

TITLE

LEAN ENTERPRISE
FUNDAMENTALS

CREDITS

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I. INTRODUCTION

The world of manufacturing has reached a turning point. Reeling from seemingly unending waves of change, manufacturing companies and those who advise them have redefined what it means to be a manufacturer. New rules have been developed for inventory policies, plant floor layout, optimal flow patterns of products through the plant, supplier relations, and cost constraints. These new rules have led to new competitive strategies fueled by quantum improvements in throughput, effectiveness, and responsiveness.

At the heart of this onslaught of change to the basic tenets of manufacturing lies the concept of lean. Being lean is based on three simple but radical concepts: eliminate waste, continuous improvement, and respect for people. Eliminating waste leads to removal of wasted activities in every aspect of the business. Waste is defined as any use of resources that does not in turn create value in the eyes of the customer. Continuous improvement is a business culture where the entire workforce of the company is involved daily in making beneficial changes to the operation that increases customer value. Respect for people runs counter to the typical business culture of command and control management, where all changes are largely driven from the top through middle managers, and lower-level employees are expected just to do as they are told. In lean organizations, everyone in the organization is involved in continuous improvement and waste reduction, and employees are assured that improved productivity will not result in job losses.

Invented by Toyota, lean production is rapidly becoming the dominant paradigm in manufacturing, driving many of the performance improvements now taking place around the world. The Toyota production system has become a model

that many diverse manufacturers—Boeing, Porsche, Pratt & Whitney, Danaher Corporation, Wiremold Company, Pella Windows, the Genie Industries division of Terex Corporation, and Lockheed Martin, to name a few—are implementing and modifying for their own purposes.

As lean concepts took hold in manufacturing, a broader realization began to occur. This realization is that lean is not something to be “done to manufacturing,” but it is a way of thinking that applies beyond the production floor and can apply to any and all processes, including the administrative support to manufacturing, new product design, sales & marketing processes, finance & accounting, and corporate offices—anywhere there are processes containing wasteful work. Companies in the service sector also began to recognize that any product that is the result of a process can be viewed through a lean lens. Thus the common term “lean production” is considered too narrow to incorporate the impact and scope of lean concepts. The term “lean enterprise” more appropriately describes a way of thinking about manufacturing, service, and support processes that is now used increasingly across a wide variety of companies and product offerings. Service-oriented companies that employ lean practices include Bank of America, Park Nicollet Health Services in Minneapolis, Minn., Jefferson Pilot Financial (Insurance), and Fujitsu Services (Technical Help Desk Services).

Many opportunities exist to improve operations performance in manufacturing, services, education, healthcare, and financial services through the use of lean concepts that identify and eliminate waste. These improvements benefit all of the stakeholders of the organization, from the shareholders who provide capital to the customers who buy its goods and services. Society

also benefits as the waste traditionally embedded in the operating processes is removed, freeing up scarce resources for other uses. Lean manufacturing and other lean methods are the key to unleashing these improvements.

II. SCOPE

This Statement on Management Accounting (SMA) is addressed to financial professionals and others who may lead or participate in efforts to implement lean concepts and processes in their organizations. The concept discussed in this document apply to:

- large and small organizations;
- enterprises in the manufacturing and services industries; and
- public and private ownership.

The information in this SMA will help financial professionals and others:

- comprehend the underlying principles of lean production and lean thinking;
- understand the various elements of lean operational systems;
- determine the uses and benefits of lean operations for their own organizations;
- learn about core tools and techniques to improve the effectiveness of lean practices;
- introduce the roles and responsibilities of financial professionals in lean enterprise implementation projects;
- understand the key obstacles in implementing lean concepts; and
- broaden employee awareness and obtain their buy-in for lean processes and techniques.

While this SMA cannot provide comprehensive knowledge of these concepts, the information in this document serves as a starting point in the exploration and implementation of lean concepts. The discussion will illustrate core ideas and provide finance and operations profession-

als with a basic understanding of lean processes and its applicability to their organization and its unique challenges. Greater detail on accounting for lean processes may be found in two separate SMAs. Additional resources on lean fundamentals are provided at the end of this SMA.

III. WHY IMPLEMENT LEAN PROCESSES

Lean processes provide a way to do more with less—less human effort, less equipment, less time, and less space—while coming closer and closer to providing customers with exactly what they want, when they want it, where they want it, and at a price that meets their cost/value expectations.

After years of benchmarking and observation in organizations around the world, Womack and Jones have found that converting a classic batch-and-queue production system to lean production helps an organization achieve the following results for manufacturing:

- Labor productivity is doubled all the way through the system for direct, managerial, and technical workers and from raw materials to delivered product. At the same time, production throughput times are cut by up to 90% with a subsequent reduction in inventory in the system by up to 90% as well.
- Errors reaching the customer and scrap within the production process are typically cut in half, as are job-related injuries and other undesirable side-effects of a nonlean production process.
- Time-to-market for new products is often halved, meaning that a wider variety of products within product families can be offered at very modest additional cost.
- The capital investments required to implement the lean approach are very modest, even negative, if facilities and equipment can be freed up and sold.

- Organizations that have completed the radical realignment of their processes can typically double productivity again through incremental improvements to the product and process within two to three years, with a similar reduction in inventories, errors, and lead times.¹

Similarly, Swank describes the lean transformation of Jefferson Pilot Financial and offers the following results for the financial services company:

- 70% reduction in turnaround time from receipt of applications to issuance of policy;
- Reduced application processing labor by 26%; and
- Reduced reissues due to processing errors by 40%.²

While the identified performance improvements should be more than enough justification for why a company should implement lean processes, one more reason exists: Global competition requires the high-quality, low-cost products and services that only lean processes can provide. An organization that fails to become flexible, responsive, and effective in every area of its operations will not be able to compete with the lean enterprise. Becoming a lean producer is not an option—it is a requirement for survival in the customer-driven global economy.

