Figure 3.10** displays the cause and effect model of the failure cost drivers

experienced in MPF Phase II. This preliminary analysis allowed the ABCM implementation team to realize that rework was the single largest contributor to failure costs, totaling \$1.3 million per quarter. The implementation team took the cause and effect analysis one step further by segmenting the different activities that make up rework. These included activities such as laminate, wheat starch, anodize, laser scribe, trim and cut, assemble, chemically mill, load, paint, and hand work. Hand working parts was the largest contributor to rework costs, comprising more than \$350,000 per quarter of the original \$1.3 million per quarter making up the total rework costs.

With this information, the ABCM implementation team segmented out in which shops the hand work costs were being incurred. These shops, denominated by numbers, represent physical locations within the MPF Phase II workspace where different laborers performed the rework activities. This different cut on the data allowed the ABCM implementation team to pinpoint which shop performed the most hand work rework activity, so as

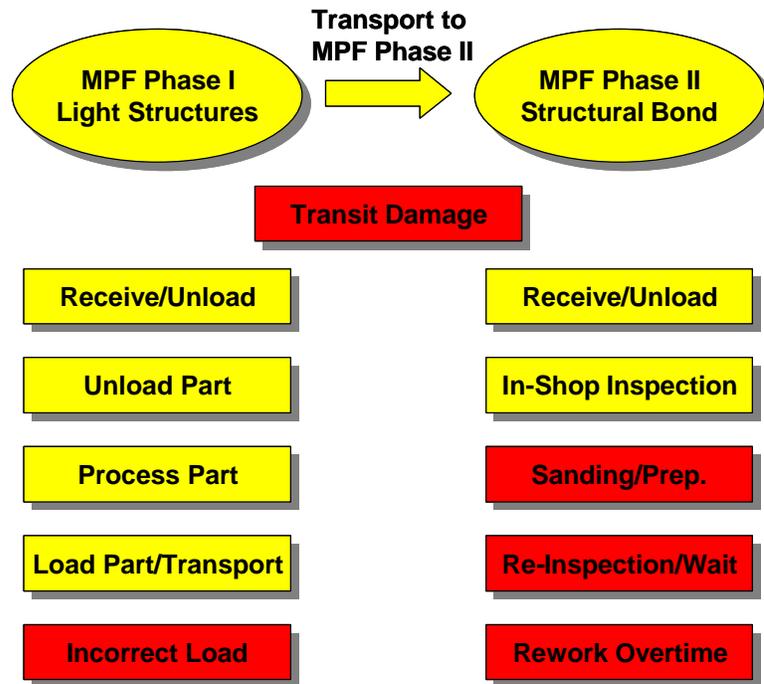
to gather information as to why it had to be done, and begin to follow a trail that would lead to the origin of the problem. In this particular instance, shop 3162 was performing more than 50% of the \$350,000 of the hand work rework activity. The rework activities performed by shop 3162 were: load batch, hand work, spray adhesive, anodize, hand paint, and machine paint. As the ABCM implementation team continued to gather information



**Figure 3.11: General process flow for parts moving from MPF Phase I to MPF Phase II.**

on the parts that were being reworked in shop 3162, it came to the realization that the shop “inherited” the defects from other MPF Phase I and II stations. To better illustrate this concept, **Figure 3.11** represents the normal flow of non-defective parts from MPF Phase I to MPF Phase II. However, in the case where a defective part was produced, the flow became as is shown in **Figure 3.12**.

The defective parts were attributed to two potential sources. The first is a part that enters MPF Phase I undamaged, and exits Phase I damaged, and gets passed to MPF Phase II regardless of its condition. This caused the accumulation of rework in shop 3162, which eventually resulted in having to offload some of the rework to outside vendors due to lack of rework capacity. Therefore, shop 3162 was expending resources



**Figure 3.12: Process flow from MPF Phase I to MPF Phase II for parts requiring rework.**

to rectify quality problems that were not originating from its normal operations, but were “inherited” from upstream processes. The ABCM implementation team, through the development of an activity analysis survey, was able to quantify the cost of the rework activity, and discern that the problem causing the rework activities was a subjective defect standard that would predicate remedial work. For example, the different shops feeding processed parts into shop 3162 performed the “scratch test”, a method by which a laborer will decide whether the part needs to be reworked, differently. In summary, prior to the ABCM implementation in MPF Phase II, the following was the normal state of the affairs:

- Criteria for what constitutes a defect were vague, subjective, and not communicated well between all the shops and QA.
- There was no standard process in place for reworking the damaged surface of fuselage panel skins and brackets.
- There was a lack of standard procedures in MPF Phase I and MPF Phase II QA, loaders, and shop leads.
- Unnecessary rework was becoming prevalent due to the subjective quality criteria.

In order to rectify the problem, the ABCM implementation team worked very closely with all the QA personnel and the shop leads to come up with a set of standardized quality criteria that could be used universally by all shops in MPF Phase I and MPF Phase II to determine whether or not a part needed to be reworked or not. Hopefully, the implementation of more standardized procedure would completely eliminate the subjectivity element when deciding whether a part was damaged or not. The following represent the improvement gains experienced in MPF Phase II after the implementation of a standard quality process:

- A stable and reliable QA process was developed with inputs from all the MPF participants.
- These standard measures were practiced through self-inspection throughout the different stages of MPF Phase I and MPF Phase II.
- MPF Phase II realized a 20% reduction in the parts that were unnecessarily reworked both, benefiting all the shops in MPF Phase I and MPF Phase II. Additionally, there was a reduction of offloaded rework to outside vendors.

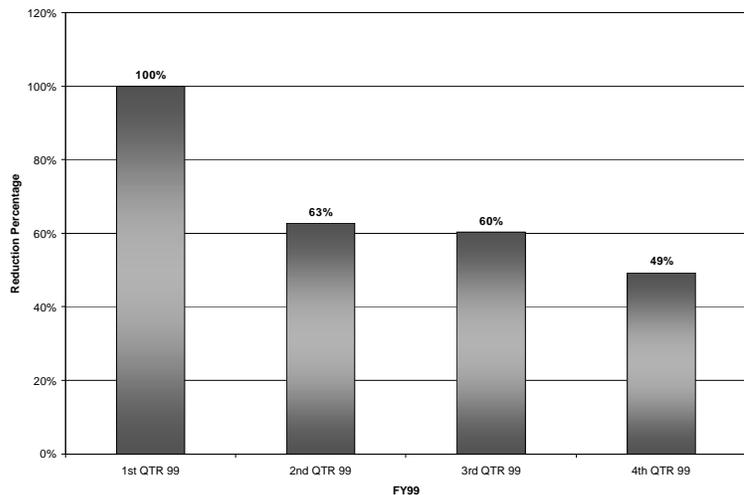
Therefore, after having performed an activity analysis, gathering information on the cost of having to do rework, and following the trail to the origin of the problem, the ABCM implementation team completed the ABC portion of the analysis. The points mentioned above represent the consequences of implementing a course of action to rectify the problem, or the ABM portion of the analysis. The ABM portion involved two stages. The first, which was mentioned earlier, was the development of a standard and reliable QA process for judging whether parts coming into MPF Phase I and MPF Phase II needed to be reworked. The second was to train MPF Phase I and MPF Phase II personnel to adopt these new standards. The ABCM implementation team estimated that the total investment required for training MPF Phase I personnel and Phase II personnel was \$8,370. This investment could potentially produce a savings of \$880,000 per year in rework charges. This \$880,000 figure was obtained through the information that the ABCM implementation team gathered from the activity survey it administered to the workers performing the rework activities. It is useful to note that prior to the ABCM pilot, BCAG Wichita Division performed a preliminary analysis of the cost savings that could be achieved by bringing work back into the plant, and quantified that number to be approximately \$100,000 per year.

The paramount part of the ABCM analysis and implementation was twofold. First, the identification of the correct costs making up the rework activities, which lead to the identification of the origin of the problem. Secondly, the correct identification of the exact savings that could be incurred through the implementation. Therefore, manufacturing managers now realize that the benefits, a savings of \$880,000, is far more than the original \$100,000 estimated not using activity analysis. The following points represent the actions undertaken after having completed the ABC analysis:

- Developed a training program for those shops experiencing significant levels of defect rework issues.
- Developed a standard, stable, and reliable process to identify quality issues, and required that all shops employ the standard method, eradicating subjective judgment in evaluating whether a part is defective or not.
- Decreased rework efforts in shop 3162 alone by 50%, as is shown in **Figure 3.13**.
- Decreased rework efforts in all shops in MPF Phase II by 20%.

These points represent the gains experienced after the ABCM implementation:

- Shop 3162 alone experienced a savings in rework costs of approximately \$900,000 per year.
- The new standard, stable, and reliable QA process was communicated well throughout all the shops.
- The training module developed could be used to address similar problems in other shops of other manufacturing areas.



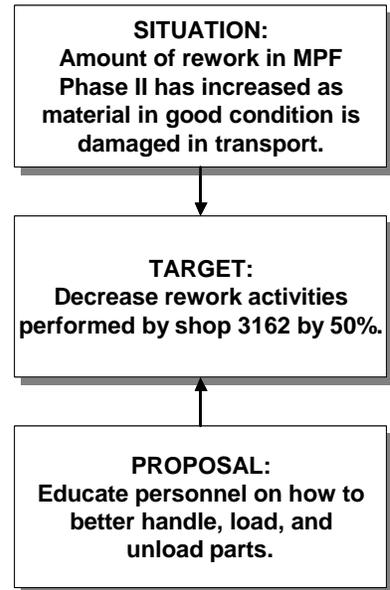
**Figure 3.13: Percentage cost reduction in shop 3162 hand work rework costs in FY99 by Quarters.**

- The benefits gained from the case study could lead to exploration of other ergonomic improvements that could improve the overall operations of the facility.
- There was a significant reduction in overtime hours due to the reduction of the rework activities.

The training program, developed to train personnel belonging to the various shops affected by the ABCM implementation, consisted of a 49 day plan to develop shop aids, and train personnel in proper materials handling (i.e.: loading and unloading parts so as to minimize chances of inadvertent nicks or scratches on the finished surface of the various panel skins and brackets).

The total investment into the training program, as was mentioned above, totaled \$8,370. **Figure 3.14** summarizes the situation, target, and proposed path to follow to resolve the cost of quality issues surfaced in MPF Phase II. In the end, the following points were cited as gains from having implemented an ABCM based analysis to resolve the problem:

- Realized cost savings and improvements.
- Labor dedicated to rework activities could be diverted to more value added work.
- Establishment of metrics involving loading and handling of touch sensitive parts.
- Established benchmarks for performance measurements.
- Realized a sizeable reduction in backward flow of defective material due to internal failures.
- Development of shop aids for all shops involved in the rework process.
- Maintained continuous quality control after the shop aid plans were put in place.
- Used the study to look for similar rework situations within the facility in other manufacturing processes, and develop implementation plans according to the process' particular needs.



**Figure 3.14: MPF Phase II goal and proposal.**

- Developed a QA communication plan where a part's quality was measured on the same scale between the shop that was sending the part, and the shop that was receiving it for further processing.

Additionally, "ABCM will continue to be used to monitor and measure gains through quarterly surveys. Improvement, expenses, and reports will be provided to the personnel involved in the study."

### **3.4. BCAG Wichita Division: ABCM Lessons Learned**

The case studies mentioned above offer the reader good examples of the various benefits reaped from ABCM implementations within a very complex manufacturing environment, and although these examples do not encompass the whole facility, they are some of the most illustrative examples of ABCM implementations found so far in the aerospace and defense sector. Along with the quantitative exercises that characterize the collection and analysis of activity cost data, the ABCM team at BCAG Wichita Division also learned many other aspects of the barriers and enablers to the widespread usage of this management practice within the aerospace and defense sector.

In conjunction with what has been mentioned in previous sections, the single largest barrier to widespread implementation of ABCM is culture. In fact, the BCAG Wichita Division ABCM team argues that culture represents 80% of the difficulties surrounding ABCM implementation, leaving the remaining 20% to technological barriers. The team argues that there has been limited involvement by the upper management and finance communities mostly because these communities have a lack of understanding of the mechanics of ABCM and the benefits that can be gained, and partly because there is a resistance to changing current business practices, especially among the finance and accounting personnel. In fact, this cultural barrier was broken down into subsections of specific behavior to counteract ABCM implementation as follows:

- "Denial – Upper management did not think that there was a strategic advantage to be gained through the adoption of ABCM."
- "Change – In most organizations change is not very easy to sell. The different stakeholders view the ABCM implementation efforts in different ways, and thus react differently, both positively and negatively."

- “Data – Different data represents a problem since without proper education the stakeholders might not understand what to do with it.”
- “Cost – Used as the biggest smokescreen, ABCM implementation cost is viewed as much higher than the benefits that can be gained from it, thus painting the implementation as a negative NPV project.”

The changes implemented so far have been through the development of educational modules that present ABCM concepts, and map out how these concepts can be applied within the context of the manufacturing activities taking place at BCAG Wichita Division. The two case studies presented serve as a proving ground where the ABCM team can practice implementations on “bite-size” projects. This enables to practice working out solutions to problems that may arise later on larger implementations, and present cost savings results to upper management. Proving the benefits of ABCM and securing additional resources to continue to migrate the ABCM implementations to cover all the operations of the facility, can tie ABCM into the facility's CM Strategy, and allow the facility to move towards a Stage IV [Kaplan et. al., 1998, pp. 252-274] accounting system. The barriers have begun to come down through education, and the presentation of cost data in such a way as to question old management decision practices. The quote below is the best way to summarize the points presented here:

**“Implementing an ABCM system is relatively easy. Changing organizational behavior is the most difficult thing you will ever do. Be clear why you are doing this, both for the company and from a personal standpoint, have patience, persistence, and passion, do not overestimate management’s commitment, and do not underestimate the resistance to change.”**

The BCAG Wichita Division ABCM team argues that technology barriers account for 20% of the implementation problems. The team states that product complexity is workable, and in fact, their belief is that it product complexity is not a problem as much as the number of “transactions” involved in producing the product. “Transactions” were defined as the number of personnel, processes, part numbers, and variations to the main product. The larger this number, the harder it is to gather activity data, through surveys, from the actual practitioners. For illustrative purposes, consider a facility that integrates pre-manufactured parts as opposed to a facility that must manufacture a product from raw materials. The latter might not be producing a complex product, but must manage a more complex manufacturing environment that includes many diverse manufacturing processes. In turn, the supplying facility must

manage a wider array of manufacturing processes unique in their own ways, and not necessarily tied to the complexity of the final product. Additionally, it is much harder to quantify the value stream of a particular product due to the complexity and breadth of the manufacturing process.

