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# Cost Management Accounting and Six Sigma

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## Abstract

Recently the concepts of productivity tools and related accounting and scorekeeping were brought to my attention as a result of conversations I had with a new client. This client is a consultant who specializes in these areas. I found the conversation intriguing. The more we discussed lean programs and Six Sigma organizational structures, the more my desire to learn these principles increased. I wanted to learn what I currently did not understand.

My first impression of lean programs, Six Sigma organization structures, and other related topics was that these apply to manufacturing industries only. As these principles were initially developed from this industry, the application can and should be made to the service industries along with other industry segments. Upon discovery of this, my desire to understand the principles of cost management accounting reached beyond pure attainment of knowledge. What if I could apply these principles to my clients that are outside of manufacturing? What if I could apply these principles to my accounting practice? The application possibilities now seemed endless.

Out of curiosity I asked one of my manufacturing clients if he had ever heard of lean, Six Sigma, or even the theory of constraints. To my surprise he had not. Please understand that this manufacturing client is of medium size and very sophisticated with robotics. They machine replacement parts for mechanical devices that are predominantly used in the oilfield and agriculture industries.

The purpose of this paper is to gain an understanding through research of Six Sigma along with a basic understanding of other related topics.

# Cost Management Accounting and Six Sigma

"Cost management techniques and accounting principles used in the 1950s and 1960s have not changed dramatically in their ability to help in managing the development and innovation in productivity and business philosophy." (Northrup, 2004, p. 2) The accounting we use today is very similar to that which we used over the last 50 years, but management philosophies over the last two decades or so have changed. If we look at production since 1950 we will find that it continually declined until about 1975. After 1975, US manufacturing companies developed innovations and started to implement change. Since 1975 these companies have learned new ways to manufacture products and have seen a steady increase in productivity. Unfortunately the way we account for and measure these activities has not changed much, and this, in part, is where the problem rests.

"The 1950s and 1960s were a total cost world." (Northrup, 2004, p. 2) Production as a cost driver, and efficiency and full utilization, were main focal points, not the quality or value of a product. Managers focused on the numbers that were reflected with traditional cost accounting methods.

"Cost management tools of the 1960s and 1970s were characterized by standard cost systems and variance analysis from standard and budget." (Northrup, 2004, p. 3) Process costs were used for allocations of overhead to determine profit by product and by customer. Forecasts and budgets were used for allocation of overhead to product cost, based on direct labor hours as the allocation basis. Costs were measured by cost centers, with the focus on whether the plant facility was being fully utilized.

The 1970s brought changes. The Japanese utilized the teachings of W. Edwards Deming from Philadelphia to retool their processes. "Deming was a statistician who started working with the Japanese in 1951 to rebuild Japan after World War II. He taught the Japanese to build and export quality, in the form of product for exporting, in turn for receiving food." (Northrup, 2004, pp. 4-5) As a result of the 1970s, Japan focused on improving manufacturing processes and developed total quality control and the concepts symbolized by the Toyota Production System that elevated Japan to industrial prominence.

> During this period of innovation, we started to see total quality control, just in time (JIT), and kanban being utilized. Total preventive maintenance, supplier partnerships, and quality function development started showing up in some of the more progressive companies. The Japanese showed us the effectiveness of employee involvement, cross-careering, and visual management. Target costing became an effective competitive weapon, which was another innovation learned from the Japanese. (Northrup, 2004, p. 4)

It was not until 1980 that the United States industrial leaders learned Mr. Deming's principles and philosophies. From Mr. Deming's book "Out of the Crisis" seven deadly diseases are:

- Lack of constancy of purpose
- Emphasis on short-term profits
- Evaluation of performance, merit rating, or annual review (Dr. Deming suggested that "management by fear" is a better name)

- Mobility of top management
- Running a company on visible figures alone (“counting the money”)
- Excessive medical costs – healthcare
- Excessive costs of warranty, fueled by lawyers who work on contingency fees

(Northrup, 2004, pp. 5-6)

Mr. Deming focuses on fourteen points for proper management:

- Constancy of purpose
- Adopt the philosophy
- Don’t rely on mass inspection
- Don’t award business on price
- Constant improvement
- Training
- Leadership
- Drive out fear
- Break down barriers
- Eliminate slogans and exhortations (warnings)
- Eliminate quotas
- Pride of workmanship
- Education and retraining
- Plan of action

(Northrup, 2004, p. 6)

As a result of Mr. Deming’s work, the 1980s brought a series of innovations for manufacturing and assembly. Some of the key principles developed by companies are:

