# Managerial accounting and continuous improvement initiatives: a retrospective and framework.

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The role of management accountants has evolved from measuring and reporting business activities to participating with other disciplines in designing and implementing improvement initiatives. Recent years have witnessed an explosion of programs designed to increase product quality, reduce costs, and improve firm performance. Examples include Just-in-Time (JIT), Total Quality Management (TQM), Target Costing, Benchmarking, Process Re-engineering, Theory of Constraints (TOC), Activity-based Costing/Management (ABC/ M), Balanced Scorecard (BSC), Six Sigma, and Mass Customization. Some researchers have argued there is no universally appropriate management system. Yet the market continues to develop new initiatives, promising if the new system is implemented or specific tools are adopted, improved firm performance will result.

This article builds a framework for understanding differences and similarities among various initiatives and identifies the historical and economic environment that contributed to their development. We consider the evolution of management initiatives in response to changes in the global competitive environment. Finally, we illustrate a framework useful for understanding the relationships among various improvement initiatives.

With the explosion of new continuous improvement initiatives in the last three decades, the role of the accountant has evolved from measuring and reporting business activities to working on teams with management science, marketing, finance, and other professionals to implement modern management initiatives. Some of the more familiar initiatives include Just-in-Time (JIT), Total Quality Management (TQM), Statistical Process Control, Target Costing, Benchmarking, Process Re-engineering, Theory of Constraints (TOC), Activity-based Costing/Management (ABC/M), Balanced Scorecard (BSC), Six Sigma, and Mass Customization. Are these tools different from traditional methods used to understand and improve processes? Are they mutually exclusive? What are their common elements? We address these questions by examining the historical context that fostered the development of modern improvement initiatives.

Our purpose is to consider the broader issues and relationships among the initiatives for the purpose of gaining an understanding of problems central to success in the new competitive environment. The first section of our article examines the historical and environmental context in which modern improvement initiatives were developed and provides an overview of each initiative. We emphasize key objectives as well as provide insights into why each initiative should improve some aspect of performance. Next, we develop a classification framework that illustrates how each technique relates to other management initiatives. We then present our conclusions and lessons learned.

HISTORICAL BACKGROUND AND OVERVIEW OF CONTINUOUS IMPROVEMENT INITIATIVES

To understand how the various modern management initiatives relate to each other, we must understand the historical context that fostered their development. For example, the advent of modern manufacturing, known as the second industrial revolution, began in the early 1900s. Major developments in this period include assembly lines and the Ford concept of mass production (e.g., Black, 1991). By the 1940s, these concepts were fully developed. However, World War II devastated much of the industrial capability of Europe and Japan. After the conflict ended, Japan and Europe rebuilt their industrial infrastructure while experimenting with new approaches to production and asset management. Two important developments that emerged from post-war Japan were JIT and Kanban, coupled with an emphasis on quality. These techniques were central to the Toyota production system that set the global standard for production efficiency.

JIT, Kanban, and TQM

Following the Second World War, Japanese companies had limited access to capital. Thus, manufacturers could not afford to produce and carry large amounts of inventory nor could they afford to purchase large numbers of new machines. As a result, companies produced for demand, rather than for inventory. To fill customer orders in a timely fashion, companies devised ways to drastically reduce manufacturing lead times and machine setup times. In doing so, they also reduced inventory carrying costs. Small batch production resulted in lower investments in work-in-process and finished goods inventories.

Japanese manufacturers understood that another effective way to reduce costs was to increase quality by doing things right the first time. With limited production equipment and capital to invest in new equipment, manufacturers could not afford the luxury of time-consuming re-work or inefficient machine setups. Japanese manufacturers were able to reduce dramatically the number of products requiring re-work. Reduced set-up times permitted smaller batch sizes, and thus manufacturers were able to identify manufacturing problems before large quantities of defective units were produced.

Toyota founder, Kiichiro Toyoda (Porter et al., 2000), stressed the flow system known as Kanban and the concept of Just-in-Time. In 1950 Taiichi Ohno, a Toyota executive, improved the system to what is commonly referred to as "Lean Production" or the Toyota production system. The lean production system attacks waste by eliminating all activities that consume resources but do not create value (Womack and Jones, 1996). The central concepts of lean thinking are:

* concentrate on activities that create value and improve the production flow,

* pull products through the system (with Kanban cards) based on customer demand (produce Just-in-Time), and

* continuous process improvement (Kaizen).

