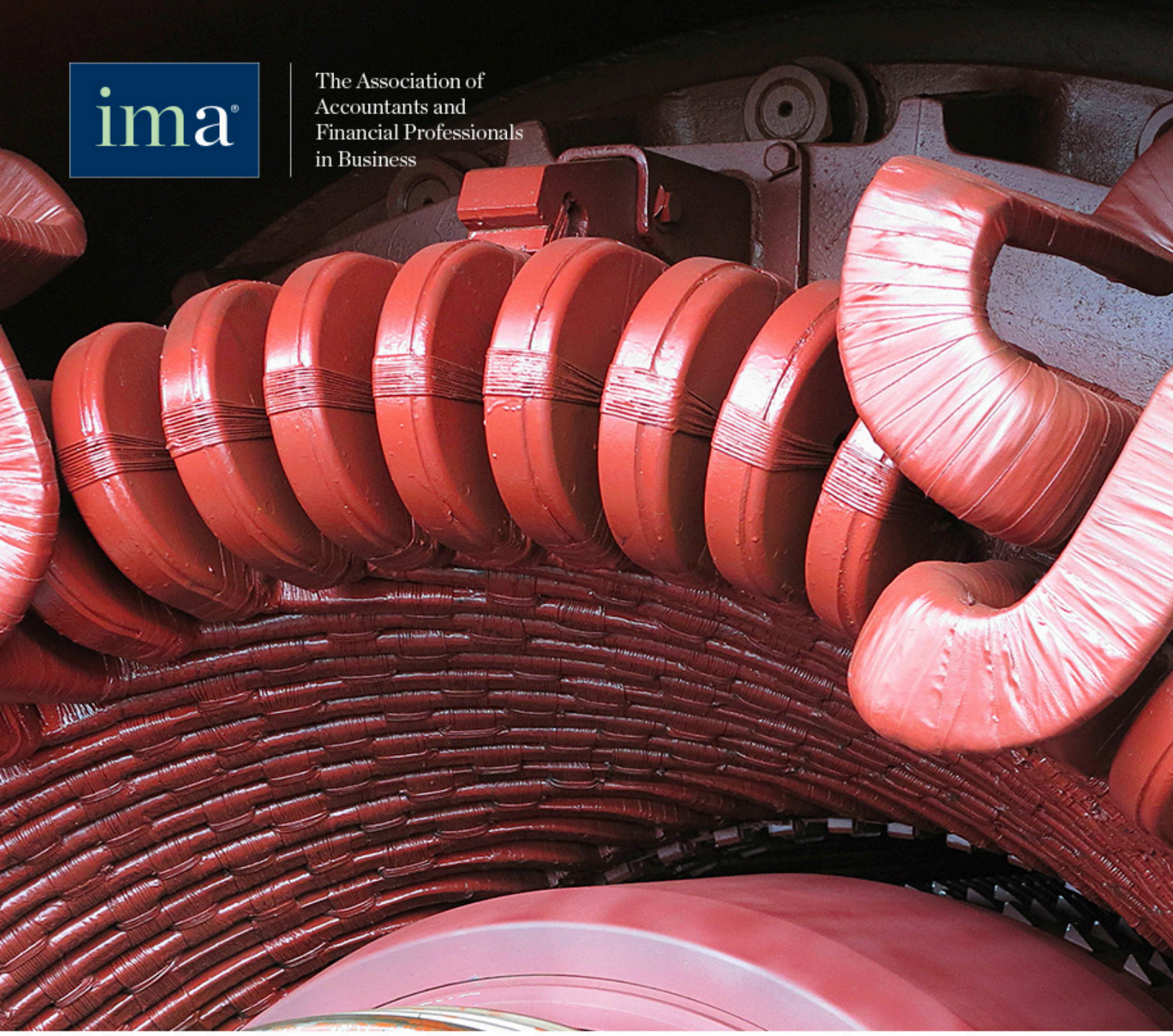
ima

The Association of Accountants and Financial Professionals in Business



Accounting for the Lean Enterprise

Major Changes to the Accounting Paradigm

About IMA

IMA®, the association of accountants and financial professionals in business, is one of the largest and most respected associations focused exclusively on advancing the management accounting profession.

Globally, IMA supports the profession through research, the CMA® (Certified Management Accountant) program, continuing education, networking, and advocacy of the highest ethical business practices. IMA has a global network of more than 65,000 members in 120 countries and 200 local chapter communities. IMA provides localized services through its offices in Montvale, N.J., USA; Zurich, Switzerland; Dubai, UAE; and Beijing, China. For more information about IMA, please visit www.imanet.org.

Accounting for the Lean Enterprise
Major Changes to the Accounting Paradigm

About the Authors

The IMA® would like to acknowledge the work of Dr. Frances A. Kennedy of Clemson University and Brian H. Maskell of BMA, Inc., on whose work this SMA is based, and Peter Brewer of Miami University, Gary Cokins of SAS, and Jean Cunningham, Business Consultant, who served as reviewers.

Published by Institute of Management Accountants

10 Paragon Drive, Suite 1
Montvale, NJ 07645
www.imanet.org

Table of Contents

Executive Summary

As companies transition from traditional management methods to a lean enterprise, their accounting, control, and measurement systems need to change. Traditional accounting systems— such as full absorption costing—were designed to support management principles like mass production, top-down command and control, departmental optimization and budgeting, and a focus on shareholder (or owner) value. The principles of lean thinking are quite different from those of traditional management methods. Traditional accounting systems can be detrimental to lean companies because they motivate behaviors that undermine the principles of lean thinking. Lean accounting methods are designed to support the transition to a lean enterprise.

This Statement on Management Accounting (SMA) is the second of three SMAs addressing the impact of "lean" on organizations. The first, Lean Enterprise Fundamentals, serves as a starting point in the exploration and implementation of lean concepts. It illustrates core ideas and provides finance and operations professionals with a basic understanding of lean processes, its applicability to their organization, and its unique challenges. This SMA focuses on the information necessary for value stream costing, a product family view of costs, decision making, budgets and financial planning, and transaction elimination.

A third SMA, Applying Lean Fundamentals beyond the Manufacturing Floor, expands the lean accounting principles to the entire enterprise and discusses performance measurements for lean organizations.

Introduction

Organizations are changing the manner in which they produce and deliver products and services in order to respond more quickly to changing competitive environments. At first sight, these changes appear to be just more programs designed to make a company more efficient and effective by applying new techniques for production, delivery of service, design of products, and administration of support activities. But when you look more deeply at these new methods—known collectively as the lean enterprise—it becomes clear that this is not just another improvement program but a fundamentally new way of conducting business. These changes require different kinds of accounting systems. Transforming a company through the application of lean thinking changes almost every aspect of its operation. These changes are based on different assumptions about the business. Lean thinking changes the way a business is managed by moving from a command and control bureaucracy to an organization based around empowered teams.[1] Lean thinking changes an organization, transforming top-down, project-driven improvement led by middle managers into continuous improvement conducted throughout the company by locally empowered teams. A team-based organization needs a different kind of financial and performance reporting system than a traditionally managed one.

Lean thinking changes the way a company views its customers. Lean organizations seek to maximize the value created for the customer. They are outward-facing organizations focusing on the customers' needs rather than the somewhat inward-looking organizations prevalent in the 20th century. Lean organizations recognize that their customers' needs change, and often rapidly, so they build flexibility into every aspect of their processes. Rather than relying on middle management "heroes" to expedite products and services through poorly designed processes, flexibility and continuous improvement are built on the foundations of the stability and standardization of company processes. This requires new kinds of financial information and performance reporting designed to enhance stability, motivate

1 Womack, James, and Jones, Daniel. *Lean Thinking: Banish Waste and Create Wealth for Your Corporation*. New York: Simon & Schuster, 1996.

continuous improvement, and quickly identify issues, problems, and changing customer needs.

Lean organizations are visually controlled. The information required to run a business is posted visually at the places it is needed. Instead of managers having meetings to discuss lengthy reports, all routine management of a business is conducted at the place where the work is done using visual reporting, which is often displayed manually on tracking boards in the area. Empowered teams and responsive processes require the availability of timely data presented in ways that people can readily understand and use. Control systems move to clear and timely reporting that everyone in the organization can immediately understand and use.

The traditional organization has many layers of supervisory management with functional reporting responsibilities. Information is reported up the chain of command, where decisions are made and communicated back down to the operating level. Many organizations (not necessarily lean) have moved to a more decentralized model with fewer layers and decision making closer to the customer. The "traditional" organization has come a long way but needs to go further still. Organizations that have transitioned to lean operations have fewer layers of management. Fewer layers mean a greater span of control. In other words, a single manager has a larger number of direct reports for which he or she is responsible. Decisions are pushed down to lower-level empowered employees who are closer to the customers.

Another structural change is the moving from a functionally-segregated organization to organizing by value streams. A value stream is the sequence of processes through which a product is transformed and delivered to the customer. By design, a value stream spans multiple functions, such as production, engineering, maintenance, sales and marketing, accounting, human resources, and shipping. Similar value streams can be identified within service organizations such as hospitals and banks. The goal of a value stream team is to create more customer value and eliminate waste throughout the entire value stream using standard continuous improvement methods. Managing by value stream requires that information be configured to reflect this new organizational form.

There are different kinds of value streams. Within manufacturing and distribution organizations, there are *order fulfillment* value streams and *product development* value streams. Order fulfillment value streams start at a sales process and run through the manufacture and delivery of the products to the customer, followed by invoicing and cash collection. Product development value streams start with ideas for new products—either initiated by needs expressed by the customers or by people within the company developing entirely new product concepts—through to the specification, design, materials sourcing, launch into production, and launch into the marketplace. These value streams cut across the familiar departments of traditional companies. Information, materials, and cash flow horizontally through the value stream rather than through the vertically organized departments of the company.

Service industry value streams similarly cut across traditional departmental organizations. The cardiac care value stream within a hospital encompasses within it all the steps required to serve the customer. They seek to eliminate waste from the process in order to provide the customer with fast and effective care, delivered with a human face. Value streams within financial services organizations travel across many traditional departments in order to supply the customers with their mortgage, insurance policy, or pension plan quickly and easily. Educational institutions recognize that value is created for their customers through many different aspects of the organizations' structure and seek to provide better value by recognizing the horizontal flow required to maximize the value for their multiple customers: student, parents, and employers.