Although the migration towards ABCM principles has been slower than expected, the ABCM team argues that slowly but steadily there has been a shift from the old view of product focus, where the paramount metric was delivery time, to a view that also includes process focus, where the paramount metric is delivery cost. Manufacturing managers are beginning to realize that proper process management will yield higher returns on the delivered products, both whether these products are delivered to internal or external customers. This vision migration from product to process management goes back to 1990 (see **Figure 3.3**) prior to commencing a set of changes that set the stage for ABCM adoption. Additionally, ABCM has shed light on a new set of cost performance metrics that vary from application to application, which go well beyond the labor hours used to account for overhead charges. This empowers manufacturing managers by giving them much more flexibility on how to manage the costs of their processes in many cases without impacting labor. The statement below summarizes the management changes taking place among manufacturing managers:

**“Culturally, ABCM allows the company to harness the power of the entire organization and change the way that it manages costs, while creating an entrepreneurial environment where the department managers can run the department efficiently.”**

In summary, the major lessons learned are as follows:

- “ABCM must be a clear goal, and be part of the overall lean strategy (see **Figure 3.2**).”
- “An effective ABCM model must address product size, complexity and diversity, and it must support the business partner role.”
- “Implementing ABCM is relatively easy, but changing the organizational behavior is the most difficult that that the implementation team has dealt with.”
- “Prior to the implementation there needs to be a clear understanding of the products and processes that will be affected by the implementation.”
- “Activities should not be defined at a too low level, since this may cause expensive tracking costs that may not yield useful results. There is a clear trade-off between the number and granularity of the activities tracked and the benefits gained from the model.”

- “There should be an upfront determination of the primary applications and goals of the implementation, and the implementation’s design should be unique to the implementation’s needs. In this case COTS software may not always yield useful results since the software may not be flexible enough to address the implementation’s needs.”
- “Successful migration of ABCM principles from pilot project to facility wide adoption must be founded on continuous education and support.”

The most common mistakes that the ABCM team have committed during different implementations are:

- “Performing adequate litmus tests (measuring the needs and goals of the implementation).”
- “Understanding the strategic nature of the business.”
- “Obtaining top management support.”
- “Clearly define goals and objectives.”
- “Form cross-functional teams and introduce expertise from across the organization into the implementation team.”
- “Relying exclusively on complex software and external consultants, and underestimating the internal knowledge held by the company’s employees.”
- “Empowering the ABCM team members.”
- “Focusing on changing culture as opposed to behavior. It must be a balanced effort.”
- “Focusing on short-term breakthroughs versus long-term continuous improvements.”
- “Providing continuous support to manufacturing or department managers affected by the implementation. Manufacturing and department managers must create an environment where ABCM implementations become self-sustaining through changes in everyday business practices.”

## **4. Analysis and Conclusion**

## 4.1. Macro View of the BCAG Implementations

The purpose of this analysis section is to comment on the more general experiences, which are not necessarily case specific, gained by the ABCM team at BCAG Wichita Division through the different pilot implementations and efforts of migrating ABCM to the whole facility. As mentioned in the previous section, the single most important factor in determining the success of ABCM implementation, which goes beyond the pilot program test case, is upper management commitment. Upper management is in control of the resources required by the ABCM team to carry out implementation work, as well as being the architects of a company strategy and vision, which along with design, manufacturing, and marketing strategies, should also contain a cost strategy. Unfortunately for the ABCM team at the BCAG Wichita Division plant, upper management support has been hard to come by. This has resulted in a number of consequences:

- Limited amount of resources allocated to the ABCM implementation effort for a facility wide implementation.
- Lack of a clear top-level vision of where ABCM fits into the facility and company's strategic context.
- A significant slow down of the implementation process even though the ABCM team has clearly showed that implementation can take as little as 30 days, down from the original 120 days.
- Creating an environment where the facility talks about ABCM but does not necessarily act on it.

In addition, the case studies that the ABCM team completed have given upper management a unique set of data that display product costs based on the “true cost” of producing a product. This new view of cost has not necessarily been enough to secure additional management support for the effort. This brings up the major barriers to implementation as are viewed by the ABCM implementation team:

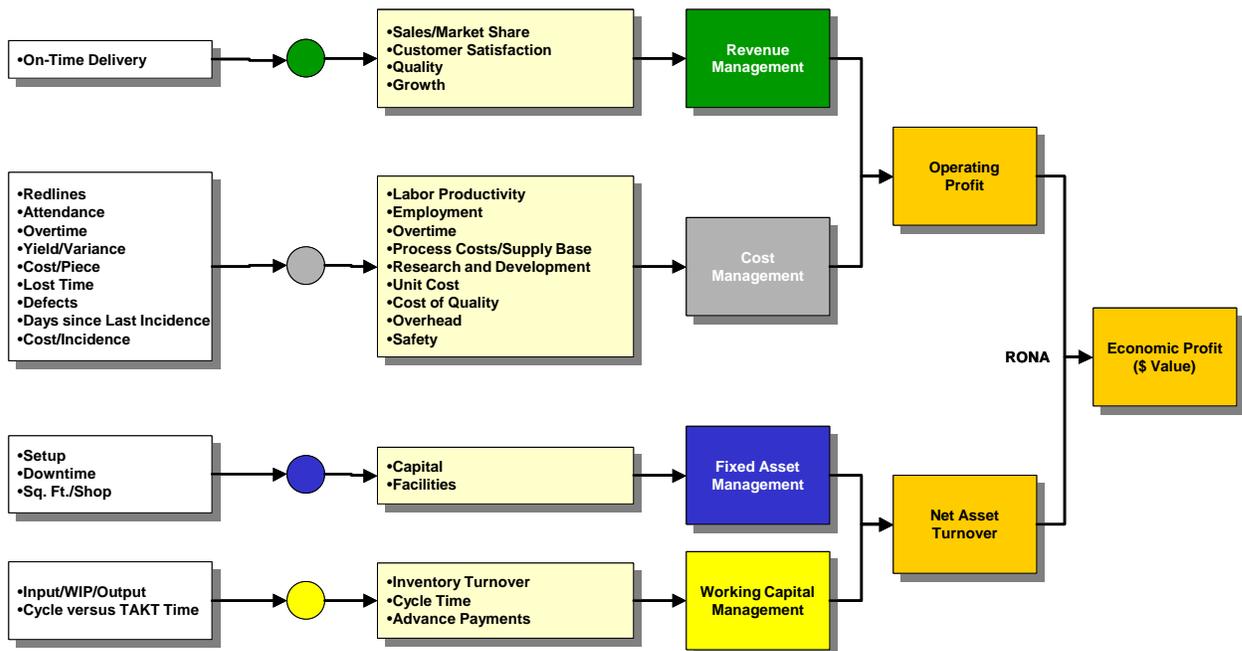
- Widespread ABCM implementation demands a cultural change on the part of the organization.

- Lack of education and knowledge on the subject of ABCM and how it can aid better business decisions.
- Lack of upper management buy-in, and recognition that the effort should be included in an overarching strategic view of company operations.
- Lack of communication in the form of feedback will exacerbate the above points since the employees that are going to be directly affected by an implementation have to understand how ABCM is helping them manage their costs better. Lack of communication across different disciplines will also have an adverse effect since lessons learned from one implementation should be used to facilitate other implementations across other areas of the company.

By contrast, reversing the above points should ensure an easier company wide implementation of ABCM techniques. Thus, the real enablers to ABCM implementation are to obtain upper management buy-in, and be able to change the culture of the organization through education and continuous communication. However, a successful implementation is not ensured only through the enablers, but also through the actual ABCM system being implemented. The ABCM team at BCAG Wichita Division has identified the following characteristics of the ideal system, as those they feel are most important:

- The system should be user-friendly.
- The system should be designed by employees or with heavy employee input, ensuring that ABCM system is designed with the company's culture in mind.
- The system should make acceptable measures of accountability to those who will or should benefit from the results, knowing that different stakeholders will have different reactions to the system's outputs.
- Everyone should easily understand the system's output, and the results should be communicable across the company. The ABCM system should operationally champion itself.
- The ABCM system should be integrated with other cost accounting and enterprise resource planning systems that already exists, but it is not a requirement.

To illustrate how the ABCM team tried to cover the above points, **Figure 4.1** displays an important element for the design and implementation of BCAG Wichita Division’s ABCM system. The graphic displays how different shop floor performance metrics can be linked directly to economic profit. These types of graphics allow the ABCM implementation team to illustrate to shop floor managers and employees the causes and effects of their operation on the company’s bottom line. The power of the graphic lies in the fact that cost impacts are now readily visible as well as being updateable continuously on a daily basis.



**Figure 4.1: BCAG Wichita Division’s “Linking the Shop Floor”.**

The ABCM team has also developed a step-by-step process that will be used for all implementations, standardizing the way that each new implementation is conceptualized, even though the implications and objectives of the implementation might be significantly different. This process, as is tabulated in **Table 4.1**, and is tied to the graphic appearing in **Figure 3.5**. The process commences with a problem formulation, looking mostly at the strategic issues associated with the particular area where the implementation has to take place. Consequently, the second step looks at developing a scope and an objective for the implementation, setting boundaries by which the implementation’s success can be measured once the implementation is completed. The third step requires the design and development of the actual model, where the ABCM surveys the organization that will receive the ABCM implementation,

and performs and selects appropriate training modules and software. The fourth step requires the ABCM team to dive deeper into the collection of activity data through surveys and interviews designed to aid in the development of activity dictionaries. The last step is analytical in nature, and it is where the ABCM team runs the data through the model and gathers the appropriate cost data to be compared to the data used from the legacy accounting system. Ultimately, the information will get presented to the appropriate management to illustrate the advantages or disadvantages of the current processes. However, recalling the information contained in **Figure 3.5**, the iterative process will eventually give way to the ninth step which will introduce ABM into the model by asking strategic type questions that can be used to adjust the problems in the process.

**Table 4.1: BCAG Wichita Division ABC model implementation steps.**

<p><b>Step 1. Strategic Issues (Problem Formulation)</b></p> <ul style="list-style-type: none"> <li>1.1 Get familiar with products and business</li> <li>1.2 Understand industry in general and in a competitive situation</li> <li>1.3 Perform the initial analysis (Litmus Tests, Willie Sutton Rule)</li> <li>1.4 Develop strategic and/or critical business issues</li> </ul> <p><b>Step 2. Objectives and Scope</b></p> <ul style="list-style-type: none"> <li>2.1 Develop objectives (strategic and operational)</li> <li>2.2 Define boundaries (what costs to include and what sites to survey)</li> <li>2.3 Select pilot site and implementation order</li> <li>2.4 Develop project management structure</li> <li>2.5 Obtain management buy-in and commitment</li> <li>2.6 Form cross functional teams (both for implementation and auditing)</li> <li>2.7 Orient and educate the team</li> <li>2.8 Kick-off project</li> </ul> <p><b>Step 3. Model System and Design</b></p> <ul style="list-style-type: none"> <li>3.1 Get familiar with computer and information systems</li> <li>3.2 Collect any available information and reports</li> <li>3.3 Determine how the organization is structured</li> <li>3.4 Determine total resources</li> <li>3.5 Perform initial account analysis</li> <li>3.6 Develop a master ABC model schematic</li> <li>3.7 Select a software package</li> <li>3.8 Train the team on the software</li> </ul> <p><b>Step 4. Model Building</b></p> <ul style="list-style-type: none"> <li>4.1 Determine interview formats and schedule</li> <li>4.2 Conduct interviews</li> <li>4.3 Identify major activities</li> <li>4.4 Develop activity dictionaries</li> <li>4.5 Identify and collect zero and first stage drivers</li> </ul> <p><b>Step 5. Drive Data to Activities, Activity Centers, and Products</b></p> <ul style="list-style-type: none"> <li>5.1 Compute activity costs</li> <li>5.2 Perform activity analysis</li> </ul> <p><b>5.3 Audit and present to management</b></p> <ul style="list-style-type: none"> <li>5.4 Develop activity center based on strategic issues</li> <li>5.5 Drive activities into activity centers to form cost pools</li> </ul>
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- 5.6 Perform activity center analysis
- 5.7 Audit and present to management**
- 5.8 Examine BOM, routing, and labor files in MRP system
- 5.9 Select a representative product sample
- 5.10 Download data from MRP to ABC model
- 5.11 Select and collect second stage cost drivers
- 5.12 Compute product costs
- 5.13 Analyze product cost distortion
- 5.14 Audit and present to management**
- Step 9. Strategic Analysis and Future Action Plan**
- 9.1 Extend ABC costing to all products
- 9.2 Analyze product, customer, and channel profitability
- 9.3 Perform “what if? Analysis
- 9.4 Recommend an action plan with associated risks and benefits, benchmarks, roadmaps, and time frame accountability
- 9.5 Develop future plan
- 9.6 Select cost drivers for use as performance metrics
- 9.7 Present to management**

The reader should pay close attention to the highlighted steps in which the information gathered is audited and presented to management. The reason for introducing the same step numerous times throughout the implementation procedure is to gain upper management support through continuous communication of the status of the implementation process. It would be an obvious conclusion to assume that as ABCM becomes a more mainstream and widespread tool, the number of presentations to management could be reduced to a single presentation at the end of the implementation.