By 1973, most Japanese manufacturers had adopted the lean Toyota production system. The basis of lean thinking was founded on the ideas of Deming and Taiichi Ohno and is built around managing product flow using Kanban. Kanban is a signal card (Womack and Jones, 1996) that identifies the product and quantity to be manufactured. When a task is finished, the product goes to the next work-station and the operator waits for the next Kanban to arrive. Hence, machines and operators are active only when they have a Kanban signal card. Because materials are only released to the shop floor when indicated by a Kanban card, this method effectively reduces work-in-process inventory and associated costs. Efficient use of capital and operating assets is an important aspect of lean manufacturing. The system is known as lean because it accomplishes more with less. Hence, the system is consistent with the economic environment in which it was developed.

The Daimler-Chrysler production facility in Vance, Alabama, provides an example of lean manufacturing in the production of the company's sports utility vehicle, the Mercedes-Benz M-class. Management designed the manufacturing facility consistent with the JIT philosophy, so there is little warehouse space at the site. Instead, Mercedes relies on "in-sequence delivery," a system whereby pre-constructed modules arrive in a prescribed sequence so the modules are ready to be placed on the manufacturing line. For example, from the moment a new vehicle production order is initiated, manufacturers of the cockpit module have 169 minutes to manufacture and deliver it to the proper place in the manufacturing line at the Mercedes facility. Mercedes and its suppliers stay in constant contact through electronic data interchange facilities that transmit order specifications and other information between the plant and suppliers. As a result of its JIT system, Mercedes saves significant inventory carrying costs in the form of financing, insuring, and storing inventory (Albright and Davis, 2000).

Another important aspect of the Japanese system is "Kaizen" or continuous improvement. The primary driver for continuous improvement is waste reduction (Tersine, 2004). But, before processes can be improved, they must be understood. Edwards Deming was an American statistician who pioneered the use of statistical techniques to understand and improve processes. When Deming was unable to convince American managers of the power of Statistical Process Control (SPC), he took his message to Japan. Japanese managers, intent on driving out waste and improving efficiency, embraced SPC techniques. They reduced costs through process improvements. At the same time, through reducing defects, re-work, the number of parts, and delays, they also improved product quality (Porter et al., 2000).

Concepts such as Just-in-Time and others discussed in this article have many elements in common with Total Quality Management (TQM). (1) The point of difference is that TQM is a holistic approach that covers all aspects of an organization's activities (Rogerson, 2002; Goleman, 2002). The quality of a product or service is dependent on all activities in the organization's supply chain. With TQM, the goal at each stage in the operational supply chain is to define and meet customer requirements in order to maximize customer satisfaction while maintaining rigorous cost control. Statistical Process Control is one such technique that permits managers to improve the effectiveness of operations, by reducing defective units, without incurring the cost of individual inspections.

Statistical Process Control (SPC)

While volumes have been written on SPC techniques, Deming's (2) primary message was how to improve management through quantitative measures. Deming claimed that management emphasizes short-term thinking and quarterly profits rather than long-term strategy. In addition, he believed management was inadequately trained, did not possess an in-depth knowledge of the company, and was looking for quick results (Deming, 1986). His statistical techniques helped management understand the differences between common-cause and special-cause variation.

The purpose of the SPC chart is to identify' and eliminate variation caused by identifiable events (special causes that are unusual enough to exceed three standard deviations above or below the process average). Common-cause variation is illustrated by a random scatter of observations around the process average, but within three standard deviations of the process average. Statistical Process Control charts help management improve processes, thereby reducing common-cause variation as well as sources of special-causes variation.

Statistical techniques were used to comply with military purchasing standards (known as MIL-STD) adopted by the US military during World War II to help ensure the quality of massive amounts of purchased goods. These standards were developed using sampling tables designed by the Bell System (Juran, 1995). Military standards played a significant role improving manufacturing in the United States because contractors had to meet a certain quality standard to earn military contracts.