While lean thinking currently has greater penetration in manufacturing and distribution industries than in service industries, the same

principles impact service organizations in similarly radical ways.

Moving a company from a departmental to a value stream orientation can be achieved through reorganization of the business or by using a matrix management approach. It is not always necessary to restructure the organization chart. It is important that the challenges of silo behavior and performance incentives be addressed. (See the SMA, *Applying Lean Fundamentals beyond the Manufacturing Floor.)*

The product and process flow changes from a forecast-driven "push" environment to a customer-driven "pull" system. A typical push system will build product according to forecast and store it until the sales force seals the deal with the customer, which can result in high inventories and greater risk of obsolescence. In a pull environment, production is triggered when the customer places an order. Consequently, customers' individual needs can be met, and excess inventory and obsolescence is avoided. This change in trigger from forecast to customer order requires a rather different information flow within operations.

In service industries, the push mentality results in airlines over-booking flights and "bumping" customers. The push system mentality results in service centers staffed by the lowest paid and least experienced employees trying to solve problems using databases. These people are measured and compensated by the number of calls they process rather than by the effectiveness of solving the customers' problems. In hospitals, the push system manifests itself through scheduling people across blocks of time and expecting them to sit around waiting for hours.

Software companies that update your computer automatically but do not provide anyone you can talk to when the update does not work, relying instead on FAQs (frequently asked questions), also exhibit this mentality. Reorganizing into value streams and converting to a customer-driven pull system necessitates that accounting professionals reassess the information and reports supplied to a company's decision makers. First, traditional periodic departmental expense reports are typically supplied to functional managers who are accountable for the costs originating in their departments.

In a value stream organization, the value stream manager and his/her team are the primary users of the financial information, which is used for cost control and decision making. Functional managers may also use this information, but it is oriented to the value stream rather than functional departments.

Second, traditional product costing methods dictate that overhead costs be absorbed into product costs. Absorption costing inherently motivates overproduction because the more volume produced, the lower the unit product cost. A value stream organization enables a simple summary direct costing with little or no allocation of costs.

Third, the traditional mindset is that producing larger batches (or providing services only at scheduled times) reduces overall costs due to the efficiencies gained from avoiding extra setup and movement costs. This mindset is deeply embedded in traditional management thinking along with the idea that division of labor creates efficiency. Traditional accounting systems often reflect this mode of thinking. These tenets are contrary to lean production, and lean accounting methods seek to provide financial information that supports lean thinking and lean methods. The impact of lean changes will flow through an organization's accounting systems and be reflected in its financial statements. Many finance professionals within companies embarking on such a transformation do not recognize that their traditional accounting systems—based on standard overhead absorption—will not accurately reflect the economic benefits from transforming to a lean organization and, in fact, may present a distorted view of the economic impact of the changes. While some organizations can ignore the accounting problems because their executive managers have a high level of commitment

to and understanding of lean thinking, other organizations may find that traditional accounting reports, measurements, and methods will undermine their lean transformation. New accounting, control, and measurement methods are needed. Given the importance of the accounting information support system in an organization, accountants must determine what information is needed by people within lean organizations and in what form that information needs to be provided.

Scope

This Statement on Management Accounting (SMA) is addressed to financial professionals who seek to provide information that is both decision-relevant and increases process understanding in organizations that are adopting lean principles. The lean accounting concepts discussed in this document apply to:

- large and small organizations,
- enterprises in the manufacturing and services industries,
- public and private, and
- for-profit and not-for-profit organizations.

This SMA does not address general business practice; it specifically applies to companies making the transition to a lean enterprise. These companies apply the principles of lean thinking to every aspect of their organization, leading to radical change throughout the company.

Lean accounting practices are summarized in two SMAs. (A third SMA, *Lean Enterprise Fundamentals*, discusses the impact of lean principles on organizations as a whole). This first lean accounting SMA, *Accounting for the Lean Enterprise: Major Changes to the Accounting Paradigm*, includes five topics:

- *Value stream costing* introduces an income statement format to control costs, promote lean behavior, and monitor performance. These income statements replace traditional statements and cost reports.
- *Decision-making methods* summarize how to make decisions, such as quotes, orders, and outsourcing, without using standard costing as a base.
- *Features and characteristics cost calculations provide* a product-family view of product costs.
- *Budgets and financial planning* reflect a value stream reporting structure including box score format and/or value stream statements.
- *Transaction elimination* challenges accounting to readdress the value of collecting and recording data using transactions and reports in favor of simple visual management methods.

The second SMA, Applying Lean Accounting Fundamentals beyond the Manufacturing Floor, strives to expand the lean accounting principles discussed in this SMA to the entire enterprise. Topics include:

- *Performance Measurement Linkage*: Key to the success of any organization is the thoughtful and explicit linkage of organizational goals and objectives to the value stream and cell goals and measurements. This topic introduces how development of a performance matrix in a value stream organization may be accomplished.
- *Accounting Organizations*: Lean processes become a part of the way all areas of the organization perform their jobs. Accounting and finance departments can look within their own processes to identify wasted resources and streamline processes.
- *Service Organizations*: The heart of lean is the management of processes. Though it is easier to visualize with a tangible product, lean principles also address organizations that provide services to its customers. In fact, many service organizations naturally pull on demand from their customers as this is the nature of their business.
- *Sales and Marketing*: Critical to the continuing growth of the business, sales and marketing must be attuned to the changes and opportunities within the value streams. These

functions begin to think in terms of product families and frequently readdress their planning mechanisms.

- *Target Costing*: In lean organizations, target costing is a major driver of change and improvement throughout the value streams. It starts by thoroughly understanding how customer value is created by a family of products or services and how the products and processes must change to create more value for the customer, and then drives process changes to bring product and service costs into line with the value needs of the customer and profit and cash needs of the business.
- *Implementing Lean Accounting Practices*: As operations demonstrate control over specific processes, the accounting practices that support each of those processes can adapt as well, eliminating a myriad of nonvalue-added transactions. Maturity paths useful for planning implementation activities are outlined.

Lean Principles and Accounting Implications

Lean production is a term used to describe a manufacturing approach that combines the best elements of craft and mass production while seeking to avoid the high cost of the craft setting and the rigidity of mass production. Lean concepts have now broadened to include service companies and the entire organization. Consequently, the term "lean enterprise" is a more inclusive descriptor. Lean enterprise goals include: improving quality and customer satisfaction, creating more value for the customers, eliminating waste, reducing lead time, and reducing costs.

Lean enterprise begins with a deep understanding of how the organization creates value for the customer and how this value is created through the company's value streams. Lean organizations continuously change their processes so that more resources are devoted to value-creating tasks and so that tasks that create no value are minimized or eliminated. This does not occur through traditional, project-based changes but through continuous improvement methods—known generically as kaizen—engaging the entire work force.

The backbone of lean processes is a carefully constructed conceptual architecture that supports the structural, interpersonal, external, and internal relationships governing a company's operations. This architecture creates the platform for accounting to support the decisions that govern these relationships. The five principles of lean are derived from Womack and Jones.[2] They include:

- *Value*: Lean starts with a definition of what constitutes value from the customer's standpoint in terms of the features and characteristics of the product or service.
  - *Implication*: Rather than targeting a predetermined standard product cost and motivating managers to overproduce in an effort to reduce variances, a lean enterprise continually redefines value based on the customer rather than an internal standard. Lean organizations have formal methods for defining and calculating customer value.
- *Value Stream*: The value stream is the sequence of processes through which a product is transformed from raw material to delivery at the customer's site. Normally, a value stream is defined by a group of related products or services that employ the same process steps.
  - *Implication*: Traditional accounting seeks to calculate standard costs for a product or service by assessing the labor and other (so called) direct costs required to provide the service or make the product, and then allocating associated support costs to the individual product or

2 The five principles of lean thinking given here differ slightly from those presented by Womack and Jones. The principle of empowered teams has been added to show the importance of people in the sustained success of a lean enterprise.

service. Lean organizations do not focus on the cost of individual products or services; they focus on the total cost of the flow through the value stream. Tracking value stream costs and profitability provides understanding, insight, excellent cost control, and leads to effective continuous improvement.

- *Flow and Pull*: The production process is designed to maximize the flow of the product through the value stream, initiated by the pull of customer demand.
  - *Implication*: Traditional production planning and purchasing is based on a forecast-driven system that internally generates demand and initiates material purchases and production orders. Optimal production is considered as being attained through large batches influenced by the false reasoning that product unit costs are reduced with large batches. Performing to budget rather than customer demand is a key performance metric. This results in excess inventory that utilizes resources and increases risk.
- *Empowerment*: The system of measurements and controls provides each employee with the information and authority to take necessary action at the time it is required.
  - *Implication*: Traditional responsibility accounting provides information to managers and supervisors (usually lagged) for them to use in managing outcomes. The result of this is that there is a tendency to manage people rather than processes. Recent advances—such as business process management (BPM), business intelligence (BI), operational dashboards, balanced scorecards, and strategy maps—have begun to address this issue. Lean techniques help facilitate this evolution by providing information that is real-time—developed and maintained by those using the informa- tion in daily decisions. Lean accounting and performance measurement seek to manage and control the process by providing people with appropriate and timely information.
- *Perfection*: Perfection is defined as 100% quality flowing in an unbroken flow at the pull of the customer.
  - *Implication*: Traditional accounting defines perfection as meeting predetermined standards. In a lean structure, empowered teams at every level within the value stream strive to continuously improve their processes so as to provide perfect, high-value products and/or services to their customers. Improvement is not driven by projects; this continuous improvement is relentless and permanent. The accounting and measurement systems need to actively support the quest for perfection. They must provide timely, valid, and understandable information to provide control and motivate continuous improvement.

More in-depth discussion of these lean principles can be found in Lean Enterprise Fundamentals.

Major Changes to the Accounting Paradigm

Traditional accounting systems present a "frozen" view of operations that doesn't reflect the continuous improvement goals of the lean enterprise. In order to provide a more balanced, dynamic view of their performance, many organizations have supplemented their traditional accounting systems with dashboards and scorecards reflecting key performance indicators (KPIs) based on operational data. Lean accounting further advances changes to the accounting paradigm by utilizing the following five principles that guide accounting for lean processes.[3]

- *Lean and simple business accounting* applies lean methods to accounting processes

3 Developed at the 2005 Lean Accounting Summit.

eliminating waste embedded in transaction processes, reports, and accounting methods.