- Benchmarking
- Cost of quality
- Point-of-sale technology
- Electronic data interchange
- Quick-response linkages to retailers
- Reengineering
- Digital design
- Rapid prototyping
- Cross-docking
- Activity-based costing and activity-based management
- Irrelevance of historically based cost management and the use of only generally accepted accounting principles to help manage and operate business
- Total quality management

Summarized from (Northrup, 2004, p. 6)

Two leaders in the late 1980s and early 1990s were Joseph M. Juran and Philip Crosby. They believed that "emphasis on quality was a necessity for doing business in a competitive world market. This led to the establishment of the Malcolm Baldrige National Quality Award in 1987. The award recognizes organizations in the United States for their achievements in quality and performance excellences." (Northrup, 2004, p. 7)

"The Juran Trilogy included:

- Quality planning
- Quality control

· Quality improvement”

(Northrup, 2004, p. 7)

Philip Crosby developed his “14 Quality Steps” which are a major part of quality management. These steps are:

· Management commitment
· Quality improvement teams
· Quality measurement
· Cost of quality evaluation
· Quality awareness
· Corrective action
· Zero defects committee
· Supervisor training
· Zero defects day
· Goal setting
· Error cause removal
· Recognition
· Quality councils
· Do it over again

(Northrup, 2004, p. 7)

During the 1980s and the 1990s one of the largest hurdles management had to overcome was the shortcomings of traditional cost accounting methods that were developed in the 1960s. These methods and systems were based on traditional GAAP.

Two methods that were developed to overcome this were activity-based costing and the balanced scorecard.

One of the most important examples of productivity and quality control was Toyota in the 1980s. Japan had opened its door to outside consultants. The Toyota Company had taken the information from the consultants and gone to a higher level. With the implementation of lean, kanban, takt time, Just in Time, and other methods, the most important thing Toyota was able to achieve was communication at all levels within the company. The use of visual displays depicting the current operation of the manufacturing plant, coupled with one-piece flow, was also of extreme value.

Today management is looking for other methods that will help with the problem of using GAAP based methods to measure production issues. Though GAAP is helpful for producing traditional financial statements, it does not by itself help management make the most effective use of company resources. Some of the new methods are customer relationship management, and business intelligence systems used in conjunction with enterprise resource planning.

The future will require a cost management accounting process that is capable of creating short-term profitability in addition to the creation and building of long-term success and creating value for the customers and the company. For all the tools available to work with, we need to provide time for proper education and training throughout the organization so that they may integrate.

Now that we have a brief history and understanding of accounting and the evolution of cost management accounting, let us proceed to discuss and research Six Sigma.

What is Six Sigma? If Six Sigma is so great, where has it been hiding all these years? Like most great inventions, Six Sigma is not all new. It combines some of the best techniques of the past with recent breakthroughs in management thinking and plain old common sense. For example, balanced scorecards are a relatively recent addition to management practices, while many of the statistical measurement tools used in Six Sigma have been around since the 1940s and earlier. Organizations are now realizing how important Six Sigma is.

> In the past decade most United States universities implemented the Total Quality Management (TQM) and Continuous Improvement (CI) approach to quality assurance instead of addressing the key issues of quality, productivity, cost and profitability, using Six Sigma approach and has been continuously losing productivity and expecting government subsidies for its survival. It is imperative that they take a good look at Six Sigma approach and incorporate it into their strategic planning process. (Bandyopadhyay, 2007, p. 806)
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> Scholars and practitioners have expressed varying views on the relationship between total quality management (TQM) and Six Sigma. Pande et al. (2000) concluded that Six Sigma can overcome many of the pitfalls encountered in the implementation of TQM and that Six Sigma's expansion thus heralds a 'rebirth' of the quality movement. (Yang, 2007, p. 654)

The term Six Sigma is a reference to a particular goal of reducing defects to near zero. Sigma is the Greek letter statisticians use to represent the state deviation of a

population. The Sigma or standard deviation tells you how much variability there is within a group of items or of the population. The more variation there is, the bigger the standard deviation. In statistical terms, the purpose of Six Sigma is to reduce variation to achieve very small standard deviations so that almost all of your products or services meet or exceed customer expectations.

Achieving Six Sigma means your processes are delivering only 3.4 defects per million opportunities - in other words, there are very few defects. Six Sigma is a philosophy involving a goal that everything should be as perfect as practically possible. Six Sigma is a methodology. Six Sigma is a symbol of quality. In Six Sigma, variation is the enemy.

Six Sigma methodology uses statistical tools to identify the final few factors, the factors that matter most for improving the quality of processes and generating bottom-line results. Six Sigma consists of five phases. Define the projects, the goals and the deliverables to customers. Measure the current performance of the process. Analyze and determine the root causes of the defects. Improve the process to eliminate defects. Control the performance of the process. This process of analysis is called DMAIC (define, measure, analyze, improve, control).