In conclusion, the ABCM team at BCAG Wichita Division also expressed a number of expectations, goals, and future developments that ABCM could play in the overall CM Strategy both for the facility and the company as a whole. Although these future milestones are very ambitious, certainly the amount of pilot program work that has been completed at the facility is enough to place BCAG Wichita Division at the forefront of ABCM implementations with the aerospace and defense industry sector. First off, the major reason that BCAG Wichita Division began to look at ABCM as a part of the overall CM Strategy was to “employ a tool that could shed light upon the overhead cost structure, and identify areas for process improvement.” In fact, the ABCM team stated that according to their implementation experience, so far ABCM has benefited operations the most. Following in turn are: CM, labor management, and overall strategy. However, the assumption is that as ABCM becomes more widespread, touching more facets of the facility’s overall operations, strategy and labor management will begin to obtain more benefits from the implementations, since so far the majority of the implementations

were restricted to pilot programs designed to reduce cost in specific manufacturing areas. The overall goals that the ABCM team hopes to achieve with subsequent implementations are:

- “Enable management to make strategic decisions based on process flow and not on labor and overhead rates, and allow management to identify which projects add value, and which projects destroy value.”
- “Introduce a better forecasting tool geared towards obtaining financial data useful for operations management type decisions.”
- “Reduce the variances and errors in predicting product cost typical of a traditional accounting system.”
- “Identify product and/or process cost drivers, and value added versus non-value added activities not noticeable through data available from a traditional cost accounting system.”
- “Quantify a product’s true ownership costs.”
- “Allocate costs more accurately, and assign resources based on the activities that actually consume them (i.e.: more accurate allocation of overhead costs as they are consumed).”

For the future, as was mentioned before, the ABCM team is laying the foundations that will enable BCAG Wichita Division to migrate towards a Stage IV accounting system, where the costs are allocated through activities, which in turn feed the information directly into the cost accounting system, as well as providing the necessary feedback to manufacturing managers to enable them to keep their operations streamlined. Additionally, the ABCM team’s view on how ABCM, lean, and the aerospace and defense industry sector fit together is as follows:

**“The aerospace and defense sector will not be truly lean if it does not adopt superior financial management practices such as ABCM.”**

The BCAG Wichita Division case studies are only pilots, and thus, are not responsible for major changes in the strategy of the facility. However, the pilots enabled BCAG Wichita Division to begin using a tool that can potentially become central to support and manage the strategy of the facility. Presently, the decisions taken by BCAG’s management based on ABCM implementations have been limited to the areas in which the implementations took place. However, there is the recognition of the power of ABCM and activity analysis, and the need to migrate to a Stage IV accounting system, where activities drive

costs that are then fed into the facility's legacy accounting systems. What prevented BCAG's management from improving the operations in those areas that were used as ABCM pilots prior to the ABCM implementations was the fact that ABCM analysis uncovered the true ownership costs of particular processes that were not readily visible through conventional cost analysis techniques. The data obtained through ABCM analysis, which is not different, but is presented differently, allows manufacturing managers to observe the implications of operations decisions on bottom line cost. Thus, the assumption is that through ABCM management is in the position of viewing cost data differently, and thus will act differently.

Another big concern was to address the question of whether the same benefits that were obtained through the ABCM implementations could have been achieved using other financial tools. The answer is "no". The ABCM team at BCAG Wichita Division argues that ABCM is the only way that these benefits could be achieved, and they firmly believe that activity analysis is the best way to quantify the true ownership cost of a product or process, and introduce a more efficient methodology of allocating overhead costs. The support for this statement is in the fact that the ABCM team at BCAG Wichita Division was able to link "cause and effect" between the activities that were analyzed in the various pilot implementations, and the cost savings that were incurred by making changes based on the data gathered.

The implementations have also enabled BCAG Wichita Division to gain a better understanding of their practices and processes. In the MPF Phase I there was a better understanding as to why the outsourcing of parts was taking place, reducing the facility's ROA for those fixed assets that were underutilized. In MPF Phase II, BCAG Wichita Division questioned its cost of quality practices, and changed the process by which a part is declared defective and in need of rework. Therefore, although the implementations are not comprehensive of the operations of the whole facility, there is evidence that ABCM data enabled BCAG Wichita Division's management to question whether current practices and processes were adding value. An important point is to note that all this was done through a common framework. This common framework illustrates that although ABCM implementations may be diverse, there is commonality between all of them through activity analysis and ABCM implementation procedures.

## 4.2. The Future of ABCM

As ABCM migrated from being a new accounting methodology introduced in academic circles to being implemented in actual business practices, it has been adopted by a number of different industries all facing the same fundamental problem; how to allocate costs more accurately than using the classic metrics. Activity analysis has uncovered sources of value addition and destruction that were not readily noticeable otherwise, enabling many companies to alter portions of their business strategies favorably. The need to uncover this new information stems from a radical change in the manufacturing cost structure in which labor costs, which comprised the largest portion of the cost structure in the early 1900s, have been presently dwarfed by overhead costs. However, the methodology used by most companies to allocate cost has not changed, questioning whether companies can actually quantify their true product ownership costs.

An overwhelming majority of the companies that have adopted ABCM operate in the commercial sector. These companies tend to be exposed to more economic variability, and thus must be able to adapt to changing market conditions to retain competitiveness. Although the varieties of industries that have adopted ABCM vary greatly, adoption in the aerospace and defense industry sector has been somewhat slower. Within the aerospace and defense industry sector, which includes companies operating in both the commercial and military sector, ABCM is more prevalent in those companies that operate commercially. As was presented above, there is enough evidence to propose an approximate profile of the typical aerospace and defense industry sector facility that is more likely to adopt ABCM practices. These facilities tend to be smaller, "brownfield" facilities that produce multiple distinct products in a medium production volume environment. They are influenced mostly by market and organizational variability, and tend to invest more resources into supply chain management and manufacturing technology improvements. They also tend to adopt employee involvement practices typical of the TPS. Economically, these facilities report higher degrees of profitability, schedule and delivery performance, customer service, quality, and productivity. The drawbacks are felt organizationally, through the disruptions that ABCM may introduce, short-term, amongst the different organizational structure tiers affected by the implementations. In fact, apart from the usual market disruptions that all companies face

with fluctuating product demand, facilities that have implemented ABCM tend to experience higher degrees of absenteeism and worker turnover rate, and somewhat lower worker satisfaction.

The case studies presented above highlight the mechanics of typical ABCM implementations within a BCAG facility, as well as offering insight into the potential benefits that can be gained through the use of ABCM. As is supported by the literature, the major barriers to ABCM widespread adoption are cultural in nature, distinguishing lack of upper management support and strategic view of ABCM within the context of other lean initiatives, among others, as the most important barriers. The major enabler is the opposite. Obtaining upper management support can be gained through extensive education on ABCM principles, and continuous communication of ABCM implementation benefits gained. Technology as a barrier was cited as a misconception in light of the fact that present information technology tools are powerful enough to handle complex implementations. From a mechanical standpoint, the number of “transactions” (i.e.: part numbers, and number of processes, or manufacturing system complexity and diversity), and not product complexity present a design challenge when architecting the ABCM model for a specific process. Moving forward, the facility hopes to migrate ABCM principles to other areas of the manufacturing process, and encompass an ever-increasing portion of the facility’s operations, and eventually migrate towards a Stage IV accounting system that uses activities to quantify costs, in line with the notion of tying the facility’s CM Strategy with the overall strategy of the company:

**“Costs have always been a strategic consideration in corporate affairs, and never so more than today. Strategically efficient companies can go beyond the mere identification of costs and focus on ways to change cost structure to serve wider corporate objectives...Basic economic understanding is more important than complex accounting techniques.”** [Hopwood, 2000, p. 8-10]

Clearly, the implementations have highlighted the potential benefits of widespread ABCM adoption. Although the case studies are to be considered pilot programs, they are an essential process by which BCAG Wichita Division is formulating the methodology that will enable then to move towards a Stage IV accounting system. The economic benefits gained are small with respect to the overall operations of the company, but do underscore the importance of a sound CM Strategy. More importantly, the case studies have shown how flexible ABCM is, allowing it to be used in a wide array of implementations. Thus, just as the companies operating outside the aerospace and defense industry

sector have benefited from ABCM implementations, so too can the aerospace and defense companies, operating both in the commercial and military sector.

There are a number of potential reasons why ABCM adoption in those aerospace and defense industry sector companies that operate mostly in the military sector has been non-existent. Central to these potential reasons rests the current product acquisition structure, and the interactions between government agencies and contractors. From other MIT research that looked at economic incentives in a particular government program, the following quote summarizes the difficult relationship that exists between government agencies and contractors:

**“...On the government side, there is concern about the policies, processes, and procedures used when assembling a contract. Anything that deviates from standard contractual terminology (as defined by senior government contracting officers) requires significant amounts of time, the willingness to take risks, and the ability to withstand pain in order to secure approvals through many levels of governmental bureaucracy.”** [Cowap, 1998, p. 64]

Additionally, through an interview with a member of the finance department at an aerospace and defense industry sector facility that manufactures products solely for the DoD, the following quote on the adoption of ABCM within CM Strategy of the program strengthens the notion that present government acquisition policies are a significant barrier to the adoption of new techniques such as ABCM:

**“We [the contractors] will not do anything unless DoD asks us to do it!”**

Further research could cover two areas. The first could quantify exactly the impact that current government acquisition policies have on the adoption of ABCM, and explore methods by which both the government and contractors could work together to introduce a “lean financial management” tool that is proving to be promising for those companies wanting to push the efficiency of their lean implementation programs further. The second could compare ABCM aerospace and defense industry sector implementations with similar implementations in other industries, and quantify any the significant differences, and the reasons behind them.

Additionally, it is useful to note how labor organizations are reacting to the adoption of ABCM. Although ABCM shifts cost cutting opportunities away from labor, the original driver of overhead costs, it is surely not an insurance policy against the prevention of changes in labor structure, especially when the labor organization in question gets associated with a non-value added process. To reinforce the views

that labor organizations have towards ABCM, the following quotes capture the opinions of some of the leaders of the larger labor unions in the USA.

**“The IAM has supported the adoption of activity based costing management (ABCM) as a way to get at the true costs of production. ABCM is a tool that, [if] properly used, exposes overhead costs, unproductive time, and a truer value to the efforts our members add to the economic process within an organization. It is not, by any means, the answer to the current management vogue of downsizing productive capacity and distributing returns to shareholders. It is, an effective accounting methodology for organizations that are in the business of adding value through complex productive processes. When teamed with a high performance work organization approach, ABCM has helped our union identify opportunities to make products or services versus buying those same products or services from a vendor.”** [S.R. Sleigh, Director of Strategic Resources, The International Association of Machinists and Aerospace Workers, AFL-CIO/CLC]

**“Activity-based cost accounting grew out of the frustration many managers and accountants felt with their existing accounting systems. They felt that an accounting system which generated final product costs built up from the costs of specific activities would better allow them to manage activities and make wiser economic decisions. For example, one major concern was that application of overhead was not sufficiently accurate. Using overhead applications such as direct labor hours or direct labor dollars was not considered good enough since it had the potential for distorting product costs. In addition, many existing cost accounting systems did not accumulate costs in a way that identified opportunities to reduce costs. For these and other reasons, managers and accountants found activity based cost accounting to be a much more sophisticated way of assigning costs to products. Its use has grown significantly since the early 1980’s. As an accounting tool that allows for better assignment of cost to product, it is certainly beneficial to managers. At the same time, it is neutral in terms of job retention. The finding that a product has more or less cost than determined by a less sophisticated accounting system may or may not be determinant of whether a company will continue to produce the product in-house or outsource it. Even if it were, some jobs would be retained and some lost.”** [G. Lazarowitz, Director, Research Department, The International Union, United Automobile, Aerospace, and Agricultural Implement Workers of America]

ABCM is certainly at its beginning phases within the aerospace and defense industry sector, but it has the potential of introducing a badly needed “lean financial” process into an industry that has already implemented a number of other lean initiatives at the manufacturing floor and engineering levels of the organization. ABCM can present cost data in a novel way, allowing the company to tie cost with value addition and strategy. ABCM not only has the potential of unveiling a product’s true ownership costs, but also has the potential of questioning the product’s value chain. In light of this, companies that choose not to adopt some form of activity analysis to quantify their operational costs might be stopping short of achieving a truly lean enterprise. In the end, the data contained herein, though limited to pilot program implementations, does suggest that ABCM is truly beneficial to the aerospace and defense industry

sector companies, as is proving to be for other companies in other industry sectors, in part supporting the hypothesis that was presented at the beginning of this research. As ABCM becomes more and more popular, and the extent of the implementations go beyond the pilot program level, industry will have the data required to evaluate the benefits that an organization operating under a truly activity driven cost strategy can gain.

# Appendix A. ABCM Status

## A.1. ABCM Usage: The Player-Keys Case Studies

As mentioned above, ABCM is being embraced as a new initiative that allows companies to target operational inefficiencies and aid in strategic decision making processes. The number of industries and companies that are spearheading both full and pilot program implementations are continuously growing in number. A second indicator of the popularity of this phenomenon is the increased focus that management-consulting firms are placing on ABCM. Numerous top name firms have created new and specialized branches that are dedicated specifically to help their customers (in this case companies from a variety of different industries), look at and help implement ABCM initiatives. Companies like Hewlett-Packard and Hoffmann-La Roche, and industry sectors from microelectronics to biotechnology research, highlight the diverse spectrum in which ABCM was employed and successfully implemented. However, even though each industry and company adopts ABCM under a different light, and each application is extremely disparate, the foundation upon which each of the implementations is constructed is common for each company.

A number of different studies show the extent of ABCM usage across many different types of industries. **Table A.1** [Player et. al., 1999, pp. vii-xi] displays an illustrative sample of companies that have employed, to different degrees, ABCM. It is the best way to illustrate the variety of companies operating in a variety of industries, that have made use of ABCM to optimize inefficient areas of their businesses.