- *Accounting processes that support lean transformation* focus on measuring and understanding the value created for the customer by concentrating on the entire value stream rather than individual products or services.
- *Clear and timely communication of information* is evidenced by easy-to-understand accounting reports that are provided frequently and not locked in to a monthly reporting cycle.
- *Planning from a lean perspective* involves people who are responsible for achieving results and are actively involved in setting goals. The process begins with a top-level strategic plan (using methods like Hoshin Strategy Deployment) and is then rolled out to business unit leaders and value stream teams (using methods like sales, operations, and financial planning).
- *Strengthen internal accounting control* when eliminating transactions through prudent planning. It is essential that accounting controls and transactions not be eliminated prematurely, but only when operations demonstrates sufficient process control. Process maps identify control risks and subsequently include changes to mitigate these risks.

Each of these principles steers the transformation of accounting practices from traditional methods to supporting lean…by thinking lean. The remainder of this document describes in greater detail five key areas where accounting can actively support lean processes.

Value Stream Costing

Managing the entire value stream is the core of successful lean enterprises. Value stream management includes value stream mapping, under- 7 3 Developed at the 2005 Lean Accounting Summit. standing customer value, eliminating waste and delay throughout the value stream, and creating high-quality processes for manufacturing products, providing services, and administering the support activities. In many lean companies, the value stream manager's responsibilities include growing the business, increasing customer value, eliminating waste from every process, and increasing cash flow and profitability. The value stream team needs timely, valid, and readily understandable financial information. Lean accounting provides income statements for each value stream—usually every week—and uses these to control costs, make decisions, and drive improvement.

Value Stream Income Statements

Value stream income statements reorganize and report information in user-friendly ways. Whereas traditional income statements present information on cost of goods sold, applied overhead, and manufacturing variances, value stream statements highlight material purchases, employee and equipment costs, and facility costs. It uses plain language that all value stream team members can understand. Exhibit 1 compares traditional and value stream income statements for a single facility having two value streams.

First, note that the top and bottom lines for the total facility are the same. What changes is the assignment of costs to value streams and the lucid way in which these costs are presented. Whenever possible, costs are assigned directly to value streams rather than allocating to cost objects. This includes costs associated both with personnel and with machines. There are occasions where a particular resource is not dedicated to a specific value stream, but is shared across multiple value streams, and its use must be allocated using simple activity drivers. These allocations of "monument" costs must be minimized. Other key differences include the following:

- *Sustaining Costs:* One difference is the separation of necessary costs that support the overall facility but cannot be directly associated with value streams. These are considered sustaining costs and are shown

Exhibit 1. Traditional and Value Stream Income Statements

Traditional Plant-Wide Income Statement

Sales	$5,563,374	100.00%
COGS at standard	$3,711,884	66.70%
Gross Profit	$1,851,490	33.30%
Material Variances	24,485	0.40%
Labor Variances	31,380	0.60%
OH Variances	64,527	1.20%
Scrap	$34,392	0.60%
Total Variances	$154,784	2.80%
Gross Operating Margin	$1,696,706	30.50%
Operating Expenses		
SG&A	$96,006	1.70%
Distribution Costs	$429,797	7.70%
Total Operating Exp	$525,803	9.50%
Net OI	$1,170,903	21.00%

Value Stream Income Statements

	VS1	VS2	Sustaining	Total Plant
Sales	$ 2,708,333	$ 2,855,041		$ 5,563,374
Material costs	$ 1,040,000	$ 691,189		$ 1,731,189
Employee costs	$ 190,667	$ 393,575	$ 358,963	$ 1,095,413
Equipment-related costs	$ 156,000	$ 357,682		$ 496,780
Occupancy costs	$ 120,022	$ 234,826	$ 36,528	$ 391,376
Other value stream costs	$ 296,942	$ 114,461		$ 411,403
Value stream profit	$ 904,702	$ 1,063,308	$ (395,491)	$ 1,437,213
	33%	46%		28%
Inventory reduction or (increase)				$ 181,436
Profit				$ 1,255,777
Corporate allocation				$ 84,874
Net OI				$ 1,170,903
ROS				21.0%

separately on the statements. These costs often include facility costs, management and support personnel costs, and other functions such as IT and HR that are not associated with the value stream directly. There is no requirement to absorb these costs into the value streams; they are reported and controlled separately.

- *Changes in Inventory*: Lean methods result in reducing stockpiles of inventory. In traditional accounting these inventory changes impact the profitability of the company. In lean accounting, these inventory changes are segregated and then applied as "below the line" adjustments. These inventory changes are reported for the whole entity, not the individual value stream. This provides a clear understanding of the impact of inventory change while giving the value stream managers information about the real profitability of their value stream uncluttered by the complexity of absorption costing. When value stream inventories become very low, this issue largely goes away.
- *Occupancy Costs*: Facility costs, such as electricity and property taxes, can be assigned to value streams according to the square footage actually used by each value stream. This provides incentive for the team to figure out ways to use less space. This freed capacity is highlighted on the value stream statements and underscores key areas of opportunity to grow the business. There is no attempt to fully absorb facilities costs. The value stream managers are charged only for the space they use.

The cost of the remaining space is charged to sustaining costs. A final aspect of value stream income statements concerns the frequency of reporting. It is common for these statements to be provided on a weekly basis. Weekly statements have the advantage of tapping into recent memory. The value stream team members can associate actions and decisions with their impact more easily when dealing with information pertaining to the prior week. Reporting more frequently gives the value stream managers better control of their costs.

Value Stream Unit Costs

Standard product costing practices are at odds with lean principles. One problem is that standard costs are predetermined and usually outdated and inaccurate for current decision making because lean organizations are constantly improving and changing. A second problem is that managing operations within a standard costing system requires monitoring and explaining myriad manufacturing variances. Most of the information is too late to have diagnostic value on the shop floor. A third problem is that these variances are easily manipulated by building more inventory than necessary. A fourth problem is that tracking and monitoring this information requires complicated and wasteful reporting systems.

Value stream costing provides a vehicle to monitor the cost of products easily and currently. Value stream cost per unit is calculated by dividing the total value stream costs (from the value stream income statement) by the total number of units shipped. For example, the total costs for the first value stream in Exhibit 1 are $1,803,631, and the number of units shipped is 150,000. This yields a value stream cost per unit of $12.02. Using shipping units as a base provides incentive to reduce inventory rather than to build excess inventory. This average cost of products or services is used as a performance measurement and is a general indicator of process improvement. There are two issues that need to be addressed: the cost of the products and the weekly variability of these costs. Lean companies aim for consistent cost reduction and very little fluctuation from one week to the next. Many companies find that weekly cost reporting reveals previously unrecognized instability in their sales and shipping processes. This instability—often caused by internal budgets and

Exhibit 2. New Order Decisions

New Order Decision
Monthly Data

	CURRENT STATE	WITH NEW ORDER	CHANGE
Revenue	$2,708,333	$ 3,033,333	$325,000
Material Costs	$1,040,000	$ 1,215,000	$175,000
Employee Costs	$190,667	$ 193,367	$ 2,700
Machine Costs	$156,000	$ 159,600	$ 3,600
Other Conversion Costs	$416,964	$ 416,964	$ 0
Profit	$904,703	$1,048,402	$143,700
VS Profit Margin	33.4%	34.6%	1.2%

incentives—is damaging to flow, cost, capacity usage, and customer service.

Decision Making

Once a facility has established clear value streams, value stream costing is quick, simple, easy to use, and provides the financial information to control the business and report externally. But it does not provide product costs. In value stream costing, we cost the value stream, not the products. It may be difficult to see how a business can be run without knowing the cost of its products. These are some of the reasons companies use standard product costs:

- Margin and profitability analysis,
- Product pricing and quoting,
- Make vs. buy decisions,
- Performance measurement,
- Financial reporting,
- Product or customer rationalization,
- Measuring cost improvements,
- Transfer pricing, and
- Valuing inventory.

We will address each of these requirements and show how they are accomplished using value stream costing information.

Margin and Profitability Analysis

Assessing the financial impact of a new sales proposal or request for quote, products, or customers is done using the profit and profitability of the value stream as a whole.

Comparing the price and the standard product costs of an individual product can be misleading because the standard product cost does not show the true financial impact of the transaction. Showing the profitability of the value stream as a whole provides correct and useful information. Assume, for example, that a company receives a request for a quote from one of its major customers. For the next 12 months, the customer plans to purchase 2,500 units of a standard product made by the company each month, for a total of 30,000 units over the year. The customer provides a target price of $130 per unit. The standard cost for the product is $137, and it appears the company will lose $7 on every unit. The logical decision would be not to accept the order.

When we look at this proposed sale from a value stream costing point of view, we see a different picture. In order to fulfill this order, the company will need to invest in new equipment and take on three more employees. Exhibit 2 shows the value stream cost information.

Adding this proposed order to the value stream is far from unprofitable. The proposed order would bring additional profit of $143,700 each month and raise the profitability of the value stream from 33.4% to 34.6%.

The decision on whether to take the order is a business decision. There are many other factors to consider in addition to the costs and profitability of the order. But from a financial point of view, this

order is quite profitable. The standard product cost and margin give misleading information that in turn leads to poor decision making. Value stream costing gives information that can lead to better decisions.

Under lean accounting, most financial analysis for decision making is done using the effect of the proposed changes on the profitability of the value stream as a whole, not the individual products. The approach is consistent with the practice of some companies of using activity-based costing (ABC) for process costing.

Product Pricing and Quoting

Most organizations focus on customer value. Some are successful, many are not. Most are not "lean" companies in terms of all the principles of lean, but they use some elements of lean. A major contribution of "lean" is its heavy focus on customer value—it is a primary principle of lean thinking. Lean organizations have formal methods for understanding and quantifying the value created for the customer. Target costing is one method that establishes a framework for defining value and cost. All prices are set from a clear and profound understanding of the value created for the customer by the company's products, service, and other attributes.