IV. FRAMEWORK FOR LEAN PROCESSES

A mass production company cannot become a lean one overnight; a rushed and superficial management effort will not yield the desired result. To support lean processes, management must build, nurture, and support the logic and machinery that drive lean production. Lean processes

are actually sophisticated practices built around several key conceptual and physical tools.

Implementing lean concepts means breaking old patterns and installing new ones. To accomplish this, an organization needs a whole new set of tools and a framework for applying them. Lean processes merge several elements to form an integrated whole, which aligns the various parts of an organization to make a change of great magnitude.

Derived from Womack and Jones, the five principles of lean processes provide a framework for the lean enterprise (Exhibit 1).³ These principles are:

- Value;
- Value Stream;
- Flow and Pull;
- Empowerment; and
- Perfection.

Principle #1: Value

Lean starts with a definition of what constitutes value from the customer's standpoint in terms of the features and characteristics of the company's product, services, and other attributes. Customer focus and leadership are two key elements of the value principle.

Customer focus

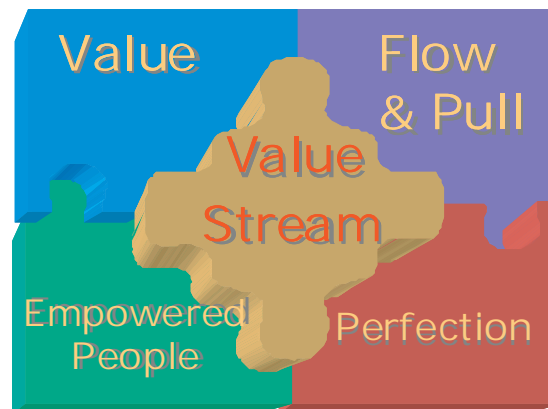
Customer focus refers to feedback processing methods that inform an organization what customers want and ensure that it is delivered. Improving performance against customer requirements is the driving force behind lean production. Customers define both the beginning and end of the operational cycle, setting performance requirements and prices based on the amount of value embedded within a product/service bundle delivered by the entire supply

¹ Womack and Jones, 1996.

² Swank, October 2003: 123-129.

³ The principles have been modified from Womack and Jones' original five by the inclusion of "respect for people" through empowerment.

EXHIBIT 1. THE FIVE PRINCIPLES OF LEAN THINKING



chain. For instance, Case Corporation used extensive customer input in the design of its most recent tractor line. This input was used to focus the design team, ensuring that minimal resources were wasted in the pursuit of product options that provided little incremental value to customers. Some features, such as the type of seat used, were ultimately driven by customer input as ergonomics were used to address customer-defined needs.

Lean companies speak of the “voice of the customer” as the driver of everything they do. This differentiates lean organizations from their traditional counterparts. It is common to find traditional manufacturers and service providers that implement some lean methods. It is rare to find such companies truly embracing customer value as their yardstick. These companies often continue to focus on stock-price and short-term profitability. Lasting success for a lean enterprise requires a primary focus on the value created for the customers.

In lean organizations, customer demand sets the pace of demand fulfillment. Lean companies

organize their products—both physical products and service products—so they are made available when the customer requires them. Lean companies refer to takt time; the rate of demand from the customers. If a product has a one-hour takt time, this means that (on average) the customers need one per hour throughout the working day. The significance of takt time is that lean organizations establish their processes so that products and services are made or provided at the same rate as the customer is requiring (or pulling) the products. This takt time applies not just to the primary processes but all support processes, including order entry, engineering, purchasing, scheduling, and so forth.

Lean companies work cooperatively with their customers. Creating high levels of value often requires close relationships with the customers. Value is often added more by the additional services and close cooperation than by the attributes of the products themselves. For example, Parker Hannifin Climate Systems Division (CSD) in New Haven, Ind., significantly increased sales to one of their major air-conditioner customers by providing services to deliver their own prod-

ucts—air-conditioner valves and regulators—in kits directly to the production line. These kits are pulled daily with very short lead times and in the sequence required by the assembly line. The kits contain parts made by CSD and parts made by other companies—including their competitors. These logistics (and other additional services) create so much value for their customer that both companies profit enormously by the arrangement.

Lean concepts let the customers pull the product as needed rather than pushing products onto the customer. Dramatic reductions in setup time provide reductions in lot size and inventory levels as well as production lead time, so the factory is flexible enough to respond to changing market demand. The goal of customer focus is zero customer dissatisfaction.

Leadership

Leadership is the management team's ability to translate customer requirements into concrete policies, organizational structures, and production strengths. In the pursuit of competitive advantage, an organization must be able to target its improvement and waste elimination efforts. There must be some scheme for putting priorities on where to expend time, effort, and resources in improvement and waste reduction efforts. The relationship of leadership to value creation is critical in providing direction and support for overall company development, improvement in cost, quality, speed, and innovation. Lean producers have the ability to adapt creatively to challenges. The success of lean companies such as Toyota, Hewlett-Packard, and Dell is founded on their ability to renew themselves again and again as they skillfully face the changes that inevitably come their way. The goal of leadership in a lean production organization is zero misalignment between strategy and human resources.

Principle #2: Value Stream

A value stream consists of all the activities required to create customer value for a product family or service offering. In manufacturing this would include all the processes needed from selling the product and taking a customer order through making and delivering a product to collecting the cash. There are also value streams that create customer value by designing new products, from idea to concept to completed design ready for production. Lean organizations carefully identify their value streams and organize their operations to maximize the value created for the customer and minimize the waste in these processes.