**Table A.1: Player-Keys ABCM case studies [Player et. al., 1999].**

<i>Company</i>	<i>Industry</i>	<i>ABCM Application</i>
Hewlett-Packard, Co.	Computers and Microelectronics	Distribution: Knowing What It Takes-and What It Costs.
Hoffmann-La Roche, Inc.	Pharmaceuticals	A Process Manufacturing Company's Prescription for Profitability.
Johnson & Johnson Medical, Inc.	Medical Devices	Using Storyboarding to Develop an ABM System.
Pennzoil Exploration and Production, Co.	Oil and Gas	Using ABM to Support Reengineering.
Current, Inc.	Paper Products	Continuous Implementation Yields Continuous Results.
The Marmon Group	Industrial Conglomerate	Multiple Project Roll-Out Creates Leverage.
Bliss & Laughlin Industries, Inc.	Steel	Using ABC for Process Analysis,

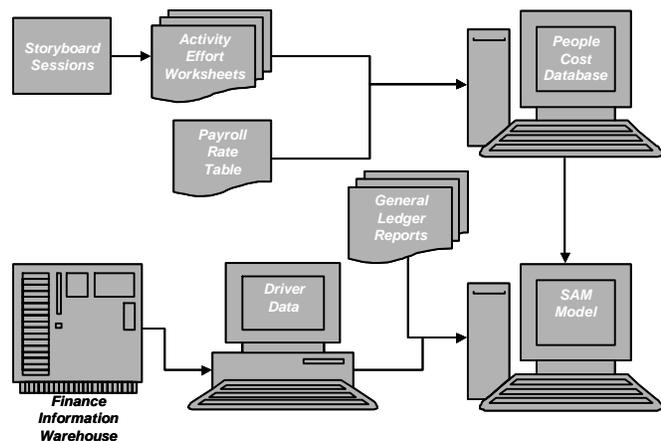
		Customer Profitability, and Manufacturing Flexibility.
TTI, Inc.	Electronics	Using ABC to Increase Revenues.
American Express Travel Related Services	Entertainment and Leisure	Using ABC for Shared Services, Charge-Outs, Activity Based Budgeting, and Benchmarking.
Telecommunications Corp.	Telecommunications	Using ABM to Understand Telecommunications Maintenance and Provisioning Process.
AT&T Paradyne, Corp.	Data Communication Equipment and Services	Advanced Use of ABM: Using ABC for Target Costing, Activity Based Budgeting, and Benchmarking.
AT&T Business Communication Services	Telecommunications	Increasing Customer and Stakeholder Satisfaction and Supporting Benchmarking and Performance Measurement with ABM.
Caterpillar, Corp.	Heavy Machinery	Target Costing: Profit Planning for New Product Development.
General Motors, Corp.	Automotive	A Framework for Assessing Cost Management System Changes.
Navistar International, Corp.	Automotive	Walking the Talk: Implementing Real Activity Based Budgeting.

Obviously, the above-mentioned companies represent only a small number of the companies that have implemented ABCM type initiatives. As stated above, companies that have implemented ABCM span a wide variety of industries, products, operational complexity and size. The goals of each of the ABCM projects is as diverse as the metrics developed to gauge the projects' successes. The bottom line, however, is a clearer understanding of the business process, or a portion thereof, resulting in changes, either operational, strategic, or both, that lead to a reduction in the cost of doing business. The following pages contain a short synopsis of some of the ABCM projects carried out by each of the companies mentioned in **Table A.1**.

Beginning from the top of the list, Hewlett-Packard pursued the ABCM road to enhance the information available to its managers and business partners. Hewlett-Packard faced strategic decisions that included what distribution channels and customers to emphasize, and what types of customer services top provide and how best to provide them. As much as these questions are very top level and open ended, the analyses carried out by the company are very much practical and analytical. Hewlett-Packard concentrated on all of its North-American Distribution Organization (HP-NADO), an entity that included 21 separate major product lines (LaserJet™, DeskJet™, DesignJet™, Vectra PC™, Net Server,

Scanner, Toner, etc.), six separate channels types (major accounts, independents, suppliers, value-added resellers, buying groups, and direct phone sales), and seven separate distribution activities (freight, distribution, marketing, engineering, order taking, receiving, and shipping). Hewlett-Packard, which, at the time of the ABCM project, had yearly revenues that exceeded \$25 billion and considered to be one of the world leaders in PC and peripheral equipment manufacturing, approached the problem by placing itself in the shoes of its customers and asking a few critical questions: what can this PC do, and how much is it going to cost?

The first question is more geared towards the product development process. However, the answer to the second question partly falls within the boundaries of the HP-



**Figure A.1: Hewlett-Packard's Strategic Activity Management Model information flow [Player et. al., 1999].**

NADO. HP-NADO distributed approximately \$7 billion in products through five depots and more than 300 resellers nationwide. Hewlett-Packard decided to employ ABC, through a project named Strategic Activity Management (SAM) to understand the true costs that contributed to product and customer profitability [Player et. al., 1999, pp. 74-75]. **Figure A.1** displays a graphical view of the general information flow into SAM [Player et. al., 1999, p. 79]. The objective sought was to be able to gather the data required to answer the following questions: which distribution channels to emphasize, which customers and customer services to emphasize, how to price those services, and how to design an optimal supplier-to-reseller configuration. As with many other ABC projects, the first stages of SAM were to understand the different activities that HP-NADO performed, and the best way to do this was to actually ask the people doing the activities. The most effective means of accomplishing this task is to survey the employees, finding out exactly what the activities are, and why they are performed. The critical decision was the granularity of the activity survey; SAM's project team had to decide how far down the organizational structure it should go to gather the activity information. ABC projects can fail on the basis of information overload, since there is a clear trade-off between the level at which the activity information

is gathered, and the cost of maintaining the ABC system once in place. Therefore, the finer the granularity (the deeper the project team moves down the organizational structure), the costlier the ABC project. In the case of HP-NADO, the team found the optimum granularity by identifying 527 key activities that included everything from receipt of materials to the billing of customers. The power of performing the survey lies in the SAM's ability to provide the information necessary to map activities to products and customers. Needless to say that this puts SAM's project team to get a clear picture of what products and customer are more profitable than others. The model that was developed through SAM included 527 activities, 180 processes, 75 customers, 27 cost drivers, and 1,410 surveyed employees. The model allowed the project team to view the data in terms of financial, strategic, and operational costs. The model highlighted areas that could be improved through operational efficiency (sales order administration, physical warehouse activities, and information technology costs). The team was also able to identify areas where the number of inefficiencies could be reduced, reducing cycle times and inventory requirements. The model also clearly showed that that 51 customers accounted for 85% of all HP-NADO orders, and that higher volume counterparts were continuously subsidizing lower volume products. Now that the project team had the power to visualize all the data, the next step was to optimize the current operations. The model allowed to run scenarios where the team could, in effect, virtually modify the structure of the organization and test scenarios such as outsourcing, benchmarking, and evaluate investment ROI and ROA. SAM allowed HP-NADO to reengineer its operation and save over \$2 million per year. Some of the more significant lessons learned from SAM are [Player et. al., 1999, p. 82]:

- “ABC techniques can be used for both product and customer cost analysis.”
- “The flexibility of ABC allows implementers to design models to meet evolving needs.”
- “It is possible to build models to fully cost products and customers, meeting both operational and strategic needs.”
- “ABC proved to be a unique and powerful tool for looking simultaneously at the cost of processes, product lines, and customer segments.”

By contrast to Hewlett-Packard, Hoffmann-La Roche operates in a completely different field, that of pharmaceuticals. Hoffmann-La Roche required its ABM effort to focus on key functional manufacturing areas: materials management, maintenance, sterile manufacturing, and quality control. Hoffmann-La

Roche decided to take small steps, thus implementing the ABM project as a pilot that could be easily evaluated and grown to encompass larger portions of the manufacturing operation. The processes were surveyed and data was collected highlighting process flow. This enabled the project team to understand, at the pilot level inefficiencies in the current flow, and evaluate each individual process. The scale of the project was not as extensive and ambitious as Hewlett-Packard's, however, the importance was paramount nonetheless. The 8-week ABM project yielded data that could be used to streamline the manufacturing process and extract cost savings without disrupting the flow of products, and their quality. By the same methodology used by Hewlett-Packard, Hoffmann-La Roche designated a 15-member team made up of cross-functional employees. This team was trained and designated to implement ABM on a small scale throughout various areas of the production process. As the team built the ABM model, it identified approximately 70 activities for 45 products from the four functional manufacturing segments, with sterile manufacturing as the centerpiece of the model. Some of the more significant lessons learned from the pilot were [Player et. al., 1999, p. 89]:

- "Have a dedicated champion who can obtain and maintain essential top management support."
- "Let the pilot be a learning experience for the team members. ABM is generally a new concept that must be well understood by the team."

In the capital-intensive oil and gas business, reengineering efforts are very popular. Pennzoil Exploration and Production faced increasing problems as world oil inventory levels increased pushing oil prices to historical lows. The oil company needed to find ways to increase value and/or reduce its operating costs. As is the case with numerous companies, a major part of the problem was the company's increasing General and Administrative costs, which can be classified as support or overhead costs in conjunction with the many oil and gas producing properties in its portfolio of extraction regions. The company, which totals \$2 billion in sales per year, required a system that highlighted which of its properties were profitable and which were not. The major requirement that the company had with its ABM effort was that it had to be in line with the other streamlining efforts that were being undertaken. The major goals of the ABM project were to: perform cost reductions based on asset opportunity costs, identify opportunities to reduce costs by reengineering processes and managing cost drivers, establish a

system that realistically assesses the benefits of reengineering, and provide the foundation for an ongoing performance measurement system and benchmarking effort. The oil company broke new grounds in that it embarked into a very ambitious project that was also designed to address some of the areas of ABM that many companies do not leverage. Pennzoil Exploration and Production realized that it needed a system that could sustain and facilitate other process improvement initiatives (sustaining lean), and that could provide continuous feedback on implementation effectiveness (measuring success). The project began with a comprehensive survey of over 1,700 employees dispersed in various company locations, trying to identify what the nature of each individual's work was, and why it was performed. Needless to say that this was a daunting task. Employees represented operated in a number of different activity categories, from acquisition to drilling to human resources and SEC reporting. In the end, the company identified 15 activity categories and over 500 activities that were used in the ABM model. Once the different activity categories and activities were selected, the next step was to map General and Administrative costs through the activity categories and activities towards a predetermined set of economic modeling and performance metrics, enabling to understand how support costs were truly being absorbed, and what was driving them. The map enabled the project team to devise help the company change the cost structure of its exploration and production efforts. The ABM implementation identified exactly what resources were needed to maintain and manage the company's properties based on its current operations [Player et. al., 1999, p. 103]. The success of the project prompted the company to migrate the use of the model to other areas of the company's business, and aid a company-wide reorganization program. The major lessons learned from the project were [Player et. al., 1999, p. 103]:

- “ABM is an effective model for planning company reorganization because it is a data-gathering analytical tool and targeting device that helps a company understand its own business more clearly.”
- “Activity analysis provides a robust set of tools to understand and know how to reengineer a business.”

From the capital-intensive world of oil and gas exploration and production to the 3,500 unique products of the Current, ABCM proves to be a versatile tool usable in diverse situations and environments. Current, a company totaling \$300 million per year in sales, manages the production of

numerous paper products such as mail catalogs, greeting cards, calendars, educational material, and bank checks on behalf of third companies. The company's philosophy has always been that each unique product had to pay for itself. However, the sheer diversity of each of the products makes the task daunting, while at the same time margins were eroding due to increased competition. Current employed ABC to help achieve the following goals: determine more accurately product cost, understand the activities that drive or cause the cost, understand how strategic decisions will affect costs, have a model that can be used to run what if analyses, and gather information for better decision making. In the end, Current wanted a methodology to follow that would enable the company to identify those products to continue producing, and those products that would have to be discontinued due to poor profitability. The relevance of Current's ABC project is the "bottom's up" approach, where the ABC team, not having full management support began the process of introducing ABC into the company's cost management system by setting up pilot programs. The first of these pilots was located in one of the plant's most demanding manufacturing environments, and the one that had the most inefficiency, the printing department. As each of the pilot programs succeeded, the ABC implementation team moved to other areas of the company. Beginning with the printing department, the ABC implementation team moved to packaging, creative design, purchasing, and finally quality assurance. The first pilot program was launched in 1991, and the last was completed in 1995. Moving through the different parts of the company, Current's ABC implementation team faced a number of difficulties that lied in having to adapt the ABC implementation techniques to each different department covered, since not each department was easily quantifiable. The most important outcome of Current's ABC effort was the realization of the true cost of its different products; management came to the realization that high volume products were subsidizing the cost of lower volume specialty products simply because resource allocation was based on machine hours and labor costs, and not on more accurate metrics. The implementation of ABC allowed Current's management to see the true cost of products based on the actual amount of resources they consumed. Current also built its ABC model to be flexible, so that as the product mix or manufacturing process changes, the model can be updated and provide an accurate representation of present operations. Some of the most important lessons learned from Current's ABC implementation are [Player et. al., 1999, p. 110]:

- “ABC is a tool, not a club; a means, not an end.”
- “One of the greatest benefits ABC offers is an opportunity to run what-if scenarios.”
- “Each product, no matter how small or inexpensive can be made to pay for itself.”
- “Because of the relatively high turnover of management personnel in some companies, it is important to continue educating and selling the value of ABCM to both new and existing managers.”