A traditional approach to product pricing is to include cost as an important factor in determining a product's tentative selling price (to be subsequently adjusted, as needed, for other factors). A simplified view of this approach would be:

PRICE = STANDARD PRODUCT COST + MARGIN

Lean organizations, utilizing target costing, turn this around:

COST = VALUE - REQUIRED PROFIT

Even traditional companies do not completely rely on cost-plus pricing because their sales and marketing people soon discover what the customers will pay and what they consider to be inadequate value for the prices they are asked to pay. Cost-plus pricing portrays an inward view that is focused on recouping costs rather than maximizing the value for the customer.

Successful value-based pricing requires more than just understanding "what the market will bear." It requires a proactive strategy for recognizing customer value, creating products and services that provide superior value, and pricing the company's offering to gain exceptional overall profitability. In addition, value stream costs can be beneficial for understanding the profitability of different product families.

Toyota Motors constantly demonstrates skills in strategic value pricing. Toyota brand vehicles are priced at around $2,000 more than similar cars from U.S. manufacturers. The public buy these cars by the thousands because they place high value on the vehicles' reliability, design, and features. When Toyota first introduced the Lexus brand, it designed a product to match the prestige European automakers such as Mercedes and BMW, but it priced its cars at $10,000- $15,000 below these competitors. Lexus sales soared, and the European companies suffered severe setbacks. Toyota recognized in the late 1990s that "the car of the 21st century" must be environmentally friendly and urgently developed hybrid vehicles, such as the Prius. These vehicles were priced much higher than Toyota's conventional cars but sold rapidly because a segment of its customers values high gas mileage and low emissions.

Target costing and its applications are discussed in greater depth in the two SMAs titled *Implementing Target Costing and Tools* and *Techniques for Implementing Target Costing*.

Make vs. Buy Decisions

Returning to our example above, if the company had been unhappy with the profitability of the product, they might decide to outsource the item from a local supplier. The supplier quotes it a price of $115 to make the product. With a target price of $130 per unit, this provides a 12% margin.

Exhibit 3. Make or Buy Decisions

Make or Buy Decisions

	CURRENT STATE	MAKE IN HOUSE	BUY FROM LOCAL SUPPLIER
Revenue	$2,708,333	$3,033,333	$3,033,333
Material Costs	$1,040,000	$1,215,000	$1,327,500
Employee Costs	$190,667	$193,367	$190,667
Machine Costs	$156,000	$159,600	$156,000
Other Conversion Costs	$416,964	$416,964	$416,964
Profit	$904,703	$1,048,403	$942,203
VS Profit Margin	36.0%	35.0%	31.1%

Though better than incurring a loss, this is still considered a low margin for this company.

Comparing this approach using value stream costing is quite simple. The result is shown in Exhibit 3.

There is no financial benefit from outsourcing this product to the local supplier. Based on this analysis it would be more advantageous to make the product in-house. Once again, we need to recognize that a business decision has a number of other issues—many nonfinancial—that must be taken into account, but from a financial perspective, making the product in-house is more beneficial.

Performance Measurements

Traditional measurements associated with mass production include both financial and nonfinancial measurements, such as labor efficiency, machine utilization, earned hours, overhead absorption, purchase price variance (PPV), and similar measurements. Use of these measurements may motivate nonlean behaviors.

Does this mean that these traditional measurements are bad metrics? No. They are perfectly good metrics if you want to be a traditional mass producer. They are inappropriate if you wish to be a lean manufacturer. There is nothing wrong with these tools, but they are the wrong tools for a lean enterprise.

What behaviors are motivated by such measurements as earned hours, labor efficiency, and machine utilization? The metrics are designed to motivate people to maximize the amount of standard hours earned in any one day or week. They motivate people to make large quantities. They also motivate people to manufacture large batches of products so as to minimize the effect of change-over time. The production people will make large batches, manufacture out of sequence, and "cherry pick" production jobs that yield high earned hours. There may also be a tendency to make quantity at the expense of quality, which leads in turn to the need for increased inspection. In short, these measurements motivate people to do the opposite of lean manufacturing. They will motivate people to build inventory in order to maximize their efficiency and make large batches instead of single-piece flow. These measurements will undermine a company's move to lean processes.

What behaviors are motivated by variance analyses like overhead absorption and PPV? These measurements create similar outcomes. For example, if a supervisor, production line, or cell has not earned enough overhead by the third week of the month, what must be done to absorb more overhead? Build inventory, of course. If you build additional inventory your overhead absorption increases, as does the month's apparent profitability. What do you get if you focus on the PPV

as the primary measurement for procurement? You get very large batches of low-price materials leading to much higher raw material and component inventory, often delivered from suppliers that are geographically distant. These behaviors—that are quite suitable for mass production— are disastrous to lean manufacturing because they increase inventory, sabotage material flow, severely limit flexibility, increase obsolescence, and undermine the value to the customer.

New kinds of performance measurements are required for lean manufacturing. The measurements used in lean production cells are often focused around the hourly rate of production in comparison to the customer takt time (the time required to complete customer orders). These measurements deal with the quantity manufactured, the quality of the product, and the capability of the pull system. The measurements also provide the primary control system of a lean shop floor, eliminating the need for complex transaction-based control systems. A detailed explanation of lean performance measurements is outside the scope of this SMA, but performance measurements for lean organizations are more thoroughly discussed in *Applying Lean Fundamentals beyond the Manufacturing Floor*.

Value streams also need a small but balanced set of performance measurements designed to drive the continuous improvement of the value stream. These measurements are (typically) reported weekly along with the value stream income statement and box score (described below). Lean measurements typically address such issues as:

- Productivity of the value stream as a whole (e.g., sales per person),
- Materials and/or information flow rate through the value stream (e.g., dock-to-dock days or order to cash days),
- Capability of the value stream's standardized work (e.g., first time through), I Overall level of process control throughout the value stream (e.g., on-time shipment to customer request date),
- Value stream costs (e.g., average cost per product),
- Performance to customer demand, I Involvement activities of team members, and
- Safety.

Lean organizations also have performance measurements that address the plant or division of the organization. These measurements are again lean focused in order to motivate appropriate lean behaviors and provide high levels of financial and operational control across an entire organization comprised of more than one value stream.

The complete set of measurements is developed from the company's lean strategy and linked to ensure common motivations throughout the company's empowered workforce. The measurements are always reported visually at the place where the work is completed, and they are maintained largely manually by the people who perform the work. There is generally no need for any arithmetic roll-up of measurements to summary levels. For example, day-by-the-hour is a measure commonly found on cell metric boards whose purpose is to ensure production to takt time. Once the day is over, the board is erased and aggregation is meaningless (although the production quantities are often transferred to spreadsheets so that trends can be identified). The impact at the value stream level is reflected in on-time deliveries and other customer service measures. Similar measures include set up times, first time through quality, operational equipment effectiveness, and so forth.

There is usually a subset of metrics that are considered key indicators of performance. A presentation method called a "box score" helps to keep these key metrics in the forefront. Exhibit 4 illustrates the format using the example company numbers, separating the metrics into operational, capacity, and financial measures. This format recognizes the immediate impact of changes on operational metrics and changes in available capacity. Financial impact usually lags these changes and depends largely on how newly available capacity is used.

Performance measurements are designed to help run the business, serve the customers, create

Exhibit 4. Box Score Format

	Last Week 9/4/xx	This Week 9/11/xx	Next Week 9/18/xx	Planned Future State 12/31/xx
Operational				
Units per person	466	470		559
On-time shipment	92%	92%		98%
Dock-to-dock days	15	15		8
First time through	65%	68%		82%
Average product cost	$112.75	$111.20		$97.61
AR days	42	43		42
Capacity[1]				
Productive	24%	24%		29%
Nonproductive	63%	63%		45%
Available	13%	13%		26%
Financial				
Sales	$2,708,333	$2,750,420		$3,277,083
Material Cost	$1,040,000	$1,056,161		$1,131,312
Conversion Cost[2]	$693,333	$698,560		$669,275
Inventory	$3,120,000	$3,112,000		$1,664,000
Profit	$975,000	$982,000		$1,1476,496
Return on Sales	36%	36%		45%

[1] The SMA, *Applying Lean Accounting Fundamentals beyond the Manufacturing Floor* discusses capacity measurements in more depth.
[2] Conversion Costs represent all value stream costs other than materials.

Exhibit 5. Product Rationalization Format

	CURRENT STATE	WITHOUT "LOW MARGIN" ITEMS
Revenue	$2,708,333	$2,437,500
Material Costs	$1,040,000	$977,600
Employee Costs	$190,667	$190,667
Machine Costs	$156,000	$156,000
Other Conversion Costs	$416,964	$416,964
Profit	$904,703	$696,269
VS Profit Margin	36.0%	28.6%

Exhibit 6. Impact of Product Decisions

		CURRENT STATE	WITHOUT "LOW MARGIN" ITEMS	ADDITIONAL NEW PRODUCTS
Operational Measurements	Units per Person	466	395	521
	On-Time Shipment	92%	99%	99%
	Dock-to-Dock Days	15	7	5
	First Time Thru	65%	75%	75%
	Average Cost	$112.75	$128.23	$111.12
	AR Days	42	35	35
Capacity	Productive Capacity	24%	18%	28%
	Non-Productive Capacity	63%	35%	42%
	Available Capacity	13%	47%	30%
Financial	Revenue	$2,708,333	$2,437,500	$3,791,666
	Material Cost	$1,040,000	$977,600	$1,216,569
	Conversion Cost	$693,333	$693,333	$693,333
	Profit	$975,000	$766,567	$1,881,764
	Return on Sales	36%	31%	50%

improvement, and empower the entire workforce. This approach contrasts with the traditional emphasis on the use of measurements to monitor and discipline the direct labor workforce.

Financial Reporting

Standard product costs are not required for financial reporting. Value stream costing can be used for all financial reporting including internal reporting to operations, corporate offices, and external reporting to stockholders, SEC, internal revenue, and so forth. The inventory valuation section (see p. 20) describes how to establish values for ending period inventory balances for external reporting purposes.

Product or Customer Rationalization

Decisions related to product and customer rationalization are also made using value stream cost information and the value stream box score.

A company had identified products it considered to be less profitable than others using productspecific information. It assumed that by removing these products they would improve their overall profitability. When the products were removed, however, the profitability of the value stream fell sharply, as shown in Exhibit 5. The reason for this is that much of the cost included in the standard product costs for these "low margin" items does not go away when the products were removed. What happened is that the company improved their service to the customers and made capacity available within the value stream—but only a part of the value stream cost was reduced. The box score in Exhibit 6 shows the impact of these changes.