Normally, production value streams are defined by a group of related products that employ the same process steps. Traditional organizations focus on optimizing units rather than the whole organization. Value stream management seeks to redefine the operating unit into a group of comprehensive value streams. It requires reorganization into value stream teams, fostering a culture for continuous improvement, mapping current and future states, and reconfiguring into work cells to speed up the flow.

Value streams are extended (as far as possible) to include all the support processes. For example, a company manufacturing electric motors for OEM customers includes sales and marketing, purchasing, customer service, design engineering, materials handling, equipment maintenance, and other processes in the value stream organization. This enables a team focused on creating value for the customer, eliminating waste, and growing their part of the business.

Value streams in service industries are set up similarly. Take the process of obtaining a personal mortgage from a bank. The process in a tradi-

tional bank will pass through many departments and will often be required to travel to more than one office building. This process leads to delays, waste, and a feeling on our part that we are being treated as a problem rather than a valued customer. A lean organization brings together all of the tasks required for mortgage processing into a single customer-focused and cross-trained team. This leads to fast response, much less waste, and a customer that is genuinely served.

Lean Organization

In traditional organizations, problems often exist at organizational boundaries. This is because each organization focuses on optimizing its self-interest rather than trying to optimize the total organizational needs. Typical symptoms of this are accumulated inventories on the shop floor and piles of paperwork in the office, both of which indicate a lack of communication, coordination, and cooperation. In contrast, lean producers are process oriented and customer conscious. To that end, lean producers restructure jobs to put workers in contact with their customers and suppliers, whether internal or external to the company. Lean organizations eliminate bureaucracy, minimize overhead, and promote responsiveness to market conditions. Senior management no longer presumes to regulate the minute details of functional relationships. Instead senior management identifies issues that require cross-functional communication and cooperation, choose team members from the functions concerned, and gives the teams power to inform and even to act on behalf of the company as a whole. The goal of a lean production organization is continuous improvement focused on the customer.

The role of the value stream manager (VSM) is very important in lean organization. The VSM is responsible for the entire flow of the products

and services provided to the customer for the range of products contained within his/her value stream. All the processes required for the sales order, production and delivery of the product or service, and collection of cash are organized under one value stream manager who takes an entrepreneurial role. In reality, it is often impossible—in the short term—to create a “perfect” value stream organization that includes unimpeded linkage between all the processes; but that is the objective of a lean value stream organization.

Improvement Culture

Lean producers equip teams and individual employees to analyze strategic gaps and quality problems to find root causes and then conceive, implement, and standardize effective solutions. Searching for the root cause of a defect or problem is an integral part of lean production. The key to discovering and eliminating defects is self-inspection procedures that give accurate and timely information about causes of defects. Everybody is responsible for perfect quality within their own work, whether this is perfect production, perfect invoicing, perfect order entry, and so on.

Self inspection can take many forms. The most basic approach is to include an inspection step into the process, but poka-yoke (mistake proofing the process), jidoka (responsive processes alerting variations), and statistical process control (SPC) are more sophisticated lean methods. The lean requirement for single-piece flow is also helpful because single-piece flow and self-inspection ensures that problems are identified on the first occurrence and can be eliminated before the error affects another product or document in the process. While fixing errors at the source may initially appear to be an inefficient response, it actually improves the effectiveness of the entire production process. It is easier and

cheaper to detect and correct a problem at its source than to undertake all the activities and costs required to fix an upstream problem with downstream effort. The further along in the production process the problem is found, the more cost and effort are added. Waste grows exponentially in this setting.

At Hewlett-Packard, the lean production view of defects—to never pass them on to the next person in line—can lead to the shutting down of a line when a major problem is detected. The various lines are linked into a smooth, uninterrupted flow, and the operators are expected to stop the process when they detect a defect. The defects are not sorted out for later attention. They are addressed and rectified.

Mapping Value Streams

A value stream is the set of all the specific actions required to bring a specific product (whether a good, service, or combination) from concept to launch (new product development value stream) or from order to delivery into the hands of the customer, and collecting the cash (order fulfillment value stream). Value stream mapping is a technique that assists the visualization of the entire process, documenting time, waste, and cost. The objective of value stream mapping is to find waste, quantify throughput time, determine value-added ratio, and provide baseline for a future state map. It is a method for helping the value stream team and senior management understand the company's level of attainment in the key elements of lean production development. The knowledge gained through this approach supplements the executives' general understanding of the company's core capabilities. It clarifies areas of strength as well as weaknesses that must be addressed in a lean enterprise.

The key elements of lean production provide a structured system for analyzing an organization's capabilities to determine which might provide a basis for competition in marketplaces. For each quarterly or annual improvement cycle, lean organizations select two or three critical elements as the target for their focused efforts. The initial value mapping serves as a baseline for later rounds of improvement. Exhibit 2 illustrates current and future state value stream maps for the Customer Order Processing part of an order fulfillment value stream.

Work Cells

As a product-oriented layout is developed and operators become capable of handling multiple processes, organizing the layout in a U-shaped form or work cell often becomes the least wasteful production method. Cellular manufacturing is manufacturing done in a work cell. A work cell is a group of dissimilar operations formed to produce a product family. Benefits of cellular manufacturing, including high quality and efficiency, result from the work cell's lack of material movement, small batches, quality at source, flexibility, and self-correcting processes. Workers and equipment are clustered together and dedicated to producing a family of outputs on a repetitive basis. Flexibility is also a benefit since it is easy for work cells to change product volume and the kind of product produced. The output rate of a work cell is easily modified by changing the number of workers and machines, and a work cell can efficiently produce output for virtually any batch size, even one. A work cell can produce all the items in a product family; some can even produce multiple product families. By linking work cells, it is possible to produce complex end-items. The goal in cellular or work-cell manufacturing within a lean production system is to