In the early 1990s, Bliss and Laughlin Industries, a steel finishing firm based in Harvey, Illinois, was experiencing the same symptoms being felt by many other companies across different industries; increasing sales and decreasing earnings. In an effort to reverse the situation, and control earnings decreases, the company’s upper management turned to ABC to make the necessary strategic changes that would enhance long-term profitability. With over 800 standard steel products, plus a number of customized items, the company served OEMs, the automotive industry, and service centers. Bliss and Laughlin hoped that ABC could be used to focus its resources on its main sources of income. As it turned out, between 1988 and 1991, the company went from net earnings of \$2 million per year, to net losses of more than \$3.6 million per year. The company began its ABC implementation in 1992, as an upper management initiative. The initiative revolved around planning the production process for profits, instead of creating a budgeting system based on costs. The overarching relationship used by Bliss and Laughlin was the following [Player et. al., 1999, p. 121]:

$$\text{Price} - \text{Required Profits} = \text{Maximum Produced and Delivered Cost}$$

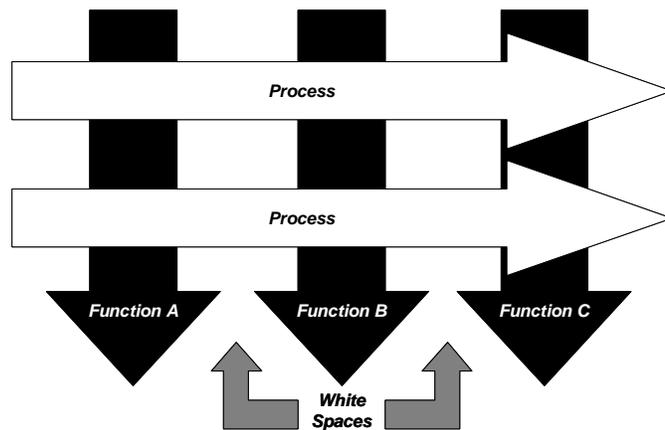
Where the company could target cost specifically, since it is the independent variable affected by the actions taken. This approach, known as target costing, is becoming an increasingly popular means of applying ABC to solve declining profitability problems. The company’s goal was to enhance the profit-planning process by understanding what market channels, customer accounts, and product mix would enhance profitability. Basically, ABC was used as a trade-off model where the company could look into its current operation, and alter it to achieve the required level of profitability. The Bliss and Laughlin team approached the problem by first identifying eight process areas that best describe the flow through the company’s “functional silos”:

- Determining customer needs.

- Preparing and delivering quotes.
- Interpreting orders from execution (scheduling the steel mill).
- Acquiring necessary resources.
- Making the product.
- Delivering the product.
- Servicing the product.
- Obtaining administrative support (interplant and corporate sustaining).

These cross-functional areas represent the points through which each process must pass to become a deliverable product. **Figure A.2** displays the concept that the Bliss and Laughlin ABC implementation team was trying to achieve [Player et. al., 1999, p. 123].

A process is the journey that new customer orders take as they go from functional area to functional area. The “white spaces” are the barriers that exist between the different departments, and are the source of operational inefficiencies. Thus, total cost was determined by business process associated with a business drives. For example,



**Figure A.2: Bliss and Laughlin’s closing the “white spaces” [Player et. al., 1999].**

determining customer needs is a process that is driven by the number of customers, scheduling the mill is a process driven by the number of shop orders, whereas acquiring resources is a process driven by the number of line items received. The power of this type of modeling is that it displays cost drivers for each process that might not have been understood before. For example, in the final model’s largest business process, making the product, the ABC implementation team found that one-third of the time, workers spent their time waiting for the raw material, and another one-third of the time was spent of working on batch related tasks such as machine changeovers, unveiling massive operational inefficiencies that drove up manufacturing costs. The power now lies in the availability of this type of information upon which management can rectify the problem through streamlining initiatives. Through cost reduction initiatives,

Bliss and Laughlin was able to reduce its manufacturing costs by over \$1 million per year, and create a system by which the company can explore improvements to enhance its manufacturing flexibility, reduce cycle time and inventory levels by analyzing the cost of retaining some of the customers in its current portfolio of customers. Some of the more important lessons learned by Bliss and Laughlin were [Player et. al., 1999, pp. 128-129]:

- “It is necessary to involve customers and obtain the necessary information about customer satisfaction in order to take appropriate action.”
- “With ABC there are two paths to follow: design a product to be more profitable or accumulate product and customer information to determine which processes need to be reengineered.”

In the PC peripheral business, AT&T Paradyne is a company specializing in the design and manufacture of data communications equipment such as modems. At the time of the case study, the company, located in Largo, Florida, employed 2,000 people and generated revenues in excess of \$400 million per year. Similarly to companies in other industries, AT&T Paradyne was facing problems allocating resource costs across its different products, where products in more mature markets were getting a high allocation of resource support as opposed to the newer products that were going to spearhead new markets. The company recognized the following [Player et. al., 1999, p. 152]:

- “Products were becoming smaller, more customer-specific, and far more expensive to manufacture.”
- “The existing accounting system was no longer of value in supporting strategic, operational, and financial life cycle decisions.”
- “Time to market was compressing, as was the window of realizing profits.”

In the early 1990s the company recognized the need to revamp its management accounting system and migrate away from the classical resource cost allocation system based on material and direct labor costs. The company recognized the need to have a system that would reveal the true cost of a product. AT&T Paradyne was hoping that this type of information would not only impact its current manufacturing operation, but would benefit future design and development efforts, highlighting the potential cost impacts of certain engineering decisions during the early stages of new product

development. AT&T Paradyne's system consisted of an ABC model designed to collect data from the various cost centers, and reconcile it with the company's General Ledger. The model consisted of four major cost elements (material cost, material acquisition cost, production cost, and support cost), 44 cost pools, and 13 activity drivers [Player et. al., 1999, p. 156]. Along with the ABC initiative, AT&T Paradyne began to implement target costing so as to facilitate product life cycle cost management. Marketing managers, who would estimate the price at which new products with specific features can be sold at to realize significant and profitable margins, initiated the target costing process. This allowed the engineering community to have a benchmark upon which to design and develop new products, using the ABC cost information to understand exactly how design and development decisions would impact the cost of the product. In AT&T Paradyne's case, the early migration to an ABC system has yielded significant benefits, of which one of them is an ABC philosophy integration into the culture of the company, one of the major hurdles that companies trying to implement ABCM often run into, and cannot resolve. AT&T Paradyne continuously evolves its system, improving it based on changes in the company's production process, and outside market conditions. In AT&T Paradyne's case, ABC, and eventually, ABCM made it possible to understand and manage activities that are the key to the company's need to advance its manufacturing process. Some of the more important lessons learned from AT&T Paradyne's experiences with ABCM are [Player et. al., 1999, p. 158]:

- "Any major undertaking, such as moving to ABM, requires communication and dedication from high-level sponsor as well as a relentless champion."
- "ABM supports strategic decisions, such as pricing, mix, make versus buy, and the kinds of investments that are needed."
- "ABC improves the concurrent engineering process by increasing cost awareness in design decisions."
- "ABC enhances ability to benchmark activities, drivers, and cost data against best-in-class competitors."
- "Linking the ABC manufacturing efforts with budgeting, inventory valuation, and performance evaluation will accelerate integration of ABC into the management of the company."

## A.2. The Foundation to Implementation Success

The above-mentioned case studies represent only a small sample of examples of companies that benefited from the usage of ABCM techniques. As was mentioned before, the hardest part of creating a common theme for ensuring that ABCM implementations are successful resides in the fact that each company will customize its approach to ABCM, and modifies the implementation to suit its specific goals. However, several academics will argue that there is a common theme that can be ascertained from the study of several ABCM applications across different industries.

Referring back to **Table A.1**, Navistar, a Chicago based truck manufacturer, began its implementation of ABC techniques in 1995 when upper management began to explore the possibilities of integrating an ABC approach into its existing cost management structure. Their goals were very precise: “align financial information with management accountability, improve product costing accuracy, establish financial measures for management decision making, directly link strategies to financial measures and operational performance metrics, and improve the accessibility of performance measurement information” [Leahy, 1999, p. 2]. With the help of outside consultants, in this case Ernst & Young LLP, Navistar began implementing ABC through a number of pilot programs designed to minimize any impact on current operations. From 1995 to 1999, Navistar successfully migrated from ABC pilot programs to full-blown company wide ABCM and Activity Based Budgeting. The well planned and executed initial pilot allowed to company to continue to build upon its success, and continue with additional more expansive pilots. Without going into the details of the ABCM pilots, this example offers a set of very simple and basic ideas that helped Navistar achieve high levels of ABCM implementation and success. Over the FY1997 and FY1998, Navistar’s sales and revenues increased by \$5.74 billion and \$7.88 billion respectively, and ROE rose by 7.1% to 38.9%, a number that is rarely seen in the automotive sector, fuelling a net income growth from \$65 million to \$299 million. This kind of performance allowed Navistar to earn the 1998 ABM Renegade Award, sponsored by the Cost Management Congress 2000.

**Table A.2: The 10 ingredients for ABCM success [Leahy, 1999].**

1. Form a corporate team with strong ABCM experience.
2. Gain acceptance from upper management early on.
3. Focus on improvement plans, not past history.
4. Reduce employee initial anxiety through education.

5. Create a dictionary of common activities and processes.
6. Promote knowledge of ABCM analysis throughout the company by establishing a rotating team structure, so that different employees are trained and released into their jobs to apply what was learned.
7. Allow flexibility within a general set of cost standards that permit individual plants to still do many things their own way.
8. Introduce the cost management tool to supplier and provide them with consultation.
9. Use ABCM to support other company wide cost efficiency efforts such as Six Sigma and ERP.
10. Anticipate and avoid pitfalls that have derailed other companies.

**Table A.2** [Leahy, 1999, p. 1] displays the essential ingredients that made up Navistar's success. These points follow in the footsteps of the lessons learned from the companies presented in the previous section. The simplicity of Navistar's success lies in the early understanding that ABCM is an enabling tool, and not a barrier. Thus the major themes are: experience, planning, education, integration, and exportation, where Navistar successfully educated its workforce, planned exactly what goals it wanted to achieve with its ABCM efforts, studied ways to integrate ABCM with other company wide improvement efforts, and exported its knowledge to its major suppliers, all through the use of an experienced team that was backed up by upper management support.

Expanding on the last point in **Table A.2**, it is interesting to note that the pitfalls that have derailed other companies are more behavioral and cultural than technical, meaning that in most cases ABCM failure are due mostly to rejection by the company's human infrastructure, and not on some technical limitation due to computing power. Player and Keys have quantified a set of 30 pitfalls that have derailed companies in their effort to implement ABCM practices. The authors have separated these pitfalls into two sets [Player et. al., 1999, pp. 3-70]. The first set, 1-10, deals with pitfalls that will derail top-down or bottom-up efforts to introduce ABCM thinking within the organization. The second set, 11-20 deals with the pitfalls that will derail ABCM pilot projects, which are the customary way that companies venture and study if ABCM brings forth enough benefits to approve a company wide spreading of the initiative. Lastly, the third set, 21-30, deals with pitfalls that hamper a company's ability to export successful pilot project into mainstream company practices.

### **A.3. Getting Off to the Right Start: Pitfalls 1-10**

Just like any product development process, the more time that is spent in ensuring and studying methodologies to ensure the success of a project, the higher the likelihood that the project will be

successful. ABCM is no different from other corporate actions such as the introduction of Six Sigma, JIT, or ERP initiatives, thus proper front-end planning ensures that the initiative does not falter in its beginning stages. The likelihood that a company will reattempt to implement a failed project initiative is much lower if the failures occur very early on the in the project's introduction. Pitfalls 1-10 deal specifically with the scenarios that can hamper ABCM implementation even before the company attempts to go ahead with a pilot project. Failure at this stage will create a situation by which the company's human fabric will associate the failure with ABCM being the wrong strategy for the company. **Table A.3** displays the pitfalls associated with getting off the right start [Player et. al., 1999, p. 6].

**Table A.3: Getting off to the right start; pitfalls 1-10 [Player et. al., 1999].**

<b>Pitfall 1</b> We cannot get top management support.
<b>Pitfall 2</b> Tell me again why we are doing this.
<b>Pitfall 3</b> What do you mean, there are three views of cost?
<b>Pitfall 4</b> The accountants are changing the allocations again.
<b>Pitfall 5</b> We will tell the employees about this later, maybe.
<b>Pitfall 6</b> We can do this without spending any money.
<b>Pitfall 7</b> We do not need training; this is not rocket science.
<b>Pitfall 8</b> It is the consultant's fault.
<b>Pitfall 9</b> We do not need resident experts.
<b>Pitfall 10</b> This does not link to other initiatives.

As is the case in many company wide initiatives, bottom-up initiatives will always face a more adversarial path to success than top-down initiatives. Top-down initiatives, usually implemented and supported by very senior members of a company's management infrastructure will take precedence over initiatives that are initiated at lower levels of the organization and are trying to gain management support. It is imperative that successful introduction of ABCM practices in a company be widely supported by senior management. Management support is necessary to ensure that there is an approval of human and other resources to ensure that the ABCM implementation can get off to the right start. Education, which in the past has been shown to effectively counteract pitfall 5, is a very effective method to expose benefit of ABCM to upper management and begin to get them involved in the process. A bottom-up initiative must not only gain the approval of senior management, though the exposure of the benefits to be gained by ABCM implementation, but should attempt to recruit one or more senior managers that will act as champions for the initiative and offer a degree of representation among the upper strata of the

organization. Managers go through a three-step process beginning with awareness, buy-in, and ownership [Player et. al., 1999, p. 6].

Pitfall 2 usually occurs because of a lack of clear objectives. The ABCM team must always be aware of what there is to be gained by the initiative, how this initiative is going to fit within the other strategy initiatives that are currently present or are planned to be introduced, and what the timeline and objectives of the implementation really are. The last thing that the ABCM implementation team needs is to present the initiative to a senior manager that is a champion of another initiative (i.e.: ERP or lean manufacturing), who sees ABCM implementation as a threat. One way to overcome this pitfall is through the five-whys questioning methodology originally developed by Toyota, and used to pinpoint failures along manufacturing lines:

- “1. Why is this project being performed? Because it will make us a better company.
2. Why will it make this a better company? Because we will better understand costs.
3. Why do we need to understand costs? Because we do not understand what causes cost.
4. Why do we need to understand what causes cost? Because we need to understand how we can reduce and avoid cost.
5. Why is avoiding and reducing cost important? To meet our objective of being the low-cost, high-quality provider.