While Deming's methods may appear operational in nature, he was a strong proponent of using quality as a competitive strategic tool. Japanese companies began partnering with suppliers to improve quality and reduce production costs further. Efficient use of the supply chain enabled companies to pro-actively manage costs during product conceptualization and design phases through a process known as Target Costing that was first developed in the 1960s.

Target Costing and Related Techniques

Japanese companies, having close relationships with suppliers, clients, and financial institutions, use the supply chain for product development and cost control (Cooper, 1995). Because of their emphasis on the supply chain, target costing was a natural fit for Japanese companies. Target costing first identifies the price customers are willing to pay for products of a specified quality and function. After deducting the required profit margin from the target selling price, the target (or allowable) cost is derived. By including engineers, suppliers, and financial specialists in the planning process, a company looks for ways to remove inefficiency to achieve target cost. Once achieved, managers continue to identify ways to make improvements in quality or to reduce costs. The philosophy of continuous improvement permeates all modern improvement initiatives discussed in this article and seems to be a common element that has defined modern manufacturing practices. During the 1950s through the 1970s, Japanese companies became significant global competitors using JIT, Kanban, Target Costing, Kaizen, and SPC.

Target Costing differs from the traditional methods (conventional and cost-plus) for determining selling price, cost, and profit. The conventional method of managing these three variables assumes the selling price is given. Thus, competitive markets largely determine selling prices, while production costs are measured after the production processes are complete. As a result, profit is the residual; selling prices and costs are not pro-actively managed. The cost-plus method assumes cost is a given. Next, a required profit margin (also a given) is added to the cost to determine the price at which the company will offer the product. Thus, the targeted selling price is the cost, plus a profit margin (or markup). However, markets will accept or reject the selling price. Product cost is not pro-actively managed using the conventional or cost-plus methods. Target Costing is a radical departure from traditional conventional and cost-plus methods because target costing assumes the market ultimately determines the selling price. In addition, profits must be sustained in the long run in order for the company to survive.

Daimler-Benz used target costing during the early 1990s when developing its new sports utility vehicle. The target selling price for the vehicle was determined after extensive market interviews and analysis. Next, the company's required return per vehicle was subtracted from the target selling price to determine the target cost. As part of the target costing process, the company used a technique known as Benchmarking. Benchmarking is a process used to target key areas for improvement. Activities and work processes are compared with those of outstanding organizations in order to identify ways to improve performance. Desired results include increased productivity, competitiveness, and quality, as well as reduced production costs. Xerox Corporation is credited for developing Benchmarking in the late 1970s in order to learn from the achievements of Japanese competitors (Camp, 1989). Benchmarking has a number of similarities to Process Re-engineering, which was popularized by Michael Hammer during the 1990s. Process Re-engineering requires a review and analysis of the processes currently used by the organization. Like Benchmarking, Process Re-engineering seeks to identify critical points where organizations can make significant improvements in quality (Goleman, 2002).

As part of the competitive benchmarking process associated with the M-class, Daimler-Benz bought and tore down competitors' vehicles to help understand their costs and manufacturing processes (Albright, 2000). The company assembled teams consisting of suppliers, design engineers, production engineers, accountants, and marketing professionals to design the vehicle prototype and production processes. Each team was responsible for a portion of the vehicle, known as a function group. Function groups included doors, sidewall and roof, electrical system, bumpers, power-train, seats, heating system, cockpit, and front end. Next, cost targets were established for each function group to ensure the sum of the parts would not exceed the vehicle's target cost. Suppliers were made a part of the design team early in the process to help meet cost targets for purchased components. Choices made during the design and development phase were largely irreversible during the production phase because approximately 80% of the production cost of the vehicle was for materials and systems provided by suppliers. The M-class project used a streamlined management structure to facilitate efficient and rapid development. Thus, Mercedes produced an entirely new vehicle from concept to production in four years (Albright, 1998).

Developments in Response to Global Economic Pressures

In the 1970s, the world economy suffered two oil crises. The economic downturn was felt most severely by European manufacturers. In the US, however, high inflation and a weak dollar helped shelter US manufacturers from foreign competition. A high level of worldwide demand for US goods placed a premium on producing throughput. As a result, manufacturers were able to pass on higher costs and lower quality to customers.