EXHIBIT 2. EXAMPLES OF VALUE STREAM CURRENT AND FUTURE STATE MAPS

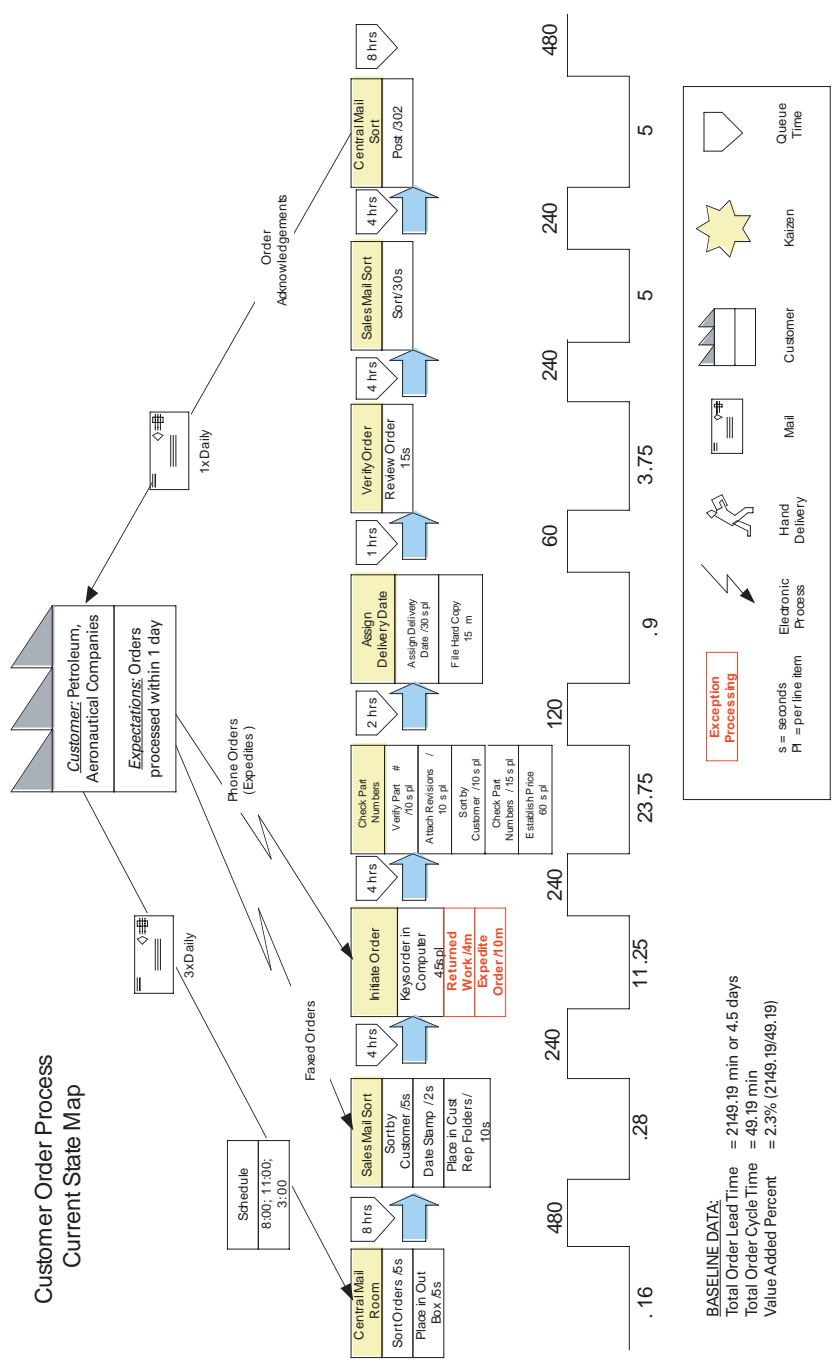
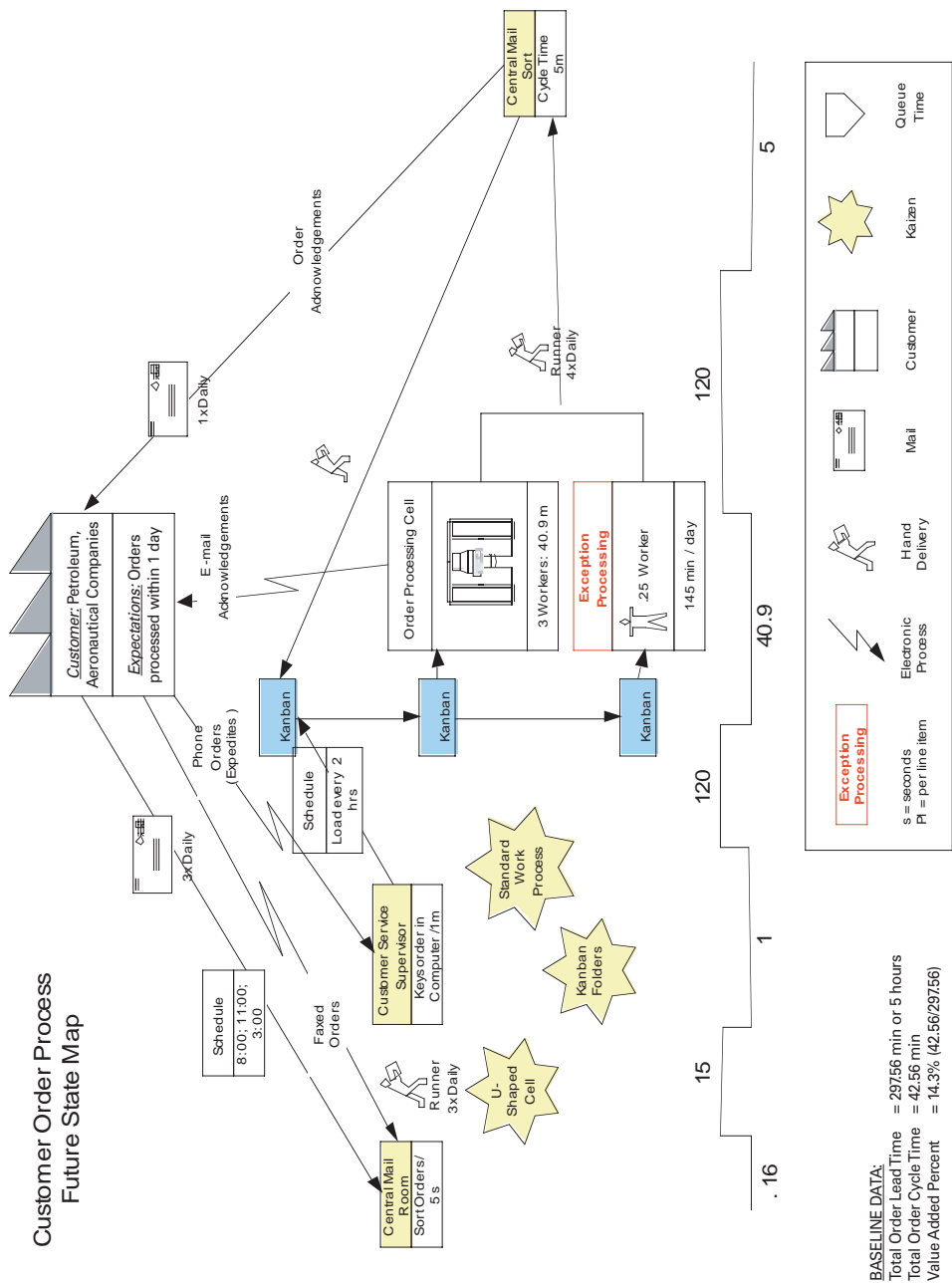