Answering why five times yields the objectives and ensures there is a consensus regarding what outcomes the company is seeking from the project...Get everyone to agree on the objectives and the project is ready to launch” [Player et. al., 1999, p. 9].

Cost management systems have evolved to provide information not only to financial managers, but also to operation managers. In effect, there are three ways to view cost: financial, operational, and strategic. The financial view is the classic cost information used by financial controllers, tax managers, external shareholders, and lenders, basically interested in the financial performance of the company for IRS and SEC type evaluations. Financial information is the basis by which financial markets evaluate the share performance of the company’s stock, which in turn becomes the key metric for evaluating upper management performance. Today, with the advent of more sophisticated cost management systems, cost information is being used more and more by operation managers, and improvement and quality

teams. Improvements in quality and operational efficiency are beginning to be gauged not only by operational capacity, but also by the impact on bottom line cost. What once was only a concern to the financial community is now increasingly becoming an operational issue. **Figure A.3** displays the three views of cost.

In the future, cost will also assume a more strategic role. Cost metrics will determine strategies used for the implementation of ABC, Target Costing, life cycle costing, and most importantly make versus buy type decisions. Top management will use this type of information to bridge mission statements and visions for

	Financial	Operational	Strategic
	VIEW		
TIME FOCUS	Yesterday	Today	Tomorrow
Users of information	Financial controllers Tax managers External shareholders Lenders Tax authorities	Line managers Process improvement teams Quality teams	Strategic planners Cost engineers Capital budgeters Product sourcing Product managers
Purposes	Financial accounting Inventory valuation Budgeting	KPIs VAIs and NVAIs Activity analysis for process improvement	ABC TC Investment justification Life-cycle costing Make/buy analysis
Level of aggregation	High aggregation, often company wide data	Little aggregation, very detailed	Plant or product line aggregation, information needed for decisions
Reporting frequency	Periodic (monthly)	Immediate (daily or hourly)	Ad hoc, usually a one time study
Type of measures needed	Financial	Physical	Financial and physical

**Figure A.3: The three views of cost [Player et. al., 1999].**

overall company strategy with actual actions and plans designed to concretely move the company in the right direction and create shareholder value. Once the concept of the three views of cost is presented, it should be obvious that one cost management system based on antiquated practices is not enough to support the needs of operation managers and company strategists.

Pitfalls 4 and 5 deal with experience, diversity, and education. ABCM projects fail simply because the ABCM implementation team is not diverse enough, meaning that there is a high concentration of financial managers, and not enough representation by other company disciplines such as manufacturing, marketing, operations, and engineering. The power of having a number of very diverse disciplines within the ABCM implementation team lies in having resident experts that can identify the activities and procedures present in their respective departments, and understand them better than someone who might not be as familiar with all aspects of the company's operational procedures. This also requires the team to be proficient in concepts of ABC and ABM. On the onset, the teams must be educated, and become very knowledgeable in the areas pertaining to ABCM. In turn, this will enable them to educate the remainder of the workforce, a key necessity that will ensure that the team does not encounter any employee resistance while implementing the various ABCM initiatives.

Obviously, it goes without saying that, as with any other project, ABCM implementation will require capital investment. Presently, there are on the market a number of COTS software packages that can be easily modified to fit the company's needs. Companies that in the past have spearheaded the development of ERP type software are now attempting to incorporate ABCM elements within the packages so as to respond to the integration concerns of companies that already have ERP software, and would like to combine it with ABCM software. Time is the second investment. ABCM implementation project can vary in scope and size, but really ambitious projects can run several years, especially if the company that is implementing ABCM is diverse, complex, and big. On average, ABCM implementation projects can run anywhere from as little as \$30,000 too much more than \$1 million. Reluctance in funding the project usually is due to a failure in understanding that the ABCM implementation project is a positive NPV project, even after the initial capital outlay, and tie-up of key personnel.

Pitfalls 7, 8, 9, and 10 are directly linked to the structure of the implementation team. First off, the team must have the knowledge and experience to carry out an ABCM implementation, which means that the team must not only understand the scope of the project, the operations of the company, but must have mastery in the concepts governing ABCM. When seeking outside help, such as through a consulting firm, this issue becomes critical. Without sufficient knowledge, outside consultancy might become more of a dictatorship, dictating how and in what direction the project should progress, instead of being an additional source of experience and knowledge. Experienced teams will not only continue to spread the knowledge gained, involving other company employees not directly involved with the ABCM implementation project, but will take up the role of resident experts. These experts will ensure that the ABCM implementation evolves in line with the company's strategy, thereby maximizing the benefits gained through the investment in ABCM, and ensuring that ABCM can be correctly integrated with future cost reduction and efficiency improvement initiatives [Player et. al., 1999, pp. 3-25].

#### **A.4. Developing the Pilot: Pitfalls 11-20**

The sheer magnitude of a company's interest in ABCM implementation, combined with the its operational complexity and scope, predicates that often companies will correctly prefer to take baby steps before attempting a company wide implementation. The use of pilot projects serves three purposes: allow the company to experiment with ABCM and evaluate its usefulness within the boundaries of its

goals, tie up a small amount of resources while the implementation and evaluation of the pilot project is carried out, and introduce ABCM into the company's fabric without disrupting current operations. Often times, ABCM pilot projects are limited to a specific process within a multi-process, multi-product manufacturing company. Developing a pilot program correctly and effectively is the second hurdle that the ABCM implementation team has to overcome in order to ensure a more probable management buy-in and a company wide adoption of the ABCM philosophy. **Table A.4** displays pitfalls 11-20 [Player et. al., 1999, p. 27].

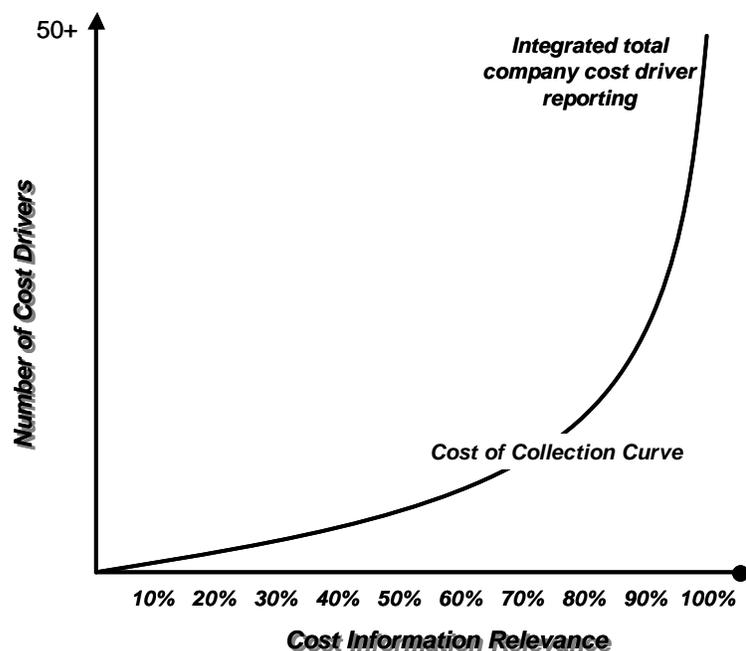
**Table A.4: Developing the pilot; pitfalls 11-20 [Player et. al., 1999].**

<b>Pitfall 11</b> We do not need a pilot.
<b>Pitfall 12</b> This thing needs a lot of detail.
<b>Pitfall 13</b> This thing does not need a lot of detail.
<b>Pitfall 14</b> What are you calling an activity?
<b>Pitfall 15</b> That activity cannot cost that much.
<b>Pitfall 16</b> We do not keep data that way.
<b>Pitfall 17</b> I think we spent that back in 1962.
<b>Pitfall 18</b> Who picked this software anyway?
<b>Pitfall 19</b> Who needs project management?
<b>Pitfall 20</b> I never dreamed it would take this long.

Obviously, the first pitfall is the denial that a pilot project is needed. However, through the three points mentioned above, a pilot project will ensure that subsequent company wide implementation is smoother and more efficient. Once the decision is taken to implement the pilot project, pitfalls 12, 13, and 14 deal directly with the design of the project. This is the point at which the team's ABCM knowledge, combined with a deep understanding of the company's operations becomes critical. Designing and implementing the pilot will require a certain degree of trade-off decisions. Teams often get bogged down with too many details, especially when the pilot goes beyond a simple process and cover a whole manufacturing line which is not as automated and still requires a substantial degree of human intervention. This pitfall can easily transform the pilot into an insurmountable technical challenge that can surely sink the pilot and any ABCM implementation effort. **Figure A.4** [Player et. al., 1999, p. 30] displays a simple relationship between the number of cost drivers chosen by the ABCM implementation team, and the cost information relevance to the goals of the ABCM pilot. On the other hand, too little detail will surely ensure that the pilot project will not satisfy the basic goals of the ABCM implementation. This will leave

the ABCM implementation team in the precarious situation where after all the capital and human investments, the project falls short of the objective of exposing enough activity cost data so that educated decisions can begin to give way to the ABM process of streamlining and strategizing new directions for the company. The of having a diverse team will ensure that the basic foundation of any ABCM project, the definitions of activities in the activity dictionary, will get the full backing of personnel directly involved in the area being defined. A failure of identifying correctly relevant activities belonging to each of the operation sub-areas of the company will surely introduce confusion and a significant amount of errors in the data gathered during the pilot project.

Pitfalls 14 and 15 are somewhat related. In essence, “care must be taken to accurately assign costs to activities and to cost objects...ABC activity drivers should have a cause and effect relationship with cost, that is, the activity driver should have a clear relationship to the cause of the cost” [Player et. al., 1999, p. 38]. It may be the case that ABCM allocated costs will not match currently available cost data. This by no means implies that the cost allocations are



**Figure A.4: Relationship between cost of data collection, and percentage of relevant data [Player et. al., 1999].**

wrong. If there is a very clear and justified methodology of assigning costs to clearly defined causes will ensure that any questioning as to the validity or magnitude of the costs can easily be justified.

Pitfalls 16 and 17 deal exclusively with the shortcomings of trying to interface the financial data between an ABM and a GAAP accounting system. In most cases, financial data that is inputted into a GAAP system will be modified to maximize tax benefits. Cost objects such as depreciation, and past year salaries can greatly affect the ABM accounting system if allocated incorrectly. GAAP accounting systems employ a system that expenses costs as they are incurred. This prevents the implementation team from

understanding exactly how and when the expensed costs start to yield benefits. ABCM accounting principles will use a life-cycle cost approach where “understanding the difference between when the cost become committed and when their related cash flow physically occurs...and it is also necessary for relating costs to the corresponding benefits they produce” [Player et. al., 1999, p. 42].

Pitfall 18 represents a very important problem that plagues many ABCM implementation teams. The choice of ABCM software to be used is very critical under numerous aspects. The development of software sophisticated enough to deal with the depth and breadth demanded by companies employing ABCM practices has obviously followed the speed at which companies adopted more expansive ABCM practices across their operations. Beginning with 1990, where the number of software packages was very small and the power and flexibility of the software was certainly limited, available packages only included those put together by consulting firms. This meant that the software installation usually came under the required additional contract of the consulting firm’s services. Today, there are over 50 COTS software packages developed and backed by companies such as Germany’s SAP and the USA’s Oracle and PeopleSoft, which are not only leveraging the power of information exchange via intranets and internet, but are continuously working to integrate ABCM add-ons to their existing ERP products. There are, however, a number of mistakes that can be encountered when choosing the correct software for the specific ABCM application. There are a number of problems that are still evident with the present ABCM software, especially for software for stand-alone PC’s. Problems include poor usage due to limited workstations, minimal post sales support, data compatibility when importing from and exporting to other company software platforms, software prices, and most importantly, failure of identifying the correct software for the correct problem. In essence, technology leaps should resolve many of the problems mentioned above, but in reality have introduced an additional degree of complexity that if underestimated can certainly be fatal to the success of the ABCM implementation project.

Lastly, pitfalls 19 and 20 are closely related. On one hand, the failure to provide sound project management will lead to the missing of important project milestones, and thus the unnecessary addition of time to the project. Poor project management is essential in ensuring that the project remains on track and absorbs the correct amount of cost and resources. Poor project management includes poor human resource and team selection, poor communication, poor leadership and commitment, and capital under

funding. Rectification of simple project management flaws are well known, and for an ABCM pilot project implementation, it is no different than in other project management problems. It is beyond the scope of this research to comment on sound project management techniques.

## A.5. Moving from Pilot to Mainstream: Pitfalls 21-30

The biggest leap of faith that a company involved in ABCM can do is to migrate the ABCM project from pilot status to company wide project. In many cases this ambitious vision is hampered by the sheer size and product mix that is characteristic of many companies today. Most migrations into mainstream adoptions are cultural and behavioral in nature [Player et. al., 1999, p. 52]. **Table A.5** displays the pitfalls that make up the last set of fatal mistakes that could cause the failure of an ABCM implementation project [Player et. al., 1999, p. 53].

**Table A.5: Moving from pilot to mainstream; pitfalls 21-30 [Player et. al., 1999].**

<b>Pitfall 21</b> I am afraid, but I do not know it.
<b>Pitfall 22</b> We are afraid, but we do not know it.
<b>Pitfall 23</b> Wait a minute – this is messing with some long held beliefs.
<b>Pitfall 24</b> What a world.
<b>Pitfall 25</b> Oh, yeah, do something with the numbers.
<b>Pitfall 26</b> Who wrote this, the legal department?
<b>Pitfall 27</b> We were supposed to get this report two months ago.
<b>Pitfall 28</b> They are overhead.
<b>Pitfall 29</b> Times are good – why bother?
<b>Pitfall 30</b> This will cost a fortune to operate.