In the 1980s, the competitive environment changed. The strong dollar and lower level of inflation resulted in a need for revisiting expenditures and cost calculations, and developing management initiatives. US manufacturers experienced increased production costs and intense international competitive pressures (Kaplan, 1984). Two new approaches to cost management--the Theory of Constraints (TOC) and Activity-based Costing/ Management (ABC/M)--were developed in the 1980s to address these competitive pressures.

The Theory of Constraints

The Theory of Constraints (TOC) developed by **Goldratt** and Cox (1986) is a production-flow management system. In every system there is one process, known as the constraint, that has the least capacity (or slowest production rate). Output for the entire system is determined by the production rate of this constraint, or bottleneck. Hence, TOC argues production flow for the entire facility must be planned around the constraint. **Goldratt** calls this flow system the Drum-Buffer-Rope system. The constraint (the drum) indicates when materials need to he released to the shop floor. Theory of Constraints is a pull system much like Toyota's manufacturing system. However, TOC is based on identifying and optimizing the bottleneck. Because the system cannot produce faster than the bottleneck production rate, the constraint should be fully utilized. Thus, other processes are subordinated to the constraint. As a result, the TOC approach to inventory is different from the Kanban system. Unlike Kanban (a system that minimizes inventory throughout the system), TOC places safety stock in front of the constraint to minimize the possibility of unscheduled downtime. Thus, TOC results in higher constraint utilization and greater throughput levels. An additional advantage of safety stock is that unexpected changes in stock levels are a signal of problems in the production process.

Improving a process using TOC requires four steps. The first step involves identifying the system constraints. Generally, bottleneck resources can be identified by observing inventory flow. Because the bottleneck produces more slowly than other resources in a production process, inventory accumulates before a bottleneck. Industrial engineers often use factory simulation software to develop models that can identify bottlenecks. The second step involves deciding how to make the best use of a constraint. For example, high value-added products generally have priority on bottleneck resources because they earn a higher profit margin per hour of the scarce bottleneck resource. Step three involves managing the process to ensure all decisions are made in the context of optimizing production on the constraint. Next, in step four, management improves the performance of the constraint. Performance of the constraint may be improved in a variety of ways. For example, management may add a second shift to permit the constraint to produce more units. Other solutions include minimizing unscheduled maintenance downtime by carefully managing scheduled maintenance to prevent breakdowns. If the bottleneck is improved to the extent that it no longer is a bottleneck, a different constraint will emerge. Step five requires management to return to step one. Thus, step five suggests that process improvement is a continuous effort.

TOC also improves flow and reduces excess work-in-process inventory by releasing materials only for those products that are sold. The advantage of TOC over the Toyota sys tern is that when a non-constraint process is down, the constraint can keep working and rebuild the safety stock. Thus, the non-constraint process that temporarily is down can catch up with the constraint because it has excess capacity.

In addition to materials flow differences, traditional accounting methods differ from those used to account for TOC. For example, the TOC approach to assigning manufacturing costs to products is different from traditional absorption cost accounting. Therefore, fixed manufacturing costs were assigned to products using a predetermined overhead rate. Estimated fixed and variable overhead costs were divided by an estimate of an activity, such as direct labor hours, machine hours, or direct labor dollars. The cost per unit of activity was applied to products as a function of the activity associated with manufacturing a product. Traditionally, an easy way to reduce the cost per unit was to increase the volume of products manufactured. Fixed costs were spread over more units, thereby reducing the cost per unit. Unfortunately, when production exceeds market demand, large stockpiles of inventory are accumulated. Clearly, the traditional accounting approach is inconsistent with lean production methods.

The TOC approach associates with inventory only the money the system invests in purchasing things that it intends to sell. Hence, TOC excludes the added value from direct labor and overhead (**Goldratt** and Fox, 1986). The purpose is to maximize throughput consistent with market demands. Throughput is defined as Sales Revenue minus Direct Materials. The throughput measure is similar to the contribution margin measure (Sales Revenue minus Variable Costs). However, there are significant differences. Because TOC generally assumes a timeframe of weeks while the traditional contribution margin assumes a timeframe of months, TOC considers direct labor as a fixed cost while the contribution margin measure generally assumes that direct labor costs are variable (Swain and Bell, 1999). In both cases, fixed costs are expensed as a capacity cost and are not added to the unit cost. (3) Some have argued that considering only variable costs ignores the long-term costs of manufacturing a diverse product line, because certain products consume more overhead support activities than others. Thus, a better system of identifying resource consumption was necessary to strategically position a company's products and services for the long run.