EXHIBIT 2. EXAMPLES OF VALUE STREAM CURRENT AND FUTURE STATE MAPS



produce at the rate of customer demand without excess motion, materials, inventory, time, or other waste.

Cells are designed so they can manufacture at a cycle time that matches the takt time of customer demand. Similarly retail, banking, insurance, and medical processes are designed to meet the demand of the customers.

Principle #3: Flow and Pull

Lean organizations seek to maximize the flow of materials, information, and cash. The production process is designed to maximize the flow of the product through the value stream, initiated by the pull of customer demand. A smooth flow necessitates partnering with customers and suppliers, single-piece flow production, setup time reduction, pull production system, and a goal of perfection. Lean administrative processes are designed to similarly maximize the flow of information and cash using the same tools of flow, setup reduction, pull processes, and perfection goals.

Partnering

Effective lean production requires the effective deployment of a set of cooperative, trust-based relationships between employees and suppliers. Instead of maintaining an arms-length contractual relationship with suppliers, lean manufacturers think of suppliers as an extension of the factory or office. All the steps taken along the value stream are transparent so each participant can verify that the other organizations are behaving in accordance with the agreed principles and objectives. Partnering allows a company to extend the knowledge and gains of lead production to the entire flow of materials and products, from the raw materials to the final goods in customers' hands. As the linkages between trading partners are improved, waste from unnecessary

steps and transactions are removed, increasing the responsiveness and flexibility of the supply chain.

For example, in a baked goods company, cost was reduced and quality improved when the company realized that the chocolate supplier could ship liquid chocolate rather than chocolate bars. The supplier was incurring extra cost, time, and effort turning the liquid chocolate into bars, which then had to be melted by the baked goods company for use in its products. Coordination across the value chain removed cost from the total process and improved the performance of the two affected organizations.

Lean producers also apply partnering to employees. Lean producers develop a mutual trust and a shared understanding of the business as the way to achieve co-destiny with employees. Employees are the people who do the improvement work irrespective of hierarchy or functional position. Lean producers extend the involvement of employees from shop floor to strategic planning. Through employee involvement at the shop-floor level, senior managers learn in detail about their operating conditions and acquire creative insights for improvement. Employee involvement in strategic planning works in much the same way. It helps senior managers gather detailed information about the company's overall strategic condition from the frontline sources. Likewise, it permits a company to capture innovative ideas from individuals throughout the organization, ideas that may be developed into strategic advantages in the future. The goal of partnering in a lean production environment is zero stakeholder dissatisfaction.

Single-Piece Flow Production

Lot sizing affects manufacturing competitive advantage because it influences the cost, quali-

ty, lead time, and flexibility of manufacturing. Traditionally, U.S. managers favored larger lot sizes—primarily because of the large expense associated with setting up production, placing orders, and making deliveries. The drawback of large lot sizes is that even when they minimize dollar costs, they lead to greater nondollar costs associated with increased production lead times, hidden defects, and reduced scheduling flexibility. Lean production acknowledges the problems and wastes connected with using large lot sizes. Small-lot production is achieved by giving more purchasing responsibility to shop-floor workers, by reorganizing the facility layout to reduce material transfer distances and cost, by locating materials at the point of use, and by working with suppliers to find ways to increase the frequency of deliveries, reduce the need for incoming inspection, and reduce the costs of handling, purchasing, and transportation. To the extent that large lot sizes and buffer stocks are maintained to absorb process variability and allow continued production in the face of problems, lot-size and buffer-stock reduction is a significant enabler of lean production. The goal of small-lot production in a lean production environment is to eliminate nonvalue work.