Pitfalls 21 and 22 deal with the ABCM implementation team not realizing that the changes brought about by ABCM will certainly meet resistance. Pitfall 21, which deals with upper management reaction, warns that even though the company has committed to migrate from a pilot to a mainstream system, the changes that occur will make people nervous. Now the ABCM methodology of measuring costs will spill into areas untouched by the pilot program, causing a change in the performance measurement of operations areas. Therefore, upper management in charge of the areas could resist to change simply because they have to consider and get used to a new way of measuring the area's cost performance. On the other hand, pitfall 22 warns against the failure to realize that at lower departmental levels, the fear will come in the form of classifying activities as value and non-value added. To the department head, this could potentially mean that someone someday could tap his/her shoulder and tell

them that the department is full of non-value added activities and that for cost reasons the department would be decreased in size, and consolidated with another department.

The ABCM implementation team will not only have to fight fear of change, but will have to deal with trying to change long held beliefs and practices that have been engrained in the company's culture. Pitfall 23 warns the ABCM implementation team that coming across a very homogeneous and compact section of the company, as would be the accounting and legal departments, it could face its greatest challenge. Changing the mentality of an organization whose beliefs have been engrained into the general corporate culture for over 100 years, and whose principles are being taught continuously today at universities and higher education institutions to future managers and accountants, will certainly make the task extremely difficult. If this was not enough, through pitfall 24, the implementation team faces the challenges of conforming to the standards set out by government agencies and other organizations that demand that a certain set of accounting principles be followed in accordance to SEC and IRS regulations. It goes without saying that the rules and regulations are based on GAAP and may hinder the adoption of more ABCM like accounting principles. Pitfall 24 is especially evident in the aerospace and defense sector where the DoD and the DCAA will control and monitor every aspect of the design, development, testing, and manufacture of new products, imposing a certain set of rules and regulations that must be followed in order to comply with the standards set by these agencies. These rules and regulations were put in place so that these agencies could have a consistent set of metrics to judge different proposals from the different companies within the aerospace and defense sector bidding for the same product development project.

Assuming that the ABCM implementation works, and that the system is now poised to extract the necessary ABC information so that ABM can be performed, the ABCM implementation team must ensure that management will take a proactive role in using the data usefully. As is often the case, the company has an ABCM system in place, but the data that is gathered is not used to make strategic decisions about the business. Again, going back to some of the pitfall mentioned in the previous sections, this pitfall predicates that the ABCM implementation team must secure sponsorship and backing from upper management members, who additionally will champion the cause.

ABCM project benefit the whole company only if the whole company understands the terminology, scope, and goals of the projects. Pitfall 26 deals exclusively with warning the ABCM implementation team that any documentation that is produced on the ABCM project must be understandable by all the people that are going to be affected by it. It will be useless to generate reports that contain complex accounting that can be understood only by the accounting community. The information must be disseminated to everyone, and be understood by everyone. In addition, though pitfall 27, the reports must be generated in such a way as to benefit the people that can use the information to modify their operations. In the past, accounting reports, apart from being completely useless from an operations point of view, were also delivered late every month. The data that was dispersed to the company's community was already old, and could not help the different functional areas of the company understand how to relate the costs displayed in the reports with the costs incurred by their operation.

An additional problem occurs when ABCM initiatives are applied to areas that do not directly benefit from the implementation, as is suggested by pitfall 28. This usually occurs when the ABCM implementation initiatives touch those areas of the company that are not considered profit centers. Since these centers are a loss, or effectively considered overhead expenses, there is no direct incentive to help the initiative. In fact, in many cases, companies that have applied ABCM to their operations have identified this as one problem that was completely unforeseen. Again, a careful plan of how to ensure that each of the areas of the company will respond favorably can be helped by considering how the non-profit centers can help in order to maximize ABCM's impact on the profit centers.

Continuing down the behavioral path, pitfalls 29 and 30 deal with shortsighted strategic views taken by the numerous members of upper management. Pitfall 29 suggests that the ABCM implementation team must pitch a very good story in order to gain upper management support especially when the company is enjoying a period of prosperity. The obvious selling point is that ABCM implementations are good to ensure that long-term growth and prosperity can be aided further through the implementation process. Finally, pitfall 30 suggests that the cost of maintaining an extensive ABCM system might not justify the cost reductions that the company will gain by it. Advances in information technology have allowed the development of more automated ABCM systems that are more cost effective, easier to maintain, and faster to run. Interface problems, both with ERP and mainstay

accounting systems have also been reduced as ERP and accounting system developers have begun to incorporate ABCM modules. However, many members of ABCM implementation teams will argue that the cost excuse is arguable, and that there is evidence that the cost reduction gains enabled through a well-implemented ABCM program, greatly outweighs the cost of maintaining the system.

## **A.6. Measuring Implementation Success**

Correctly measuring the success of ABCM implementations is still a matter of debate amongst the many ABCM scholars around the country. A number of different papers published in the journals such as the JMAR present different scholarly views based on data gathered through industry surveys. Works by Shields (University of Memphis, and later Michigan State University), Foster (Stanford University), Swenson (University of Idaho), McGowan (Texas A&M University), and Klammer (University of North Texas), represent the bulk of the work done in trying to assess metrics by which ABCM implementation success is viewed by those companies within which ABCM implementations have taken place. The purpose of this sub-section is to highlight the most important data from each of these authors, and present how, on average, companies rate their ABCM implementation efforts.

In 1995, Shields surveyed 143 firms to gather data and associate a firms' success in implementing ABCM with ABCM implementation success variables [Shields, 1995, pp. 148-165]. Shields set out to conform five separate hypotheses:

1. "There is a significant variation in the degree of success forms have with ABC."
2. "Several behavioral and organization variables explain significant variation in ABC [implementation] success; these include: top management support, linkage to competitive strategy, linkage to performance evaluation and compensation, training in ABC usage, non-accounting ownership as opposed to accounting ownership, consensus about and clarity of ABC objectives, and [availability] of sufficient internal resources."
3. "Technical variables do not explain significant variation in ABC success; these include: canned software, customized software, stand-alone versus integrated systems, and [usage] of external consultants."
4. "ABC implementation variables are used in subsets consisting of the behavioral and organizational variables or the technical variables."

5. “The subsets of behavioral and organizational implementation variables explain more variation in ABC success than do the subsets of the technical implementation variables” [Shields, 1995, p. 152].

The 143 firms surveyed represented a varied cross-sectional collection of disciplines, ranging from commercial manufacturing (72%), commercial non-manufacturing (22%), defense contracts (5%), and non-defensive contracts (2%). The 143 firms had a sales range between \$1 million and \$32 billion, with average annual sales of \$2.15 billion. The average number of employees was 15,944. All the companies surveyed had implemented ABCM projects whose age varied from 1 to 74 months, and whose average age was 19 months, or just above 1.5 years. Shields used 17 separate degree factors to measure their impact on ABCM implementation success. These degree factors were coupled with a rating system from 1 (extremely low) to 7 (extremely high), as is shown in **Table A.6** [Shields, 1995, p. 157].

**Table A.6: Factors important in influencing ABCM implementation success [Shields, 1995].**

	<i>Ext. Low</i>						<i>Ext. High</i>	<i>Mean</i>
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	
Stand-alone system	10%	9%	6%	8%	11%	18%	38%	5.10
Top management support	4%	8%	8%	11%	25%	25%	19%	4.93
Canned software	14%	6%	8%	6%	12%	26%	28%	4.85
Accounting ownership	14%	7%	9%	11%	15%	26%	18%	4.59
Link to competitive strategy	9%	12%	12%	14%	20%	18%	15%	4.39
Clear and concise objectives	1%	16%	16%	23%	22%	17%	5%	4.19
Training – implementation	8%	12%	14%	18%	25%	18%	5%	4.15
Consensus about objectives	6%	12%	14%	26%	24%	13%	5%	4.11
Training – usage	7%	16%	16%	23%	17%	17%	4%	3.97
Training – design	4%	18%	5%	26%	21%	12%	4%	3.94
Link to quality initiatives	9%	14%	21%	13%	27%	10%	6%	3.90
Non-accounting ownership	11%	13%	19%	18%	15%	18%	4%	3.84
Resource adequacy	7%	15%	22%	23%	15%	13%	5%	3.81
External consultants	29%	14%	12%	11%	13%	12%	9%	3.39
Link to speed initiatives (JIT, ERP, etc.)	21%	17%	18%	13%	17%	11%	3%	3.30
Customized software	45%	15%	9%	8%	5%	12%	6%	2.75
Link to performance evaluation and compensation	52%	16%	9%	9%	5%	6%	3%	2.27

Aggregating the data from **Table A.6** into one data point can summarize shields conclusions. Overall, the 143 companies surveyed rate their ABCM implementation success at an average of 4.35, or give it a score of 62.1% [Shields, 1995, p. 159]. From a financial standpoint, 75% of the companies surveyed stated that they received a positive financial benefit from the implementation, whereas the remaining 25%

stated that they received no financial benefit. As **Table A.6** clearly displays, implementation success is factors are extremely varied, and the majority of the important factors (those receiving higher scores on the 1 to 7 scale) are more behavioral and cultural in nature than technical.

One can state that the data presented by Shields is encouraging, but should be more supportive of ABCM success if one is to argue that ABCM is essential in sustaining companies' drive to lean. In the same year, 1995, D.W. Swenson attempted to quantify the benefits of ABCM usage specifically to the manufacturing industry [Swenson, 1995, pp. 167-180]. Swenson surveyed 60 individuals at 25 different manufacturing facilities. The individuals surveyed were classified into three groups: corporate level financial managers who were responsible for implementing ABCM at various locations, but considered themselves facilitators and not leaders of the ABCM efforts (corporate facilitators), financial managers who resided at specific plant sites, preparing ABCM reports and used limited ABCM data in strategic decision making processes (financial managers), and non-financial managers who were the primary users of ABCM information (non-financial managers). The firms sampled had been using ABCM for an average of 2.6 years, with a low of 12 months, and a high of 6 years. Swenson found that although all facilities were manufacturing sites, "[68%] of the firms had initially adopted ABCM to improve strategic decision making (i.e.: product costing and customer profitability). The remaining [32%] placed more emphasis on supporting operational decision (i.e.: process improvement). As the ABCM systems evolved, those facilities placing more emphasis on strategic decision making gradually migrated towards supporting operational decisions. This trend reflects the perception of some respondents that developing a better product costing methodology is a one-time fix. Operational improvement, on the other hand, is a continuous process necessary for a firm's survival" [Swenson, 1995, p. 169]. Swenson measured the level of satisfaction with the facilities' CM Strategy in three major areas (product costing, cost control, and performance measurement) before and after the implementation of ABCM initiatives. **Table A.7** displays the results, highlighting that across the board all the different types of employees surveyed agree that the CM Strategy is greatly improved after the adoption of ABCM [Swenson, 1995, p. 171]. In the survey, 1 represented "Dissatisfied", while 4 represented "Very Satisfied".

**Table A.7: Change in satisfaction with CM Strategy before and after ABCM implementation [Swenson, 1995].**

<b>(Note that CM S = CM Strategy)</b>	<b>Product Costing</b>	<b>Cost Control</b>	<b>Performance Measurement</b>	
Average Satisfaction with CM S prior to ABCM	1.61	1.23	1.69	
Average Satisfaction with CM S after to ABCM	3.38	3.23	2.53	Corporate Facilitators
Improvement in satisfaction with CM S following ABCM	1.77 (110%)	2.00 (163%)	0.84 (50%)	
Average Satisfaction with CM S prior to ABCM	1.61	1.44	2.16	
Average Satisfaction with CM S after to ABCM	3.22	3.11	2.88	Financial Managers
Improvement in satisfaction with CM S following ABCM	1.61 (100%)	1.67 (116%)	0.72 (33%)	
Average Satisfaction with CM S prior to ABCM	1.26	1.20	1.86	
Average Satisfaction with CM S after to ABCM	2.73	2.80	2.40	Non-Financial Managers
Improvement in satisfaction with CM S following ABCM	1.47 (117%)	1.60 (133%)	0.54 (29%)	
Average Satisfaction with CM S prior to ABCM	1.49	1.31	1.93	
Average Satisfaction with CM S after to ABCM	3.13	3.04	2.62	Combined
Improvement in satisfaction with CM S following ABCM	1.64 (110%)	1.73 (132%)	0.69 (36%)	

Even though Swenson's study is not as comprehensive as some other studies, it does highlight evidence of broad support for ABCM implementations within the manufacturing environment. Additionally, even though the number of sites surveyed is somewhat limited (25), Swenson does cover a great variety of manufacturing facilities. In fact, Swenson surveys manufacturing facilities operating in the following industries, where the number in parenthesis represents the number of facilities as part of the total sample: Textiles (1), Forest Products (2), Plastics (2), Chemicals (1), Tires (1) Consumer Products (3) Medical Products (1), Pharmaceuticals (1), Farm Implements (1), Automotive (2), Automotive Parts (3), Major Appliances (1), Electronics (2), Computer (1), and aerospace and defense sector (3) [Swenson, 1995, p. 173].