Six Sigma is the most effective problem-solving methodology available for improving business and organizational performance. "Companies have shown that they can attain dramatic results by applying Six Sigma methods toward the improvement of process quality. This is because the Six Sigma method requires that practitioners measure and analyze their processes." (Weinstein, 2008, p. 234) "Six Sigma has provided a framework for using data to evaluate producibility." (Rumpf,

2007, p. 173) A Six Sigma improvement occurs when the key outcomes of a business or work process are improved dramatically, often by 70% or more.

> A Six Sigma organization uses Six Sigma methods and tools to improve performance.
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> The Six Sigma approach to managing is all about identifying what is known and not known about the various processes that a company relies upon to conduct its business, and then taking action in the form of problem solving teams working on projects in targeted areas, to reduce the errors and rework within these processes — errors that cost time, money, opportunities, and customers. (Hsieh, 2007, p. 1)

"The six sigma approach has been increasingly adopted worldwide in the manufacturing sector in order to enhance the productivity and quality performance and to make the process robust to quality variations." (Anand, 2007, p. 2365) Outcomes of Six Sigma are lower costs, revenue growth, improved customer satisfaction, increased capacity and capability, reduced complexity, lower cycle time, and minimal defects and errors.

Every mistake an organization or person makes ultimately has a cost. It can be a lost customer, the need to do a certain task over again, a part that has to be replaced, time or material wasted, efficiency loss, or productivity squandered. In fact, waste and mistakes cost many organizations as much as 20 to 30% of the revenue. That's a shocking number. Imagine throwing 20 to 30% of your money away in the garbage every time you cash a check. It seems ludicrous, but that's what many organizations do. "Today, organisations that don't take quality seriously simply won't survive." (Herbert, 2008, p. 52)

All businesses, organizations, and individuals have room to improve. No operation is run so tightly that another ounce of inefficiency and waste cannot be squeezed out. By their nature, organizations tend to become messy as they grow. Procedures, technology, systems, and processes -- the way of doing business becomes a culture with bottlenecks, meaning work piles up in one part of the organization while other parts sit idle with nothing to do. Six Sigma also applies to service based businesses. "Six Sigma has inspired the approach to quality management in many industries including health care since it began in the manufacturing sector at Motorola." (Martin, 2007, p. 24)

One of the first steps that an organization will take toward the implementation of Six Sigma is choosing a Six Sigma team. In developing any Six Sigma team, there are seven basic functions and roles that must be developed. These functions and roles are leadership group or counsel, project sponsors and champions, implementation leader, Six Sigma coach master black belt, team leader or project leader black belt, team members, and process owner. It is very important that all team members, along with management, owners, and employees, understand the importance of Six Sigma. Any organization or corporation is only as strong as its weakest link.

> Tangible commitment and support from senior company executives remains the number one factor for a successful Six Sigma deployment, and in particular successful project execution. Such commitment and support sends a clear message throughout the organisation, acting as the sharp point of the arrow and allowing Black Belts the freedom to focus on completing projects (rather than having to manage through the minefield of company politics). However, executive commitment and engagement

> cannot be taken for granted. A portion of executive compensation should therefore be linked to reaching corporate Six Sigma goals and objectives, including the ROI and audited benefits of the program – "you get what you measure…" (Van Dyk, 2008, p. 2)
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> The relationships demonstrated between quality culture development and organisational factors such as management commitment, creating awareness of quality, training, employee participation and performance evaluation, provides managers with some understanding of the processes that are likely to drive quality-oriented behaviour within organisations. Cultural change efforts can hence be designed to have maximum effect. It seems that the Six Sigma management programme does embody many of these factors; hence the hypothesis that a Six Sigma management programme can play a part in the development of a quality culture is supported. (Davison, 2007, p. 260)

The next step an organization needs to take in the implementation of Six Sigma is to set business metrics. If you don't have measurements, you can't make progress because you don't know where you are. Simply put, everyone needs a scorecard. In business, the most important scorecard is profit. Business benchmarks provide a way to objectively quantify a process. Any benchmark that helps management understand its operations might be a business measurement tool; number of products completed per job run, percent of defects from a process, hours required to deliver a certain number of outputs or provide a service, and so on. Business benchmarking provides data that Six Sigma

managers can use to better understand their processes and identify target areas for improvement.