Similar methods are also adopted in administrative and service value streams. Processes such as order taking, purchasing, accounts payable check runs, and invoicing are done one at a time instead of being delayed and completed in one large batch. A Minneapolis hospital significantly reduced the amount of time it takes for their patients to complete endoscopic tests by scheduling their arrival times in 10 minute increments instead of hourly. When patients were scheduled hourly they had to wait an average of 30 minutes for their procedure. By scheduling in 10 minute increments the average wait time fell to five minutes. This change—together with a number of

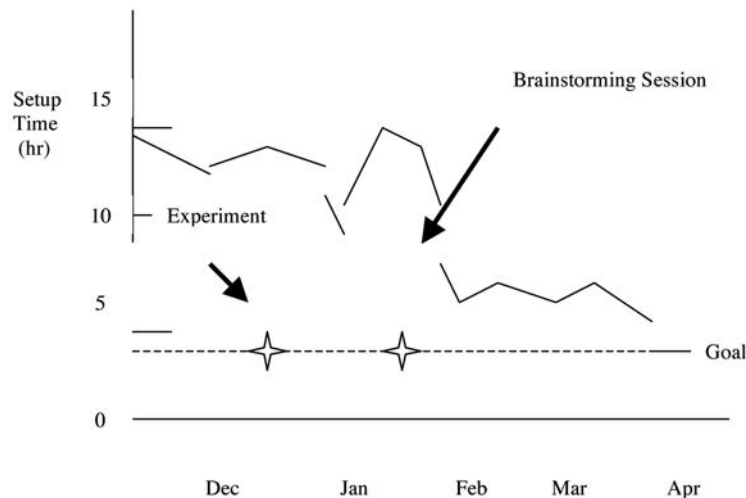
other lean improvements—halved the total time for the procedures, more than doubled the number of procedures per day, and enabled the doctors to spend 15 minutes with each patient instead of less than 10 minutes. Better service, lower cost, much fewer errors, and less waste; this is what lean service processes look like.

Setup-Time Reduction

Simplified setup and reduced setup time permit reduced-lot-size production and result in increased production capacity, flexibility, and resource utilization, as well as improved product quality and customer satisfaction. Although setup procedures vary widely with type of equipment and equipment application, the methodology to improve setups developed by Shingo, called single-minute exchange of dies (SMED), can be applied to virtually any setup procedure. The principal objective of improvement is to reduce the internal setup time—that is, the setup time during which the machine or operation must be stopped. Setup-time reduction is one of the most important foundations of lean production. Exhibit 3 shows setup improvements in a Canadian automotive company.

It originally took four different skilled trade personnel 14 hours or more to carry out a rather complicated setup operation. Communication among the personnel was considered a big problem. When, as an experiment, everybody involved in the setup was present at the machine, however, the setup was completed in three hours and 45 minutes. After holding one brainstorming session and developing better communication, the people involved reduced the average setup time by almost 10 hours within one month. The goal of setup-time reduction in a lean production system is to eliminate nonvalue-adding work.

EXHIBIT 3. HISTORY OF SETUP-TIME REDUCTION IN A CANADIAN COMPANY



Source: Suzuki, 1987: 35.

Pull-Production System

At one time, manufacturers could offer a single product of a standardized size and shape. But with increased world competition and diversified user needs, a manufacturer's ability to respond quickly to the market can become an issue of survival. Turning to the final assembly line where the finished goods come out, one still finds that many such lines all over the world operate in a fashion similar to batch-processing machines. The same kind of product may be produced for a day, a week, or longer before the next product comes out. To keep materials moving smoothly, organizations hold enough inventory between the stages of the process to buffer against any problems. In contrast, pull production is a way of controlling a process and reacting quickly to changes without relying on inventory. In a pull system, each stage of a process produces exactly what the immediate downstream stage

requests; in effect, material is pulled through the process by each stage, producing only what is demanded of it from the next stage. This contrasts to push production wherein every stage produces according to a preplanned schedule then pushes material to the next stage, whether that next stage is ready for it or not. Pull production requires a shift for production control to worker teams. The goal of pull production systems in lean production is to eliminate nonvalue-adding work.

Lean Equipment Management

One of the outcomes of lean production is the recognition that reliability is an essential element of a stable, effective flow. Total preventative maintenance (TPM) or the scheduled analysis, repair, and adjustment of machines are used to reduce the risk of unscheduled downtime. Unplanned work stoppages due to machine prob-

lems are always an issue of concern, but when every process in a facility is linked in a lean system, the impact of unplanned downtime ripples through the entire facility. The cost and productivity impacts of unplanned downtime are so large that a significant investment in preventing these problems can be justified. Machines are maintained to achieve a 100% on-demand utilization rate for immediate use as required by the next process. Having zero machine troubles is achieved effectively by involving operators in maintaining normal machine operating conditions, detecting abnormal machine conditions as early as possible, and developing countermeasures to regain normal machine conditions. TPM represents a commitment to equipment performance beyond original equipment design parameters and a move to make equipment a source of competitive advantage. One goal of TPM in lean production is zero breakdowns and the virtual elimination of equipment malfunction and equipment-related sources of product defects. A second goal is equipment restoration and redesign so that equipment performs better than new and in ways competitors' equipment cannot.

Principle #4: Empowerment

Empowerment involves the system of measurements and controls that provides each employee with the information and authority to take necessary action at the time it is required so as to add value for the customer and eliminate waste from the process.

Empowerment

The involvement of line and shop-floor workers is fundamental to lean production initiatives. For this reason, companies should elicit and listen to workers' ideas about improvement and empower them to make more decisions and perform tasks that are improvement related. The people involved in the project may vary depend-

ing on the nature of the project. A multidisciplinary team approach often helps in dealing with cross-functional problems.

Empowerment is not used for purely altruistic purposes. There is so much change required to transform an organization to lean that everyone must be engaged in concerted continuous improvement. Lean organizations recognize that the process experts are very often the people who perform the processes. To get the fastest and most effective improvement, the company must engage these people's talents and ideas. For many companies this leads—over time—to a radical change in management style: from command and control to empowered teams.