The removal of these troublesome products improved the company's operational performance but increased the company's average costs and reduced profits. At the same time, 34% additional available capacity was freed up. This is key. The company only benefits from this new capacity if the free capacity is recognized and used to advantage by introducing new, highrevenue products using some of the capacity freed up by the "low margin" products. This idea is consistent with the experience of many companies who found that eliminating or reducing nonvalue-added activities as part of an ABC implementation was not enough by itself; they also needed to eliminate the excess capacity or find productive uses for it.

Measuring Cost Improvement

It is important when transitioning to a lean enterprise to have a clear understanding of the impact

Exhibit 7. Measuring Short-Term Financial Impact of Change

		CURRENT STATE	SHORT TERM FUTURE STATE
Operational	Units per Person	466	466
	On-Time Shipment	92%	98%
	Dock-to-Dock Days	15	10
	First Time Thru	65%	82%
	Average Cost	$117.32	$115.23
	AR Days	42	42
Capacity	Productive Capacity	24%	24%
	Non-Productive Capacity	63%	44%
	Available Capacity	13%	32%
Financial	Revenue	$2,708,333	$2,708,333
	Material Cost	$1,040,000	$1,019,200
	Conversion Cost	$763,631	$752,176
	Profit	$904,703	$936,957
	Return on Sales	33%	35%

of the changes being made. Many companies expect to see significant short-term cost savings when introducing lean manufacturing and other lean methods. Over the longer term, lean manufacturing is the low-cost method of production; but these cost savings do not come in the short term. There are some short-term costs savings, but the significant savings generally come over a longer period as many aspects of lean are introduced and become mature. It is important when making lean improvement to truly understand the impact of lean changes and use these changes for the financial benefit of the company. Significant short-term improvement in inventory levels as measured by either inventory turns or days supply on hand should be noted. Some short-term savings are possible with significant reduction in scrap, overtime, expedite costs, and warehouse rental costs.

The primary goal of most lean improvement—particularly in the short term—is to eliminate waste from the company's processes. When waste is eliminated there may be cost savings, but most of the reduced waste translates into available capacity. The financial benefit of these lean changes is determined by what the company does to make use of this newly freed up capacity. Exhibit 7 shows an example from a value stream within our example company.

This company started its lean changes in this value stream by drawing a "current state" map. It then developed a "future state" map, which included a number of significant changes to eliminate waste throughout the value stream. Before embarking on the improvement projects required to realize these improvements, the team calculated the expected impact of the future state on the value stream. As can be seen, there is significant improvement in the operational measurements, including much better on-time shipment, much less inventory, and much improved quality. But the financial impact is rather low. There is some cost saving owing to the reduction of material scrap, but very little else. Consequently there is little cost reduction and little improvement in profit.

One significant impact of these changes on the value stream is the reduction in nonproductive capacity and the increase in available capacity. The financial benefit of these changes to the value stream comes when this new available capacity is used to benefit the company. The available capacity can be used to increase sales, allow the

introduction of new products, provide additional services to the customers, produce inhouse products or components that are currently outsourced, and other changes that increase revenue and/or reduce costs.

Another large impact of these changes is a significant decrease in inventory levels. This is largely due to producing only to demand and filling orders with finished goods inventory on hand. The immediate impact is seen in inventory change measures, such as days supply of inventory and inventory turns. But it is extremely important to note that as on-hand inventory is depleted and inventory is moved from the balance sheet to cost of goods sold on the income statement, there will be a decrease in net income. This is due to expensing in the current period overhead costs that were previously capitalized as finished goods inventory. It is crucial that this negative financial impact be anticipated and that upper level managers be educated to understand that this is a short-term phenomenon. This is reversed as inventory levels reduce to a desirably low level and orders are filled mostly from production.

It is also possible to reduce costs by eliminating people and selling equipment. But successful companies making the lean transformation strive to make a commitment to their people that no one will lose his or her employment as a result of lean improvement. You cannot empower people to make lean changes and then "let them go" when the changes occur. This would impede any further lean improvement. Through employee attrition and by reducing overtime, however, reduction in labor cost is a reasonable expectation. Reducing rented inventory space is also possible.

The key decision is to develop a plan for using the newly available capacity to provide financial and operational benefit to the company. These decisions must be made up-front at the beginning of the improvement process because it usually takes time for these plans to reach fruition and bring significant financial improvement. In the case of our example company, it added new products, in-sourced some subassemblies, and rented out floor space that was freed up as production moved from batch-and-queue to singlepiece flow cellular manufacturing.

Exhibit 8 illustrates that there is plenty of room for increasing the output of the value stream, as there is still a considerable amount of available capacity remaining to be used.

Transfer Pricing

In most companies, transfer pricing is the only legitimate need for assigning a product cost to an individual product. When a product is moving from one location to another within the same organization, and when those locations are in different countries, it is necessary to have a transfer price that is usually based on the product cost. Some companies, however, calculate transfer prices based on their product prices rather than their costs; most, however, use product cost as the basis for transfer pricing. When a product cost is needed for transfer pricing (or other requirement), the features and characteristics method of product costing, which we will discuss later (p. 23), is recommended.

Inventory Valuation

As lean methods take hold within a company, inventory levels fall dramatically. It is common for lean companies to see 50%-90% inventory reductions. As inventory falls, the value of the inventory becomes much less significant; it has much lower materiality. In addition to the inventory levels being lower, the material comes under better control. This level of control is created by the combination of low inventory, visual controls, pull systems with vendors, and the responsibility for purchasing and inventory control residing within the value stream team.

When inventory is low and under control, simple inventory valuation methods can be used. When inventory is high and out of control—the usual situation with many manufacturers, distributors, and service organizations such as hospitals—it is necessary to use computer systems to track it, product costs to value it, and physical inventory

Exhibit 8. Measuring Financial Impact of Increased Capacity

		CURRENT STATE	SHORT TERM FUTURE STATE	LONGER TERM FUTURE STATE
Operational Measurements	Units per Person	466	466	559
	On-Time Shipment	92%	98%	98%
	Dock-to-Dock Days	15	10	8
	First Time Thru	65%	82%	82%
	Average Cost	$117.32	$115.23	$101.28
	AR Days	42	42	42
Capacity	Productive Capacity	24%	24%	29%
	Non-Productive Capacity	63%	44%	45%
	Available Capacity	13%	32%	26%
Financial	Revenue	$2,708,333	$2,708,333	$3,277,083
	Material Cost	$1,040,000	$1,019,200	$1,131,312
	Conversion Cost	$763,631	$752,176	$737,133
	Profit	$904,703	$936,957	$1,408,638
	Return on Sales	33%	35%	43%

(or cycle counting) to maintain accuracy. When lean methods are used to bring the inventory under control, these wasteful methods are not necessary. Some examples of simpler inventory valuation methods are given below.

Days of Stock. It is common for lean companies to track the number of days of inventory they hold in purchased materials, WIP, and finished goods. This is used as a performance measurement to gauge the rate of material flow through the value stream. When they have this information, it is easy to calculate the inventory value. In Exhibit 9, the material cost for the month in the value stream is $100,000, or $5,000 per day (in a 20-day month). The total conversion cost in the value stream is $150,000, or $7,500 per day. If there are eight days of raw materials, then the valuation is 8 * $5,000, or $60,000. The value of three days of WIP comes to three days of material cost and 1.5 days of conversion cost— assuming the WIP items are half complete on average. The value of finished goods is 12 days of material cost and 12 days of conversion cost.

Material Cost Plus Days of Conversion Cost. Some lean companies keep track of the material cost of their inventory and then apply the conversion costs using the number of days. In the example above, the material cost is already known to be a total of $115,000. This is already reported as inventory on the balance sheet. At month end, the controller needs to apply the conversion costs as a reversing journal entry to the balance sheet. There are 13.5 days of conversion cost to be applied; 12 days of finished goods and 1.5 days of WIP. The conversion cost that is debited to inventory on the balance sheet would be 13.5 * $7,500 = $101,250.

Quantity of Finished Goods. In companies that have large finished goods inventory there are some methods to calculate finished goods value. Suppose the company has 90 units of finished goods in stock and that it manufactured 150 units during the month. The value of the finished goods inventory will be the total monthly value stream cost ($100,000 + $150,000, or $250,000) multiplied by 90/150 (0.6). This comes to $250,000 * 0.6 = $150,000. Consider that the company had 190

Exhibit 9. Inventory Value Example

	This Month Material Cost $100,000 Conversion Costs $150,000	Per Day $5,000 $7,500	
	Raw Materials	Work in Process	Finished Goods
DAYS	8	3	12
Material Cost	$40,000	$15,000	$60,000
Conversion Cost	$ 0	$11,250	$90,000
INVENTORY VALUE	$40,000	$26,250	$150,000

units instead of 90 units. This is more than the quantity manufactured this month—150 units. In this case, the finished goods inventory is valued at the total cost of the value stream for this month and 40/150 of the toal cost of the prior month (if the prior month's production quantity was also 150 units). The assumption is that the 150 made this month are all in finished goods inventory, together with 40/150 of the items manufactured during the prior month. (In other words, a first-in, first-out (FIFO) inventory flow is generally assumed.) This assumption is true on average when the inventory is low, under control, and there is a pull system.

Average Costs. It is common to track the average costs of products in a value stream as a primary performance measurement each week. The value of finished goods inventory can be calculated by multiplying the number of units in stock by the average product cost for the month. If there is more than one month of finished goods inventory, then the average costs from prior months (or weeks) will also be used. This method assumes first-in, first-out (FIFO) inventory management, a well controlled inventory process, and a reasonable consistency of mix.

Product Cost. If a company has larger finished goods inventories, then the valuation will be more traditional. There are many companies that have become adept at lean methods within production and have very low purchased materials and WIP, but maintain high finished goods because they are stored in warehouses in many different geographic locations. They need a method to value their inventory until they solve the problems necessitating the carrying of high inventory levels.

Under these circumstances, it is necessary to track the quantity of finished goods on the computer systems and to maintain a product cost for each item. This is traditional except the product cost is calculated using features and characteristics costing (F&C). F&C is usually simpler to calculate than a standard cost and is a more accurate number. It can be used for inventory valuation when there are high levels of stocks that are caused by problems remaining to be resolved.