Activity-based Costing/Management

During the late 1980s Robin Cooper and Robert Kaplan of Harvard Business School were instrumental in developing Activity-based Costing/ Management (Cooper, 1988a, 1988b, 1989a, 1989b, 1990; Kaplan, 1984, 1988; Kaplan and Cooper, 1988). We use the term ABC/M to denote Activity-based Costing/Management. Activity-based Management encompasses ABC and uses it as a major source of information. Activity-based Management can be viewed as an information system that has the broad objectives of improving decision making by providing accurate cost information, and reducing costs by encouraging and supporting continuous improvement efforts. (4) Activity-based Costing differs from traditional overhead assignment methods as a result of using better overhead "cost drivers" or allocation bases. In the early 1900s the majority of manufacturing costs were labor-related. Therefore, labor was used as the basis for assigning overhead to output. When production processes became more complex and labor costs made up a smaller portion of total costs, using labor as a basis for assigning costs resulted in inaccurate allocations and less than optimal production choices.

One of the problems with the traditional, labor-related (or machine-related) allocation bases is that they do not take economies of scale into account. Products manufactured in large production runs are allocated the same cost per unit as those manufactured in small production runs. Unfortunately, some costs do not change as a function of the batch size. For example, if a machine requires a costly setup between two different batches of a product, traditional costing systems would spread the setup cost equally among all units produced, without regard for the batch in which they were produced. Logically, if a setup cost is fixed, setup costs associated with units in the smaller batch should be higher than those produced in the large batch. Thus, activity-based costing typically penalizes small-batch production, relative to conventional, volume-based systems.

In addition, Activity-based Costing systems typically allocate more costs to complex products, than to less complex products. Activity-based systems capture the cost of activities consumed by products and assign those costs in proportion to activities consumed. Alternatively, traditional volume-based systems use average allocation rates to assign complexity costs across the entire product line. Thus, traditional cost systems under-allocate complexity costs to highly complex products, and over-allocate complexity costs to less complex products. As a result, most products are either over-costed or under-costed by the traditional, volume-based system. Activity-based systems are designed to remove the effects of averaging the overhead assignment of complexity costs.

In an ABC system, cost allocation involves two stages. In the first stage, overhead costs from the general ledger (e.g., depreciation, indirect salaries, utilities) are allocated to activity pools according to the type of activity carried out in each pool. Activity pools are collections of costs that relate to an activity. For example, a pool for machine setups would include the cost of supplies, indirect labor, energy, and depreciation of equipment used in setup activities. A common method of allocating costs to a pool is in proportion to time or effort. Suppose 60 percent of an engineer's time is spent supervising machine setups and 40 percent is spent supervising material movements. The engineer's salary and benefits would be allocated in those proportions to a setup pool and a materials movement pool.

In the second stage, costs are allocated from activity pools to a cost object, such as a good or service. For example, all costs in the setup pool would be divided by the number of setups to determine the cost per setup. Alternatively, if setups vary in complexity, the allocation base could be the number of setup hours. In that case, output from the setup pool would be expressed in terms of a setup cost per hour.

Activity costing and TOC both indirectly address the problem of efficiency measures. In an attempt to improve production, efficiency measures were introduced to the work floor. These measures encouraged workers to increase production on their machines by reducing idle time. However, as the TOC points out, total throughput does not increase unless the bottleneck produces more units. Relative to the bottleneck, non-bottleneck resources have excess capacity. Thus, managers who subscribe to TOC expect idle time on these resources. Companies were beginning to use these new tools to view their production processes differently. However, performance measures were needed to align operating decisions with strategic objectives. Traditional financial measures were inadequate for this purpose. Kaplan and Norton recognized how management incentives were linked to short-term income numbers. These incentives encourage managers to make decisions to improve the bottom line in the short run but are sub-optimal in the long run. To link the competitive strategy (long-term focus) with performance, Kaplan and Norton developed the Balanced Scorecard (BSC) (1992, 1996).