For empowerment to be effective, the team members must have a clear picture of the company's goals and strategies. There must be alignment of purpose. The team members must also be well trained and educated in their own processes, in lean principles and methods, and standard improvement methodologies. Third, the people must be empowered to make the changes required to improve their processes, create more value, and eliminate waste. Fourth, the team must be accountable for their activities, often using ongoing measurements and periodic reviews.

By definition lean processes can never be completely mastered. A true world-class competitor will always strive to improve, refine, and surpass today's achievements. The zero-waste goal of each key element is continuously moving on.

Principle #5: Perfection

The pursuit of perfection is fundamental to lean thinking. The objective is not to make sporadic leaps of improvement to overtake a competitor in the marketplace. The purpose is for everyone in

the organization to focus on making incremental improvement in their own processes day in and day out. While few of these improvements will significantly change the process, the collective effect of these changes is radical improvement in quality, cost, service, flow, and customer value. The goal is nothing less than perfection. Everyone realizes that perfection is unlikely to be achieved; but that is the goal. This is very different from the traditional company's attempts to balance their objectives using such tools as economic order quantities or inventory rationalization.

The goal of lean processes is zero waste, zero lost information, and zero defects. It is critical that workers receive information concerning customer requirements and current process performance in order to strive for perfection. Information architecture and standard operating procedures are key to providing necessary information.

Information Architecture

Lean processes necessitate the creation of a framework that supports a team-based lean organization and distributes information efficiently. Architectural features include improvement-oriented performance measures and management accounting systems as well as the use of visual control techniques such as hand-posted measurement boards or lighted electronic displays. These boards, which are visible from every workstation, show hourly production targets, takt-time achieved, equipment breakdowns, personnel shortages, and overtime requirements. Information architectures are tied to improvements in cost, quality, delivery, product-development innovation and lead times, and process flexibility. Specifically, lean production information architectures seek to achieve the following:

- link daily operations to strategic objectives;
- provide visual management;
- balance financial with nonfinancial measures;
- transform the organization from a rigid-vertical to

- a response-horizontal decision-making system;
- motivate workers and managers through visual information and involvement;
- identify and eliminate waste;
- measure what is important to customers;
- accelerate organizational learning and acceptance of change in customer expectations; and
- translate company flexibility into specific measurements.

Standard Operations

Without standard operations, improvement potential is very limited. Things will fall back into a chaotic state. Standard operations are the work procedures, sequences of tasks, and times prescribed for production of a unit of output. The main elements of standard operations are the standard completion time per unit, standard operations routine, and standard WIP. The completion time per unit is the average time required to complete a task or an operation (group of tasks). A group of operations combined in a particular, prescribed sequence is the standard operations procedures (SOP). The standard WIP is the minimum in-process inventory necessary for a process to function effectively. All information about completion times per unit, the operations routine, and standard WIP is summarized on a standard operations sheet (SOS). The SOS is prominently displayed so workers at each operation and work cell can readily refer to it. Standard operations serve vital functions in lean production. They are essential for communicating and teaching standard times and procedures, and they give planners and schedulers accurate, up-to-date information about cycle times and operations capacity.

Standard operations and standardized work is similarly essential for lean administrative processes. Visual work instruction and standard process flows are commonly used. Visual performance measurement boards and posted contin-

uous improvement projects provide control and motivate ongoing analysis of problems leading to waste reduction, improved productivity, and faster, better service to the customers. Improvement cannot be sustained without visual standardized work, and additional improvement cannot be made without a clear understanding of the “current state.”

V. IMPLEMENTATION PHASES

By examining successful lean production transformations across the world, a specific sequence of steps and initiatives can be identified that produce the best results. This sequence has four key phases. These four phases represent a standard work plan, a framework for training, and a basic structure for the implementation of lean production. While each lean production implementation is unique, an organi-

zation’s implementation plan will likely include most of or all four phases outlined in Exhibit 4, although not necessarily in the exact order presented. Keep in mind, the four basic steps to lean production implementation are:

- developing a conceptual design;
- creating an organizational structure to channel the value streams;
- installing business systems to encourage lean thinking; and
- completing the transformation.

While organizations can modify the sequence and emphasis placed on these phases to meet the needs of a particular situation, these activities are recommended as a guide for implementing lean-production-based initiatives. Exhibit 4 exemplifies phases and activities typical of lean practices implementation.

EXHIBIT 4. LEAN PRACTICES IMPLEMENTATION PHASES

PHASE	STEPS
Developing a conceptual design	Confirm objectives and scope Find burning platform Map value streams
Creating a new organization to channel the value stream	Reorganize by product family and value stream Create a lean business function Devise a policy for excess people Develop a growth strategy Instill a “perfection” mindset
Installing a business system to encourage lean thinking	Introduce lean management accounting Implement transparency Deploy right-sized machines
Completing the transformation	Apply these steps to suppliers and customers Make transition from top-down to bottom-up improvement initiatives

Source: adapted from Womack and Jones, 1996: 270.

Developing a Conceptual Design

During the first six months of implementation, the typical objectives of the lean production initiative are to ensure that a sound design and focus for the effort are developed and communicated to key stakeholders. Steps that must be completed at this stage include:

- confirming objectives and scope of the project;
- creating the “burning platform”; and
- organizing and educating value stream teams.

Confirming Objectives and Scope of the Lean Transformation Process

Lean organizations use Hoshin Strategy Deployment to drive the strategic goals of the company into daily reality. Hoshin was developed by Japanese companies in the 20th century from a platform of management by objectives (MBO). These companies recognized the power of coordination through MBO but also recognized that the weakness of MBO was its top-down approach. Hoshin combines the cross-company coordination of MBO with a collaborative development method that creates consensus and commitment rather than imposing management’s goals onto people.