How do we know how much inventory we have? Traditional companies hate taking physical inventory counts, yet they must do them. These counts can take several days to complete. They tie up resources counting, reporting, and reconciling the inventory figures. This process also disrupts production. While it may be of benefit to the auditors, it is of no practical help to the company.

Many companies try to "solve" this by moving to regular cycle counting. Instead of a full, annual stock count, the physical inventory is done little by little each week. More expensive items are

counted more often than inexpensive commodities. These activities are wasteful of course, but they satisfy the auditors and keep the balance sheet accurate.

Lean companies take the opposite approach. They move back to a full physical stock count; not annually, but monthly or even weekly. The reason is that a full physical count is quick and easy. When inventory is low and controlled visually, it is very easy to count. Often it is not necessary to count the actual parts; you can just count the kanbans. The material and components are stored in standard containers with a standard kanban quantity in every container, and it is simple to count the number of containers or the number of kanban cards associated with them.

It is common for lean organizations to no longer track inventory on the computer system. If the visual control is effective, there is no need for a second, parallel tracking system.

Summary of Decision Making in Lean Accounting

When using lean accounting, regular decisions relating to such things as profitability, make vs. buy, sourcing, product and customer rationalization, and so forth, are made using value stream cost and profitability information, not the costs of individual products. Instead of calculating the margins for a product or an order, decisions can be made based on the effect on the value stream as a whole.

The calculation of individual product costs using full absorption costing methods are not helpful to companies using value stream costing. These methodologies are flawed by their underlying assumptions and efforts to create more complex cost allocations—while providing more "accurate" product costs. This has led to increased complexity and wasteful transactions.[4] In general, it is important that the costing methodology utilized by an organization be able to accurately reflect the effect on costs of changes in the activity level. Value stream accounting is such a costing methodology. Making routine decisions using value stream cost information is generally quick, simple, and accurate. There is no need to calculate a product cost; value stream costing provides better information leading to better decisions. The value stream information is better for decision making because:

- It is real information and does not contain the complex (often baffling) assumptions of full absorption product costing.
- The cost and revenue information is clearly understood by the people using the information, which enables them to make more informed decisions.
- The financial information is up to date, often to the current week.

When making a decision, the true cost changes that will occur are applied to the value stream cost information. The impact of the suggested actions is shown in the profitability of the value stream. This provides accurate and understandable information that shows the true impact of the decision on the value stream. This cost and profitability analysis can be readily calculated because current value stream income statements are available, and the impact of the suggested actions can be calculated quickly and easily. Sometimes these calculations apply to a single option, but often there are several alternatives that need to be assessed to understand the true financial impact of each alternative.

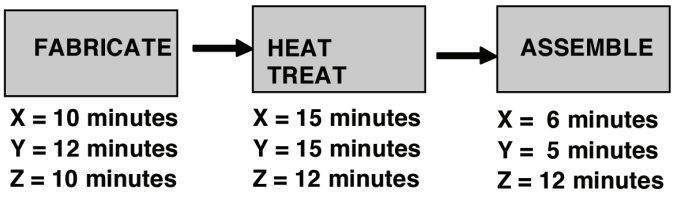
Features and Characteristics

There is little need in lean accounting to calculate a product cost because the traditional needs for product costs are no longer necessary:

- In traditional companies, the price of a product is often based to a large extent on product cost. Lean companies price products based on the value of the product to the customer or market.
- Traditional companies need a product cost to calculate the value of their inventories. Lean

4 Kaplan, Robert S., and Anderson, Steven R. "Time Driven Activity-Based Costing." Harvard Business Review. November 2004.

Exhibit 10. Impact of Bottleneck on Product Cost



companies have very low inventories and—when inventories are low—there are much simpler ways to value inventory.

- Traditional companies use product costs to make decisions about the profitability of an order, customer, or product family. They also use product cost to make decisions relating to make vs. buy or sourcing of products. Lean companies use value stream costing for these kinds of decisions; they assess the impact of these decisions on the profit and profitability of the whole value stream, not the individual product.
- Traditional companies evaluate manufacturing variances for efficiency monitoring. Lean companies rely on shop floor measures and box scores for understanding performance and improvement impact. As the need for a product cost no longer exists, there is no longer a need to maintain a complex system such as standard costing to calculate the cost of each product. If the cost of a product is required, it can be readily calculated on an "as needed" basis.

When a product cost is required, features and characteristics (F&C) costing is often used. F&C recognizes that the cost of a product is not determined by the amount of labor time (or machine time) required to make the product; it is determined by the rate of flow of the product through the value stream.[5] F&C product costing determines the features and characteristics of the product that affect the rate of flow through the value stream.

Consider the following example (see Exhibit 10). A value stream manufactures three products: X, Y, and Z. Each product goes through three cells, each of which has a team of people and machines. Using value stream costing, we calculate the total conversion cost (excluding materials) of the value stream to be $1,000 per hour.

How many Xs can we make each hour? Four. The flow through the heat treatment furnace limits the production quantity to four per hour. The cycle time of the bottleneck (or constraint) operation is 15 minutes; so the cycle time of the entire value stream is 15 minutes. We can produce one X every 15 minutes.

If the material cost for an X is $200 per unit and the conversion cost is $1,000 per hour, then the total cost of the product is:

$$\$200 + (\$1,000 / 4) = \$450$$

5 The features and characteristics method of product costing mirrors some of the methods developed by Eli Goldratt and his companions in the Theory of Constraints (TOC movement. TOC provided an excellent academic framework for understanding that costs are determined by rate of flow rather than labor time, and this was demonstrated cleverly in the book The Goal. A full explanation of throughput costing is given in Thomas Corbett's book Throughput Accounting (North River Press, 1998).

Exhibit 11. Product Cost Conversion Chart

Size	Regular Steel	Stainless Steel
Small	0.80	1.20
Medium	1.00	1.25
Large	1.50	2.00

Average Conversion Cost = $200

Product Y is similar. The value stream can make four Ys per hour. If the material cost for a Y is also $200, then the cost of a Y is the same as an X:

$200 + ($1,000 / 4) = $450

It is evident from this example that the standard product cost calculation for X and Y provides erroneous and misleading information. It would show Y as having a higher cost than X because there is more labor and/or machine time used to make the product (X=31 minutes; Y=32 minutes; Z=34 minutes). In fact, the value stream costs are not expended based on the number of hours worked, but on the rate of flow through the value stream.

Product Z, on the other hand, flows more quickly through the value stream because its cycle time through the bottleneck operation is only 12 minutes, and the value stream can make five Zs per hour. If the material cost for a Z is also $200 per unit, then the product cost for a Z is:

$200 + ($1,000 / 5) = $400

The cost of Z is lower than X despite Z taking more total labor and/or machine time in the process. The cost of the product is primarily related to the rate of flow through the value stream, not the amount of labor or machine time required to make the product.

The F&C method of product cost calculation creates a simple matrix of the features and characteristics of the products (or the service, if we are costing a service) that truly affect the rate of flow through the value stream. In the simple example above, the rate of flow through the heat treatment oven is determined by the size of the product and the type of material: regular steel or stainless steel. Average conversion cost represents the labor and support costs to convert material into finished product. Exhibit 11 illustrates such a conversion matrix

Product Z is a medium-sized product made from regular steel. The cost of a Z is:

Material Cost + Average Conversion * 1.00
$200 + ($200 * 1.00) = $400

Products X and Y are medium-sized products made from stainless steel. Their product costs are:

$200 + ($200 * 1.25) = $450

From this simple matrix, we can calculate the cost of any product when we know its features and characteristics—in this case, the type of steel and the size. This conversion cost is calculated from the average cost for the products manufactured in the value stream, and this average cost can be updated as frequently as required.

Material costs are usually calculated by exploding the bill of materials against the latest actual material cost or the latest average actual material cost. It is possible—in some cases—to also derive the material cost using the same features and characteristics process. For example, a company making rubber seals finds that the conversion cost of a product is determined by the type of rubber (which affects the cure time) and

the number of cavities in the mold when the product is pressed. A 20-cavity mold product is half the cost of a 10-cavity mold product. The material cost is also determined by the same two features of the product. The type of material determines the cost per pound, and the number of cavities per mold determines the amount of material required to make the product.

The material cost and the conversion cost is determined by the same features and characteristics.

A word of caution: Calculating product costs using the features and characteristics method results in a more accurate product cost, and it is (usually) a much simpler method of calculation than a standard product cost based on production routing information, but it would still be inappropriate for most decisions. The only legitimate uses of product cost calculated this way are for transfer pricing and for the valuation of finished goods inventory when the amount of inventory is high.

Lean Budgets and Financial Planning

Financial planning in lean organizations is more dynamic than is usual in traditional companies. The planning and budgeting process is done every month (typically) and is used to create an integrated "game plan" across the organization. The process is commonly called sales, operations, and financial planning (SOFP).

The budgets are an outcome of a formal planning process designed to ensure that the company has all of the things in place to create maximum value for the customer and sufficient capacity is available to meet customer needs. Budgeting is not an end in itself but comes out of the planning process and uses the latest and most reliable information. One criticism of traditional budgeting processes is that they are done several months before the new year starts and are often out of date even before they come into action. It is said that business is so dynamic that traditional annual budgets are not helpful for planning and control.

The SOFP process varies with different kinds of organizations (manufacturing, distribution, service, education, healthcare, etc.), but all organizations follows similar steps.

- STEP ONE. The sales and marketing people provide estimates of the expected requirements to meet customer needs. These forecasts are expressed in operational terms, such as the number of products to be sold or number of patients requiring service at the AIDS clinic. Typically these forecasts are done for each month over a 12-month period. They are not expressed in terms of dollars or other financial numbers. The forecasts are done at a macro level. There may be a forecast for each value stream or product families within value streams. Detailed level forecasting should be avoided for planning purposes because more aggregated numbers are more accurate. If new products and services are being added to the offering from the value stream, then these need to be included in the forecasts of customer demand.
- STEP TWO. The operations people forecast the capacity that will be available each month to fulfill customer needs. These forecasts are again by value stream or product family within value stream. The forecasts are based on the value stream's demonstrated capacity in recent months and takes into account the planned changes and improvements to the value streams over the next 12 months.
- STEP THREE. The middle managers involved in the forecasts get together for an "SOFP meeting." During this formal and strictly agendadriven meeting, each value stream is reviewed, and decisions are made relating to changes required to match the customers' expected demand with the value stream's capacity to meet those needs. Most of the planning is completed within this formal meeting. There will be some issues, however, that the managers can either not agree on or for which they do not have the authority to make changes. These issues are referred to

the "Executive SOFP meeting" in Step Five below.