Balanced Scorecard

The BSC recognizes that financial performance is only one indicator of a company's success. Non-financial measures also help focus the organization on achieving strategic objectives. These measures can be lagging (show how the company performed in the past) or leading (show how the company should perform in the future). For certain firms, non-financial measures such as developing a new copyright, patent, or improving customer loyalty, are better indicators of future performance. When evaluating multi-divisional performance, certain measures (such as net income) are common across divisions while other measures (such as sales per square foot of retail space) are unique. The strength of the Balanced Scorecard is the utilization of common and unique measures as well as financial and non-financial measures that link strategy with performance.

The strategic vision for achieving the company's financial goals is articulated throughout the scorecard development process. A balanced scorecard typically uses four perspectives to classify and organize various measures. The first perspective is financial. Performance measures are designed to address the question "How do shareholders perceive us?" Typical examples include return on assets (ROA), cash flow, earnings per share (EPS), and sales growth. The second perspective is the customer perspective. Performance measures address the question: "How do customers perceive us?" Customer-related measures may include customer satisfaction and customer turnover. The Internal process perspective addresses the question: "At what must we excel?" In order to improve customer satisfaction, we must excel at maximizing on-time delivery and minimizing defect rates, for example. The learning and growth perspective asks the question: "What is necessary to meet the goals of the financial, customer, and internal process perspectives?" Notice the cascading nature of the performance measures. In order to achieve our financial goals we must delight the customer. In order to delight the customer, we must achieve superior internal processes.

In order to achieve superior internal processes, we must train employees and stakeholders and invest in resources to permit individuals to continue to learn and add value.

For example, Tri-Cities Community Bank (Albright et al., 2001) illustrates how a mid-sized bank implemented the balanced scorecard approach. The company's scorecard contained financial and non-financial measures as follows:

* Financial: growth in non-interest income and growth in deposit balances

* Customer: number of new customers, customer satisfaction, and customer retention

* Internal Process: new products introduced

* Learning and Growth: employee training hours

Management identified two financial measures consistent with the company's strategy--growth in non-interest income and growth in deposit balances. In order to achieve these objectives, the company must delight its existing customers and attract new ones. Thus, three performance indicators that measure customer satisfaction were selected--number of new customers, customer satisfaction, and customer retention. Through customer surveys, management learned that customers expect bank sales officers to be knowledgeable about new product introductions. Customers also expected timely introductions of products and services that meet their changing needs. Thus, the scorecard implementation team selected new product introductions and employee training hours for internal process and learning and growth measures, respectively. After eighteen months of using the scorecard, key financial measures were improved. In addition, employees reported greater levels of satisfaction because they understood their role in helping the organization achieve its strategic goals. Thus, the scorecard appears to motivate behavior consistent with strategic objectives, and to communicate these objectives to employees throughout the organization.

Six Sigma

Statistical techniques had been used for years to identify common and special-cause variation. In 1987, engineers at Motorola built on these concepts and developed Six Sigma (Folaron and Morgan, 2003). The term Six Sigma stands for six standard deviations, which is a statistically derived performance target of 3.4 defects per 1 million opportunities. Like SPC and TOC, it recognizes problems caused by process variation. Motorola and GE successfully implemented the method in 1987 and 1995, respectively (Pande et al., 2000).

Six Sigma methodology is the culmination of a long history of quality improvement techniques. For example, during the mid-1800s some manufacturers used go gauges and no-go gauges to ensure parts met certain dimensional criteria. These dimensional criteria eventually evolved into product specifications. However, testing each individual component proved costly and impractical. Thus, sampling techniques were developed to replace 100% inspection.

In the 1920s, Walter Shewhart developed a new data collection and display format, known as the statistical process control chart. As a result, quality professionals monitored the stability of processes, rather than sorting through daily output in search of defective units. Unfortunately, as the use of statistical sampling grew, the responsibility for quality shifted from the operators to quality control engineers. Operators began to feel isolated from the process as statisticians became the quality experts.