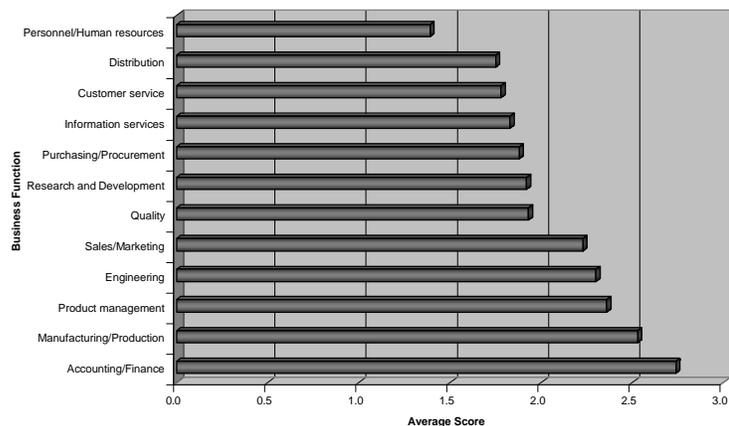
In 1997, G. Foster and D.W. Swenson set out to develop a more comprehensive study on measuring the success of ABCM implementations and their determinants. The study encompassed 166 ABCM sites in 132 separate companies. The study was subdivided into two different measurement

approaches: the a priori approach, and the factor analysis approach. The a priori approach measured extent of ABCM data used in decision making, decision actions taken as a consequence of ABCM data, dollar improvements due to ABCM usage, and management evaluation of the overall ABCM implementation. The factor analysis approach identified four factors used as means of measuring success rates: decision use, product/customer applications, function/manager applications, and manager group success perception. Of the two measurement techniques, the a priori measurement is the most interesting one. Starting with measuring the extent of ABCM data used in decision making processes, Foster and Swenson presented 14 different specific decision areas in which ABCM might be used to aid decision making. The scale used was 5 (excellent), 4 (good), 3 (average), 2 (fair), and 1 (poor). The findings show that the top three areas of decision making where ABCM was used most frequently were [Foster et. al., 1997, p. 114]:

- Identifying opportunities for improvement – average score of 3.46 from 141 respondents.
- Product management decisions – average score of 3.02 from 117 respondents.
- Driving process improvement decisions – average score of 3.01 from 138 respondents.

Moving on to the next category, Foster and Swenson gathered information on which business functions and managerial groups are the ones that use ABCM data most frequently within the organizations surveyed. This time the scale was 5 (all the time), 4 (most of the time), 3 (half of the time), 2 (sometimes), and 1 (never). As

**Figure A.5** shows, the top three business functions to use ABCM data in their decision making processes are accounting and finance, manufacturing and production, and product management [Foster et. al., 1997, p. 115]. Foster and Swenson go further by slicing the data in a different way. **Figure A.6** displays the management groups that most



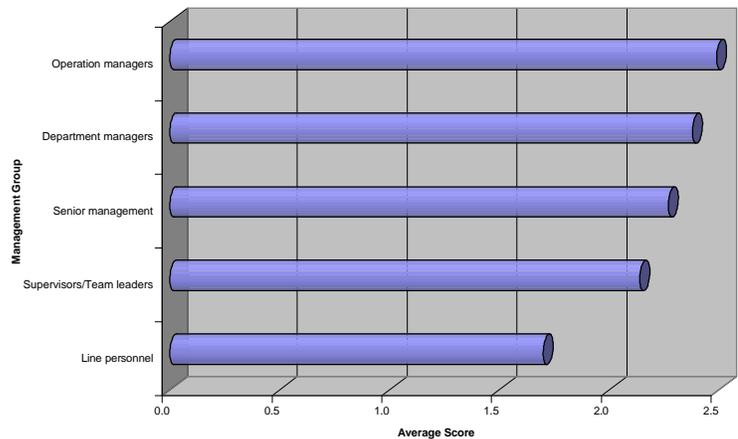
**Figure A.5: Frequency with which business functions use ABCM information for decision making [Foster et. al., 1997].**

frequently use ABCM data; operation managers are the ones that most frequently use the data [Foster et. al., 1997, p. 115].

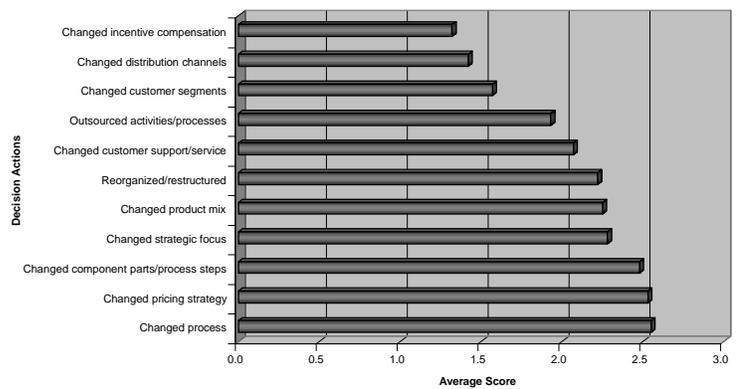
Foster and Swenson were also able to ascertain how ABCM implementation changed decisions. In this case, Foster and Swenson proposed 11 different decision actions, and gathered information on how much influence ABCM had on each. The scale was as follows: 5 (very significant changes), 4 (significant changes), 3 (moderate changes), 2 (minor changes), and 1 (no changes). As is shown in **Figure A.7**, the three top decisions most influenced by ABCM data are process changes, changes in the pricing strategy, and changes in component parts or process steps.

Next, Foster and Swenson looked at the dollar improvement experienced as a result of ABCM implementation. In the end, this is the impact that companies are most interested in. Foster and Swenson used the following scale: 5 (significant dollar improvement), 4 (extensive dollar improvement), 3 (moderate dollar improvement), 2 (some dollar improvement), and 1 (no dollar improvement). The two researchers found that the implementation areas

that were most affected by ABCM, economically, were (the numbers in parenthesis being the average scores): product and service profitability (2.54), manufacturing and production (2.50), overhead support



**Figure A.6: Frequency with which management groups use ABCM data for decision making [Foster et. al., 1997].**



**Figure A.7: Decision actions most taken as a result of ABCM implementation [Foster et. al., 1997].**

(2.44), sales and marketing (2.17), product and service design (2.09), customer satisfaction (2.03), and distribution (1.93).

Lastly, Foster and Swenson asked different management groups to evaluate their perceived success of the ABCM implementation projects. Here too, without generating a graph, ABCM champions were at the top of the list, giving ABCM implementations a score of 3.54. Senior managers (3.31), operational managers (3.11), supervisors and team leaders (3.06), department managers (3.05), and line personnel (2.76) followed the ABCM champions. The scale used was: 5 (extremely successful), 4 (very successful), 3 (moderately successful), 2 (unproven), and 1 (complete failure). It is useful to note that in the surveys, senior managers were rating ABCM implementations more highly successful than operation managers, thus suggesting very different grading criteria. ABCM champions at the top of the list are no surprise, since the majority of the ABCM implementation projects come under their direct responsibility. From the responses received, it seems that ABCM champions did a very good job of selling the positive points of ABCM implementation to senior management, somewhat overlooking the needs of operations managers, the management group that in the end makes use of ABCM data more frequently [Foster et. al., 1997, p. 120].

The above researches highlight one of the problems with ABCM, being a concrete means of impact measurement. As with any other strategy actions introduced into a company, the impacts and benefits are hard to quantify, and experiences can vary strongly between different sites of similar companies. As was stated by Foster and Swenson, “measuring the success of ABCM is part of a more general challenge of measuring the success of any major change in managerial methods (be it accounting, quality, customer-focus, and so on). Many business writers promote new managerial methods based on anecdotes or less-than-systematic evidence as to their deliverable benefits. Subsequently, research o ABCM or other management proposals could be enriched by having a developing body of literature that discusses alternative success measures, alternative means of estimating them, and issues in evaluating their reliability” [Foster et. al., 1997, p. 136].

## **A.7. The Aerospace and Defense Industry Sector**

It is no news that the aerospace and defense sector is the industrial sector having the most problems with the adoption of ABCM practices. The aerospace and defense sector stands to operate in a

very unique environment where its sole customer creates both the domestic and, to a certain degree, the industry's foreign market. Presently, ABCM is not being widely adopted partly because there is no clear policy on how to use ABCM information on government contracts. The following quote summarizes the views of some of the most experienced ABCM practitioners today, S. Players and D.E. Keys, on this deficiency within the aerospace and defense sector:

**“Look at the defense industry. Lack of top management support has crippled its ability to implement ABM. While many defense companies have had successful pilots showing the benefits of changing business practices, very few result in permanent ABM systems. Why? Top management already owns a different view of the business, a view that is focused on viewing costs as required by the CASB and other government procurement regulations. More than one ABM project had stopped at the end of the pilot phase because of fear of creating cost and pricing data subject to government disclosure. Top management teams sometimes believe that the government would require cost reductions on contracts for which ABC costs turn out to be less than the cost using traditional methods and, conversely, would not allow increases on those contracts for which the ABC cost proves to be higher.**

**While the DCAA has encouraged ABC implementations and promised understanding and support, defense contractors are wary. Many have shifted their focus away from ABC for product costing (and its inherent DCAA risks) to activity analysis. In this shift, the goal is to reduce overall overhead costs. These cost reductions appear to be much more appealing to top management.” [Player et. al., 1999, p. 7]**

Even though the adoption of ABCM practices represents a small front upon which the government agencies and members of the aerospace and defense sector play out their relationship, it is a way to illustrate how unique the relationship between these two entities actually is. Not only does the government control every phase of production during a new development project, but also, contractors have to adhere to a very strict set of rules that determine standards that govern everything from documentation to archiving, including accounting standards. There is the appearance that on any contract issued the DoD, DCAA, and other government agencies are more interested in capping the profits that the contractor, ensuring that the government is not overpaying for goods and services received, through stringent control of every aspect of the development process, as opposed to allowing the contractors to develop the product freely and initiating cost reduction initiatives that will ultimately benefit the purchaser of the product, a system that has worked wonders for the non-defense related industries and their consumers. Partly to be blamed is the current status of defense acquisition, which through a cost plus system of developing new products does not offer defense contractors plausible incentives to reduce their development costs. As a result, within the industry, overhead costs have

ballooned to unprecedented levels (i.e.: in many cases, overhead is still being allocated based on labor hours in areas where the level of automation is so high that operators essentially only push a button to get the machines running, and then move on to other tasks), while there is evidence that true ownership costs are impossible to extract from the companies current accounting data.

Unfortunately, this situation has spilled into more macro-economic factors governing the aerospace and defense sector as a whole. To illustrate this point, **Figure A.8** displays the total returns of both the Dow Jones Industrials Average and the Dow Jones Industrials Average Aerospace Index for the



**Figure A.8: Total return comparison between the Dow Jones Industrials Average and the Dow Jones Industrials Average Aerospace Index over the last a 5 years [Bigcharts.com].**

last 5 years. The Dow Jones Industrials Average is a price-weighted average of 30 actively traded blue chip stocks (common stocks of USA nationally known companies that have a long record of profit growth and dividend payments, and that have a reputation for quality management, products, and services), which are primarily industrials. Similarly, the Dow Jones Industrials Average Aerospace Index represents a broad based collection of stocks representative of the aerospace and defense sector. While the Dow Jones Industrials Average has returned over 140% to investors over the last 5 years, investors in the

aerospace and defense sector as a whole received only 40%, meaning that Dow Jones Industrials Average investors received, as is shown in the bottom portion of **Figure A.8**, received an extra 102.2% ROI. It is alarming to note that until a few months ago, the return on the Dow Jones Industrials Average Aerospace Index was -10%. Therefore, macro-economically, contractors are fighting a battle on two fronts: the first with their major customer, and the second with the market, or their major source of financing. This whole situation has been exacerbated by the governments push towards a consolidation of the industry, which in recent years has seen a number of mergers and acquisitions transactions that have reshaped the aerospace and defense sector landscape as a whole, where shareholder value has been destroyed, through plunging stock prices, as opposed to being created (see **Figure A.8**).

Going back to the topic of ABCM, fortunately enough, there is recognition that enabling the its adoption is a one of a series of steps that can help aerospace and defense sector contractors retain competitiveness, while at the same time continue to operate in the difficult environment of a shrinking defense budget. This recognition came as far back as September 1993 through a report developed by the DSB on Defense Manufacturing Enterprise Strategy for the Office of the Undersecretary of Defense for Acquisition [Defense Science Board Task Force, 1993, pp. v-32]. In the report, the DSB Task Force highlights a series of critical initiatives that it deems paramount in ensuring that both the DoD and its contractors can continue to operate effectively. “The need for process improvement is urgent because the DoD acquisition community is facing a real crisis, resulting from a severely reduced procurement budget and the existence of high fixed overhead, administrative, and support costs. This crisis, which can only result in reduced readiness, can be tampered if the DoD adopts the enterprise process approach” [Defense Science Board Task Force, 1993, preface memorandum]. The DSB Task Force identified four desired goals: reduce overhead, rational downsizing, maintain public trust and confidence, and impact ongoing programs. One of the ways that the DSB Task Force envisioned the attainment of those goals is through the adoption of ABC:

**“...The DoD should implement ABC to identify the non-value-added costs associated with contractor compliance with government procurement requirements, the significant contribution to overhead costs associated with the tracking of Government Furnished Equipment, and the cost of capacity of the defense industrial base. ABC is a tool used extensively in the private sector for answering specific questions about product costs, for measuring cost reductions resulting from process improvements, and for understanding the profitability and costs of product lines. The information obtained can then be used to develop**

**strategies to reduce those identified costs. In conjunction with reducing overhead costs, PROCAS is a process that promises reduced overhead costs to both industry and government while increasing manufacturing productivity and product yield.”** [Defense Science Board Task Force, 1993, p. 28]

While the DSB Task Force recognizes ABC as a high payoff initiative that can be used to identify and quantify overhead costs, it goes as far as recognizing the following barriers to implementation [Defense Science Board Task Force, 1993, presentation p. 5]:

- “Weapons’ requirements are almost totally performance driven, thus, there is little incentive to strive for cost/performance trade-offs, or for cost reducing design changes.”
- “Defense contracting is unduly based on justifying and auditing costs, rather than striving to reduce costs.”
- “DoD developments now take over 16 years (from concept through first production) and result in increasingly expensive weapon systems.”
- “The thrust to improve has been overshadowed by a risk averse approach driven by an excessive focus on fraud and abuse. This focus permeates the entire enterprise and adds significantly to cost while detracting from efficiency and effectiveness objectives.”

Even though the DSB Task Force mostly concentrated upon the relationship between DoD, government and the defense industrial base, the report accurately identifies the need for widespread adoption of many best business practices already proliferating throughout the private sector, amongst which is ABCM.

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