- STEP FOUR. Using the information coming out of the SOFP meeting, finance creates budgets for the next 12 months. These budgets are 26 derived from the most recent and most accurate information available to the company and from the value stream costing information. There is short-term information relating to the expected month-end results and longer-term information relating to such things as the need for capital purchases or changes to headcount within the value stream.
- STEP FIVE: The final step of the SOFP process is the Executive SOFP meeting. This is presided over by the president of the organization (or the most senior person within the entity) and is a short, well-planned meeting. Each value stream is briefly reviewed and exceptions discussed. The company's executive team makes decisions and creates a jointly agreed upon "game plan" for the organization for the next 12 months. This game plan is updated each month. The purpose of the game plan is to create coordination across the company's sales and marketing, operations, new product development, administration, and other processes to ensure customers' needs are fully met in the short term and longer term.
- The short-term issues coming from the SOFP process include:
  - Establish production cycle times to match customer needs,
  - Create level scheduling,
  - Recalculate kanban quantities,
  - Determine manning levels for cells and the value stream,
  - Finalize project plans for new product introductions and continuous improvement,
  - Create month-end financial results in advance, and
  - Initiate sales programs to make the best use of resources. I The longer-term issues coming from the SOFP process include:
  - Change staffing levels to meet future needs,
  - Purchase or redeploy capital equipment,
  - Outsourcing decisions, 4 Raw material and component planning,
  - Develop new marketing strategies,
  - Establish new product development programs,
  - Establish long-term continuous improvement plans, and
  - Budgeting & financial planning.

The budgeting process is an outcome of the broader planning process. SOFP is a formal, systematic approach for planning the value streams to create value for the customers. It requires considerable cooperation across the company's processes, including sales and marketing, operations, new product development, administration, and finance. SOFP is an effective approach to planning and budgeting because it encompasses all aspects of planning within a single, formal, effective process. SOFP replaces myriad formal and informal meetings with a single authoritative process that creates a company-wide game plan.

Transaction Elimination

Companies employing traditional manufacturing methods frequently have processes that are out of control. This lack of control is manifested by late deliveries, large inventories, frequent expediting to meet customers' needs, constant shortages of materials from suppliers and delays, complex processes, and so forth. Similar chaos and complexity can be seen in service industries, schools, hospitals, and government agencies.

Does this mean that these organizations are run by incompetent managers? No. The reason for the problems listed above is that there are so many issues and problems within their processes and those of their suppliers and partners that the only way to provide any kind of acceptable service to customers is to crisis-manage and expedite.

These companies become successful by the heroic efforts of their employees.

It is the responsibility of the senior financial executive to provide valid and accurate financial information both internally and externally. In order to do this, the company must have systems to collect detailed financial information throughout the company's processes and report what has actually occurred. When a company has processes that are out of control, it is imperative to have systems that collect the "actual" information throughout the company in order to provide financial reports that meet the needs for regulated external reporting and internal business management.

There are two approaches to out of control processes. One approach is to apply a complex technology solution; the second is to bring the processes under control. For the most part, Western companies have taken the first approach. The introduction of Materials Requirements Planning (MRP) systems in the 1970s was designed to bring materials procurement under control. This was followed by Capacity Requirements Planning, which was designed to bring shop floor machine loading under control.

During the 1980s, Manufacturing Resource Planning (MRPII) was developed. It couples the production and materials planning with shop floor execution and "closes the loop" between the plan and the actual performance in the plant. The 1990s brought Enterprise Resource Planning (ERP), which linked all the company's operations into a single integrated (sometimes multinational) system. The company's sales and marketing processes, materials processes, accounting processes, HR processes, engineering processes, production processes, and distribution processes all run on the same large, complex system. Similar systems were developed to address banking, insurance, stock broking, logistics, transportation services, government agencies, healthcare, and other industries.

These systems recognize the chaotic nature of business and attempt to overcome these issues by tracking, recording, analyzing, and reporting the processes so they can be managed by the company's middle managers. These systems have been quite successful. Much of the increased productivity of American companies is credited to the use of these kinds of information systems.

Lean organizations take a very different approach. When there is instability or lack of control with a process, they seek to address the root causes of the problem and eliminate it. As these root causes are eliminated, it is no longer necessary to have complex systems to provide financial and operational control because the control is built into the processes themselves.

A simple example would be helpful to expand on these points. What kind and how many transactions are needed to provide financial control to a company that has 80% on-time delivery, six-week production lead times, high levels of scrap and rework, constant expediting, WIP that varies considerably from one day to the next, and a monthend "meet the numbers" mentality? The answer is thousands of transactions. The processes are fundamentally out of control, and there is a need to track the individual processes in great detail every day to provide valid financial information.

Now say that this company embarked on a lean manufacturing transformation. The production lead time fell to three days, on-time delivery reached 98%, inventory is low and consistent owing to an effective pull system, and there is reasonable linearity of demand and production. The company has not yet become "world class," but the managers have worked hard to bring a first level of lean flow through the plant. How many and what kind of transactions are required under these new circumstances? Because there is a good deal of control and stability within the company's processes, the answer is "not many."

Lean companies transfer control from the traditional transactional control to building control into the operational processes. As the operational process are brought under control using lean root cause analysis and visual lean methods, there is no longer a need for complex transactional control systems.

Exhibit 12. Example For Planning Transaction Elimination: Work Orders

REASONS FOR WORK ORDERS	LEAN APPROACH
Authorize production	Kanban or sales order authorizes production
Track WIP inventory and valuation	When production cycle times are short there is no need to track WIP. WIP is low under visual control, and can be easily identified & valued.
Report labor used in production	There is no need for labor reporting when using value stream costing.
Track status of the order	When production lead times are short and under visual control, there is no need to track the status of the order.
Give instructions for making the product	Use visual work instructions and standardized work sheets.
Give bill of materials information	Visual work instructions and standardized work sheets. Sometimes these can be printed on the kanban card.
Report completion of the job	Production completion information is tracked by visual performance measurements in the cell.
Update inventory of components & raw materials	There is no need to track component and raw materials on the computer system because they are under good visual control.
Schedule production	Production is scheduled using level scheduling boards based on an effective monthly *sales, operations, and financial planning* process.
Identify the products in the process	Products are identified visually by their kanban cards and customized standard containers.
Calculate product costs	There is no need to calculate the cost of individual production jobs when value stream costing is used.
Report scrap	Scrap is controlled using hourly performance measurements in the cells and departments. There are formal continuous improvement methods to resolve these problems by changing standardized work.
Report labor efficiency	This is not a measurement used by lean companies. Lean measurements are used in the cells and at the value stream level to understand and improve productivity.
Variance reporting	These are not measurements used by lean companies. Value stream costing and cell measurements eliminate the need for comparing so-called actual costs against standard.

Does this mean that lean organizations are against computer systems? No. There is an important place for information systems within lean organizations but, by and large, information systems are not required for daily operational control of, for example, a production shop floor. Lean organizations are not anti-systems, but are more pro-visual management and for self-controlling processes. If the most visual and lowest-waste method to bring the processes under control includes computer systems, then computer systems should be used. But generally this is not the case because visual management is usually best served through more manual methods for daily operational control.

Eliminating Transactions

Transactions are eliminated prudently and carefully. Transactional controls are only eliminated when they are demonstrably no longer needed. It is usually best to determine in advance the circumstances that must prevail in order to remove control systems. It is possible to develop a maturity path plan where the controller can determine what must be in place within the operation for particular transactional controls to be removed.

Some transaction-heavy processes within manufacturing companies include the work-order and production control processes, the purchasing and accounts payable processes, and the inventory tracking and reporting systems. The first steps toward eliminating the work order processes could include:

- Start with identifying how many and what kind of transactions are currently required to run the business.
- Make a list of all the reasons for using the work order and its associated transactions.
- Establish how—in the longer run as lean methods take shape within the company—these reasons are eliminated or replaced by lean tools. An example is given in Exhibit 12.
- Once the controller and the operations managers understand how the processes will be brought under control using lean methods and measurements, then a maturity path plan can be developed that maps out the step-by-step changes required to introduce the lean methods and bring them to a point where the processes are under good operational control and the transactions can be eliminated.
- Once these changes are made, the transactional systems can then be gradually removed as the processes are brought under control operationally.

It is always a good idea to bring auditors (internal or external) into these decisions. If the auditors are part of the design of the visual management processes, then they will be able to better audit the success (or otherwise) of these processes in maintaining control. The audit rules and methods need to be changed because there is no longer a need to audit transactions. Instead, the need is to audit the operational processes to ensure that operational and financial control is maintained.

Conclusion

Industries are changing the way they produce and deliver products and/or services to customers in order to compete in rapidly changing environments. Production companies adopting the lean principles reconfigure manufacturing lines into cells and reorganize them from functional departmental units into value stream teams responsible for the complete flow of material from receipt to finished product delivery. Similar changes are made in service organizations where departments are reorganized into value streams and processes are performed in cross-functional cells or teams. These changes represent a radical departure from prior traditional structures that are vertically control oriented with decisions made only at the manager and supervisor level.

Traditional management accounting has evolved over the years to better support operations as they change. As companies adopt lean principles and strive to reduce waste, promote a smooth pull system, and provide stellar product

and service quality, it is time to reflect on traditional management accounting practices and how they can better support decisions within lean-thinking organizations. The lean accounting practices and decision techniques presented in this SMA offer alternatives for management accountants to explore when supporting their organization as they embark on implementing lean techniques.

Glossary

This glossary provides definitions of words commonly used within lean organizations. For a more comprehensive lexicon of lean terminology, refer to Chet Marchwinski and John Shook's *Lean Lexicon: Graphical Glossary for Lean Thinkers*, referenced in the Resource List.

3 REPORT. A standard method of summarizing problem solving exercises, status reports, and planning exercises; a Toyota practice.

ANDON BOARD. A visual control device in a production area, typically a lighted overhead display, giving the status of the production system and alerting team members to emerging problems.

BATCH-AND-QUEUE. The mass-production practice of making large lots of a part and then sending the batch to wait in the queue before the next operation in the production process.