When setting business benchmarks, standard deviation becomes an integral part. Standard deviation is the average difference between any value in a series of values and the mean of all the values in that series. This statistic is a measure of the variation in a distribution of values. Along with standard deviation, the Bell curve, charts, and graphs become very valuable. Once we have our data we can start plotting the data on a control chart. If we plot enough values on a control chart we will likely find that the distribution of values forms some variant of a bell shaped curve. This curve can assume various shapes. However, in a normal curve, statisticians have determined that about 68.2% of values will be within one standard deviation of the mean, about 95.5% will be within two standard deviations, and 99.7% will be within three standard deviations. Our goal is to reduce the variation in the process. The first thing we need to do is determine how much variation is acceptable; then, with those values, we can set our lower specification limit and our upper specification limit. These are the upper and lower boundaries within which the system or process must operate.

How does all of this discussion of variation and standard deviation and curve rates relate to Six Sigma? The goal of Six Sigma is to reduce the standard deviation of the process variation to the point that six standard deviations or Six Sigma can fit within specification limits. Six Sigma will take into consideration process capabilities. "Process capability refers to the ability of a process to produce a defect-free product or service in a controlled manner of production or service environment. Various indicators are used-some address overall performance, some address potential performance." (Shashidahar,

2003, p. 1) "The *capability index* (Cp) of a process is usually expressed as *process width* (the difference between USL and LSL) divided by six times the standard deviation (six sigma) of the process… The higher your Cp, the less variation in your process." (Brue, 2002, p. 42)

> There's a second process capability index, Cpk. In essence, this splits the process capability of Cp into two values… In addition to the lower and upper specification limits, there's another pair of limits that should be plotted for any process - the *lower control limit* (LCL) and the *upper control limit* (UCL). These values mark the minimum and maximum inherent limits of the process, based on data collected from the process. If the control limits are within the specification limits or align with them, then this process is considered to be *capable* of meeting the specifications. If either or both of the control limits are outside the specification limits, then the process is considered *incapable* of meeting the specifications. (Brue, 2002, p. 43)

Please keep in mind this brief discussion of Cp and Cpk is in the most simplistic form. In addition, other important tools have not been discussed.

Measurement is crucial to the success of your Six Sigma initiative. It makes a lasting difference between business as usual and dramatic improvement in productivity and profitability. Metrics apply statistical tools to evaluate and quantify the performance of any process. Metrics show you the true cost of poor quality and indicate the direct relationship between quality and cost. When you increase the former you can reduce the

latter resulting in even greater customer satisfaction. Metrics must be clear and simple and must yield information quickly, so you can improve your processes continuously.

When implementing Six Sigma, keep your objectives clear. Stay on track. Focus on results. It is a good idea to make sure that all executives readily communicate why, when, and how the undertaking of the Six Sigma project is going to be done. It is also a good idea to take a survey from the individuals involved in a Six Sigma project to find out actually how much they know about Six Sigma tools and to gauge the extent and depth of training that will be needed before you get started. Plan your Six Sigma initiative well. There are many steps to organize and many individuals to prepare and coordinate, to ensure the best possible outcomes. In some situations, choosing an outside consultant with the demonstrated qualifications is important to ensure that the Six Sigma initiative will be implemented and monitored.

When setting the roles and responsibilities of individuals, please keep in mind that your primary resources are your people, particularly the ones who will play the key roles in your Six Sigma project. Understanding and defining key operational roles from the start is very important. All the key players should know their responsibilities and roles and how all the roles will work together. Involve executive managers in leading the Six Sigma initiatives and in promoting it throughout the organization. Their leadership is critical to success. Owners must buy into the process in question and be dedicated to doing whatever it takes to make it easier for the leaders, such as master black belts, to achieve results. Use the expertise and experience of leaders such as master black belts whenever and wherever you can. Outside skilled practitioners can be extraordinarily

valuable and are important in helping you get your initiative under way. Please keep in mind that training can develop the essential qualities, but it cannot create them.

> There is usually a time lag between adoption of a strategy and its effect on financial results. We admit that there can be a great amount of discomfort for management immediately after adopting any costly strategic initiative. Often, these initiatives do not show immediate financial gains, and it is during these trying times that many potentially successful initiatives are abandoned. It is, therefore, important for the organization to change its culture to focus more on long-term financial performance and less on short-term results. (DeBusk, 2008, p. 15)

Variation is the enemy in any process. Variation can be broken down into two categories, expected and unexpected. Expected variation should be monitored and reduced, whereas unexpected variation should be eliminated. Six Sigma is the best methodology to use to promote the effective and efficient use of company resources.

"Through wisdom a house is built, And by understanding it is established; By knowledge the rooms are filled With all precious and pleasant riches." (Proverbs 24: 3-4)

The information in this paper is a brief discussion of Six Sigma and some of the tools that are available from it. Hopefully, by reading this paper you have gained a basic understanding of cost management accounting and Six Sigma.

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