During the 1980s, Philip Crosby (1979) introduced manufacturers to the concept of zero defects as a way to address foreign competition and an economy in recession. Crosby promoted the idea that quality is free and that each person in the organization has a responsibility to learn to use quality tools. Quality concepts continued to grow in importance during the 1980s as the Geneva-based International Organization for Standardization (ISO) developed standards that were adopted by most of the industrialized world. In the late 1980s, the United States government established the Malcolm Baldrige National Quality Award to encourage US companies to improve quality that is consistent with the best global competitors. Motorola won the first Baldrige award based on its metric-based, customer-focused quality. Motorola would later develop Six Sigma techniques, focusing on continuous improvement that is financially justified.

AlliedSignal was one of the first companies to use Six Sigma methodology. The company's CEO, Larry Bossidy, used the techniques effectively and introduced them to Jack Welch in 1995. Welch embraced the methodology by making it a corporate requirement at General Electric. His successes are well documented (Folaron and Morgan, 2003).

Like the systems discussed earlier, Six Sigma is a process of continuous improvement. The advantage of Six Sigma over other statistical quality improvement programs is the use of a performance target and the link to financial improvement. Hence, Six Sigma techniques attempt to link strategy, quality improvement, and improved financial outcomes.

Mass Customization

Stan Davis first used the term "Mass Customization" in the late 1980s. Gaining popularity during the 1990s, companies that use Mass Customization seek to identify the desires of customers and do only and exactly what each one needs (Pine, 2004). The world's premier user of Mass Customization is Dell Computer. Lenscrafters is another well-known company that has customized products to individual customers at a cost comparable to mass-produced goods. Each Lenscrafters store maintains a production facility to avoid the costs and delays of sending prescriptions to labs that use batch production techniques. The result is a prescription lens quickly delivered to an individual customer. McGraw-Hill developed custom college textbooks for individual classes based on their expansive library of texts. Land's End customizes jeans, chinos, blouses, and outerwear according to individual customer's measurements. The apparel industry can benefit enormously from mass customization because each year large numbers of clothing items are produced and sold at severely-discounted prices because companies produce goods that do not fit their consumers. Historically, mass production and customization have been at two ends of the manufacturing spectrum. However, the future indicates an integration of mass production and customization to create a philosophy of Mass Customization (Selladurai, 2004).

MODERN CONTINUOUS IMPROVEMENT INITIATIVES--RELATIONSHIPS AND LESSONS LEARNED

Each of the methods discussed in the previous section continues to be evaluated by academics and practitioners (e.g., Schaefer et al., 2004; Davila and Wouters, 2004). Most have been subjected to empirical studies that evaluate changes in outcomes and test significant independent variables thought to drive results (e.g. Ittner et al., 2002; Fullerton et al., 2003). The purpose of our article is to consider the relationships among various improvement methods and to develop a framework useful for understanding broader issues driving the global use of continuous improvement initiatives. We believe the initiatives discussed in this article may be classified into three general categories: managing production flow, reducing process variation, and focusing on strategic management.

* Managing production flow. Both Kanban, as part of lean, and Drum-Buffer-Rope (DBR), as part of TOC, were developed to improve production flow. Kanban and DBR techniques reduce waste and improve efficiency by controlling when new materials are released to the floor. In doing so, they help reduce inventory and capital investment costs. In addition, TOC strives to increase throughput by continuously improving the performance of bottleneck resources. Thus, both approaches reduce inventory and improve process flow. Both are pull systems; however, TOC uses the constraint (or drum) to indicate when new materials need to be released, while Kanban uses cards to indicate when production should take place. Process Re-engineering and Mass Customization both seek to streamline production processes and reduce costs.

* Reducing process variation. Statistical Process Control and Six Sigma techniques were developed to understand and reduce process variation. Six Sigma does not stop with process improvement, but requires evidence of enhanced financial performance resulting from improved processes.

* Focusing on strategic management. While seemingly different approaches, TQM, Target Costing, Benchmarking, Activity-based Costing/Management, and the Balanced Scorecard are related strategic techniques. For example, Target Costing and Benchmarking are used to eliminate waste and to remove costs during the design stage of a product's lifecycle. (Though, Benchmarking can be used effectively during the production phase, as well.) Activity-based Costing techniques help identify and eliminate activities that are non-value added. The purpose is to understand the cost of process complexity, though the temporal focus varies among the techniques. For example, Target Costing uses proforma cost, while ABC uses existing activity costs. Activity-based Costing/Management preceded the Balanced Scorecard; Robert Kaplan of Harvard Business School was instrumental in developing both approaches (Kaplan and Norton, 1992; Cooper and Kaplan, 1991; Kaplan, 1988, 1984, 1983). The BSC establishes causal links from activities to strategic outcomes and communicates core values and strategic objectives throughout the organization. Scorecards are used to assess each business unit's progress in achieving performance targets.