CELLS. The layout of machines of different types performing different operations in a tight sequence, typically in a U-shape, to permit single-piece flow and flexible deployment of human effort by means of multi-machine working.

CHANGEOVER. The installation of a new type of tool in a metal working machine, a different paint in a painting system, a new plastic resin and a new mold in an injection molding machine, new software in a computer, and so on. The term applies whenever a production device is assigned to perform a different operation.

CYCLE TIME. The time required to complete one cycle of an operation. If cycle time for every operation can be reduced to equal "takt time," products can be made in single-piece flow.

FEATURES AND CHARACTERISTICS (F&C) PRODUCT COSTING. Method for calculating product costs by identifying the features and characteristics of the product that affects its rate of flow through the value stream. The value stream average cost is adjusted based on the product features and characteristics to yield the product cost.

FIVE S (5S). Five related terms (each beginning with an S) describing workplace practice conducive to visual control: sort, straighten, scrub, standardize, sustain. It is a method of achieving workplace orderliness to achieve visual management.

FIVE WHYS. Taiichi Ohno's practice of asking "Why" five times whenever a problem was encountered in order to identify the root cause of the problem so that effective countermeasures could be developed and implemented.

FLOW. The progressive achievement of tasks along a value stream so that a product proceeds from design to launch, order to delivery, and raw materials into a finished products in the hands of the customer with no stoppages, scrap, or backflows.

GEMBA. Japanese for "actual place." Used to stress the importance of lean improvement being done at the place where the work is done using detailed visual observation.

HOSHIN KANRI. Japanese term meaning "deployment of the company's strategy." The Hoshin process is used to provide a formal method for deploying the company's strategy throughout the organization. The Hoshin process seeks to create a high level of consensus through collaborative planning rather than top-down change management.

JIDOKA. The part of the production system that reacts and responds to abnormalities that arise in the production process.

KAIZEN. Continuous incremental improvement of an activity to create more value with less waste.

LEAN PROMOTION OFFICE. A resource for a lean transformation. The team provides value stream managers with technical assistance to use lean methods to transform the flow within the value stream.

LEVEL SELLING. A system of customer relations that attempts to eliminate surges in demand caused by the selling system itself (for example, due to quarterly or monthly sales targets) and that strives to create long-term relations with customers so that future purchases can be anticipated by the production system.

MATERIAL REQUIREMENTS PLANNING (MRP). A computerized system used to determine the quantity and timing requirements for materials used in a production operation. MRP systems use a master production schedule, a bill of materials listing every item needed for each product to be made, and information on current inventories of these items in order to schedule the production and delivery of the necessary items. Rarely used in lean production.

MONUMENT. A machine, person, or department of a large scale that must be shared across more than one value stream.

PACEMAKER. The process in the value stream that sets the pace of production. The pacemaker may be the bottleneck operation that constrains the rate of of flow through the value stream.

PERFORMANCE MEASUREMENTS LINKAGE CHART. Method for linking corporate, plant, value stream, and cell/process performance measurements with the company's strategy. The primary purpose is to ensure that the measurements reflect the aims and balance of the company's strategy.

PLAN-DO-CHECK-ACT. A systematic process improvement methodology requiring the proposal of a change, the implementation of the change, measuring the effect of the change, and taking appropriate action. Also called the Deming Cycle. 32 POKA-YOKE. A mistake-proofing device or procedure to prevent a defect during order taking or manufacture.

POLICY DEPLOYMENT. Management process that aligns—both vertically and horizontally—a firm's functions and activities with its strategic objective. A specific plan—typically annual— is developed with precise goals, actions, timelines, responsibilities, and measures. Sometimes called strategy deployment or Hoshin. PULL. A system of cascading production and delivery instructions from downstream to upstream activities in which nothing is produced by the upstream supplier until the downstream customer signals a need.

QUALITY FUNCTION DEPLOYMENT (QFD). A visual decision-making procedure for multiskilled project teams; it develops a common understanding of the voice of the customer and a consensus on the final engineering specifications of the product that has the commitment of the entire team.

SEVEN WASTES. Taiichi Ohno's (Toyota manager, the father of lean thinking) categorization of the kinds of waste within an organization: overproduction, waiting, transportation, unnecessary processing, inventory, motion, and inspection.

SINGLE MINUTE EXCHANGE OF DIES (SMED). A series of techniques for changeovers of production machinery in less than 10 minutes.

SINGLE-PIECE FLOW. A situation in which products proceed, one complete product at a time, through various operations in design, order taking, and production without interruptions, backflows, or scrap.

STANDARDIZED WORK. A precise description of each work activity specifying cycle time, takt time, the work sequence of specific tasks, and the minimum inventory of parts on hand needed to conduct the activity.

SUPERMARKET. A stocking point for inventory that has low inventory that is visually controlled and is replenished using a pull system.

TAKT TIME. The available production time divided by the rate of customer demand. Takt time sets the pace of production to match the rate of customer demand and becomes the heart of any lean system.

TARGET COST. The development and production cost that a product cannot exceed if the customer is to be satisfied with the value of the product while the manufacturer obtains an acceptable return on its investment.

THROUGHPUT TIME. The time required for a product to proceed from concept to launch, order entry to delivery, or raw materials into a finished product in the hands of the customer.

VALUE STREAM. All the actions—both valuecreating and waste—required to bring a product from concept to launch (new product development value stream) or from the sale through to delivery and collection of cash (order fulfillment value stream). These include actions to process information, transform the product, move the materials and the product, and exchange cash.

VALUE STREAM COSTING. A simple summary of the direct costing of value streams.

VISUAL MANAGEMENT. The placement in plain view of all tools, parts, production activities, documentation, performance measurements, and other aspects and methods for the control and improvement of the value stream. Visual management applies equally in administrative and service processes. WASTE. An activity that consumes resources but creates no value for the customer. Muda (vulgar Japanese word for "waste") is divided into Muda 1 and Muda 2. Muda 1 is waste that creates no value but in unavoidable with current technologies and policies. An example would be the payroll process. Muda 2 creates no value and can be eliminated. An example would be shop-floor labor reporting.

Resource List

Lean Accounting

Fiune, Orest, and Cunningham, Jean. *Real Numbers*. Durham, NC: Managing Time Press, 2003.

Johnson, H. Thomas, and Broms, Anders. *Profit Beyond Measure: Extraordinary Results through Attention to Work and People*. Free Press, 2000. Maskell, Brian, an d Baggaley, Bruce. *Practical Lean Accounting*. New York: Productivity Press, 2003.

Solomon, Jerrold. *Who's Counting: A Lean Accounting Business* Novel. WCM Associates, 2003.

Waddell, Willam, and Bodek, Norman. *Rebith of American Industry*. Vancouver, WA: PCS Press, 2005.

Implementing Lean Operations

Allen, John (ed.). *Lean Manufacturing: A Plant Floor Guide*. Dearborn, MI: SME, 2001.

Dennis, Pascal. *Lean Production Simplified*, New York: Productivity Press, 2002.

Keyte, Beau, and Locher, Drew. *The Complete Lean Enterprise: Value Stream Mapping for Administrative & Office Processes*. New York: Productivity Press, 2004.

Liker, Jeffrey, (ed.). *Becoming Lean: The Inside Stories of U.S. Manufacturers*. New York: Productivity Press, 1997.

Marchwinski, Chet, and Shook, John. *Lean Lexicon: Graphical Glossary for Lean Thinkers*. Brookline, MA: Lean Enterprise Institute, 2003.

Rother, Mike, and Shook, John. *Learning to See: Value Stream Mapping to Add Value and Eliminate Muda*. Brookline, MA: Lean Enterprise Institute, 1998.

Womack, James, and Jones, Daniel. Lean *Thinking: Banish Waste and Create Wealth in Your Corporation*. New York: Simon and Schuster, 1996.

Womack, James, and Jones, Daniel. L*ean Solutions: How Companies and Customers Can Create Value and Wealth Together*. New York: Free Press, 2005.

Toyota Production System and Just in Time

Hirano, Hiroyuki. J*IT Implementation Manual: The Complete Guide to Just-in-Time Manufacturing*. Portland, OR: Productivity Press, 1990.

Liker, Jeffrey. *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer*. New York: McGraw-Hill, 2004.

Ohno, Taiichi. *Toyota Production System: Beyond Large-Scale Production*. Portland, OR: Productivity Press, 1988.

Shingo, Shiego. *A Study of the Toyota Production System from an Industrial Engineering Viewpoint*. Portland, OR: Productivity Press, 1989.

Cross-Functional Management

Emiliani, Bob. *Better Thinking, Better Results: Using the Power of Lean as a Total Business Solution*. Kensington, CT: CLBM, 2003.

Ishikawa, Kaoru. *What Is Total Quality Control?* Englewood Cliffs, NJ: Prentice-Hall, 1985.

Mann, David. *Creating a Lean Culture: Tools to Sustain Lean Conversions*. New York: Productivity Press, 2005Monden, Yasuhiro. Toyota Management System: Linking the Seven Key Functional Areas. Portland, OR: Productivity Press, 1993.

Seddon, John. *Freedom from Command & Control: A Better Way to Make Work*. New York: Productivity Press, 2005.

Visual Controls

Galsworth, Gwendolyn. *Visual Workplace: Visual Thinking*. Portland, OR: Visual Lean Enterprise Press, 2005.

Hirano, Hiroyuki. *5S for Operators*. Portland, OR: Productivity Press, 1996.

Nikkan, Kogyo Shimbun (ed.). *Visual Control Systems*. Portland, OR: Productivity Press, 1995.

Videos

Lean Accounting. Society of Manufacturing Engineers, 2005.

Mapping Your Value Stream. Society of Manufacturing Engineers, 2002.

Toast Kaizen: An Introduction to Lean Principles. Greater Boston Manufacturing Partnership, 2005.

What Lean Means. Association of Manufacturing Excellence, 2001.

Websites

www.maskell.com/LeanAcctg.htm
Website devoted to Lean Accounting methods.

www.leanaccountingsummit.com
Nonprofit organization organizing annual Lean Accounting Summit conference.

www.lean.org
Lean Enterprise Institute

www.superfactory.com
Wide-ranging website for lean and other manufacturing methods

www.NWLean.net
Network of companies assisting other companies to implement lean