Figure 1 illustrates our classification framework as well as a timeline of development. We believe all of the improvement methods, whether or not explicitly stated by their developers and advocates, include the philosophy of Kaizen and Lean. Kaizen implies a mindset of continuous improvement, while lean represents the mindset of eliminating waste. Thus, we believe a common, or unifying, thread that runs across all initiatives discussed in our article is continuous improvement.

To gain an understanding of the bigger picture and issues of continuous improvement, we draw upon a model first developed by the Consortium for Advanced Manufacturing--International (CAM-I) (1991), as shown in Figure 2. Consortium for Advanced Manufacturing--International developed the activity-based management model in the early 1990s in response to the rapidly developing theory and practice of activity-based management. While the model certainly was not developed to provide a unifying structure for a variety of improvement tools, closer observation reveals a broader perspective on key organizational relationships. For example, Figure 2 illustrates a cost view on the vertical axis and a process view on the horizontal axis. The cost view begins with resources that flow to activities (i.e., machine setup activities consume labor and supplies). Cost objects (i.e., products and services) require activities (i.e., machine setups). The cost view assigns costs associated with activities to products or services that consume activities.

[FIGURE 2 OMITTED]

Alternatively, the process view begins with cost drivers. A cost driver answers the question "Why is this work done?" Therefore, activities are pep formed as a result of cost drivers. Performance measurement systems capture the effectiveness and efficiency of activities performed. For example, making the strategic decision to offer a broad product line (a cost driver) causes numerous machine setup activities (an activity). Performance measurement systems measure and evaluate the time required to conduct the activities.

In searching for the common thread among the continuous improvement initiatives, we believe Figure 2 provides a key piece of evidence. For example, the common element for the cost view and the process view is the activity. Consistent with the ABM framework, activities are the common element in all three categories of management initiatives discussed in this article. Thus, each of our continuous improvement initiatives is fundamentally based on understanding activities. Furthermore, we believe the initiatives have the following characteristics in common:

* All initiatives attempt to reduce waste and improve processes by understanding activities. However, when analyzed at a more detailed level, the initiatives accomplish these objectives using various means. We identified managing the production flow, reducing process variation, and a focus on strategic management as different ways of understanding and improving activities.

* All initiatives emphasize a mindset of continuous improvement.

* Each initiative is a product of evolution. As changes occurred in the economic and competitive environments, management tools were developed in response. These improvement initiatives were not developed in a vacuum, and were not created without regard to techniques that preceded them. Therefore, we conclude each technique is evolutionary, not revolutionary.

* Are the initiatives discussed in this article a collection of examples of old wine in new bottles? Probably not. As the past 50 years have demonstrated, the only constant is change. The continuous improvement initiatives provide a fresh, yet incremental, approach in response to a changing environment.

Recent years have witnessed an explosion of initiatives to increase product quality, reduce costs, and improve firm performance. This article uses an historical framework for understanding principles common to improvement initiatives including Just-in-Time (JIT), Total Quality Management (TQM), Statistical Process Control (SPC), Kanban, Target Costing, Benchmarking, Process Re-engineering, Theory of Constraints (TOC), Activity-based Costing/Management (ABC/ M), Balanced Scorecard (BSC), Six Sigma, and Mass Customization. Understanding activities emerges as a central theme of each initiative. In particular, understanding the production system and managing flow are important aspects of the management initiatives discussed. The competitive environment has been a driver for implementing new initiatives. Because of threats from a common environment, initiatives discussed in this article have many commonalities when analyzed from a broader perspective. Our purpose has been to identify and briefly describe key initiatives, to draw parallels and consider commonalities, and to explore the evolutionary versus revolutionary growth of the initiatives developed over the past 50 years of modern manufacturing practice. We believe new refinements of techniques will continue to evolve in response to a changing competitive environment.