The Hoshin process starts at the top of the company as a direct outcome of strategic planning. The senior executives determine the three or four primary breakthrough goals for the company this year and document these goals onto formal charts that are a key method for the communication of Hoshin planning throughout the company.

The primary objectives are developed by the senior management team. Each of these team members then develops Hoshin charts for his/her own area of responsibility. These charts translate the primary goals into specific actions and goals within each team member’s area. The

team members then work with the people who work directly for them to develop Hoshin charts for each aspect of their responsibilities, and the primary objectives are moved down to the third level of the organization. Unlike MBO, these goals are not imposed on the managers. The development of the Hoshin charts is a collaborative process using what is called *catch-ball*. The managers “tosses the ball” to the next person who reviews and makes changes to the plan. The “ball” is then tossed back to the manager who reviews it again and tosses it back. This continues until both a consensus is reached. The “ball” is also tossed to other related managers who are developing their own plans to ensure that each person’s plans are consistent with others in their area. This process continues until there is full agreement among the people.

While the process may take some time to complete, the outcome for each person is a Hoshin chart that details the changes he/she is responsible for over the next 12 months. These responsibilities have been built up—within the framework of the company’s overall goals—by a highly cooperative and collaborative process. The outcome of this process is:

- a clearly defined set of tasks and goals for each part of the company;
- the people responsible for the achievement of these tasks are fully committed to their achievement; and
- appropriate resources have been made available to ensure the success of these improvements.

The Hoshin planning process is rolled down to the value streams, and the value stream managers are typically the people to develop the lowest-level Hoshin chart, although the process may go to lower levels if the value stream is large and covers diverse processes. Other nonvalue-

stream departments may also have their own Hoshin charts.

The final outcome of the Hoshin process is a company that is thoroughly aligned to the achievement of lean (and other) changes throughout the company and people who are committed to the achievement of these changes owing to their participation in the development of the plan.

Many successful lean organizations establish audacious goals for improvement. The Wiremold Company set the following goals:

- 100% customer service;
- 50% reduction in defects every year;
- 20% productivity gain every year;
- 20x inventory turns;
- 20% profit sharing;
- visual controls and 5S; and
- double in size every three to five years.⁴

Creating the “Burning Platform”

It is difficult to find an organization that is willing to take the necessary steps to adopt lean thinking across the board in a short period of time. How can a change agent take a seemingly secure organization (for example, Microsoft in the 1990s) and introduce lean thinking?

One approach is to take some subunit of the organization that is in crisis and focus all the energies on applying lean remedies to it. Ideally, this would be a business unit with a set of product families, but it could be a single plant, one product development group, or even one product line in a plant or one development team for a specific product. This is also the way leaders who are not near the top of their organization can take the lead on a lean breakthrough: apply lean thinking to their own troubled business unit or facility. Then, once dramatic change has been

introduced in the unit, the leaders of other units can be invited over for hands-on learning and can take ideas back to their units. The selection of this “pilot” area is important. The pilot must be a significant part of the business so that the lean changes strike at the heart of the company’s problems. If an “easy” area is selected, the changes will not have the desired impact on the organization; others can ignore it and get on with business as usual.

Even if no subunit of the organization is in crisis, there may be an opportunity for dramatic change if a lean competitor can be found. For example, a small business unit of a key competitor may have made the transition to lean production with striking results. By focusing on this instance of superior practice it may be possible to introduce significant change. Another common example for a growing company is the opportunity to meet the growth need with existing resources to improve profit position.

As momentum is gained, the scope of the lean initiative is typically expanded. Running counter to most project management beliefs, this expansion of scope allows the benefits of integration of solutions and approach to take place from the onset. This helps reduce costly rework downstream and ensures that a systems solution is pursued.

Creating an Organizational Structure to Channel the Value Streams

As the conceptual design is completed, attention turns to creating a new organizational structure that will allow the objectives of the lean design to be attained. Taking place from six months into the project through year two, the key objectives of this phase include:

- reorganizing by product line and value stream;
- devising a policy for excess people;

⁴ Emiliani, 2003.

- developing a growth strategy; and
- instilling a “perfection” mindset.

Reorganizing by Product Line and Value Stream

Organizing around a value stream allows an organization to channel its flow of value to customers and to avoid the reemergence of the various forms of waste that reduce overall performance. This means identifying the organization’s product families and rethinking the organization’s functions to realign marketing/sales, product development, scheduling, production, and purchasing activities into coherent units. The exact way to do this typically varies with the nature of the business, the sales volume for products, and the type and number of customers. But the basic idea can be applied in most businesses.

Devising a Policy for Excess People

It is critical to create an effective policy to deal with the reality that the removal of excess activities and waste from the process translates into excess people. The rule of thumb is that when organizations convert from a batch-and-queue activity to lean production techniques, human effort typically is reduced by 75%.

Because the culture underlying lean production is based on cooperation, trust, and participation, people will not freely support this effort if it results in the loss of their own jobs. Organizations implementing lean production usually guarantee that no one will lose his or her employment due to the introduction of lean techniques; although it is likely that many people’s jobs will change and expand. And companies must keep their promise, or improvements will be impossible to sustain. The correct approach is to build momentum for change while sending people no longer needed to other locations in

the organization. As the organization demonstrates over time that in fact everyone’s job security is increased, employees gradually become more cooperative and proactive.

Developing a Growth Strategy

Creating a growth strategy means that these “excess” people are immediately re-channeled into new positions for new products and processes. The resources freed up by removing waste need to be redirected to create more value for all stakeholders. If all of the improvements are dropped straight to the bottom line, the organization will not achieve long-term growth. Sustainable performance comes from investing freed resources to create new sources of value and improvement. For example, some organizations pass cost savings directly through to gain volume. Others speed up development of projects in the pipeline to spur sales and increase market share. Others focus on shortening production lead times, delivering exactly on schedule, and making the configuration of product the customer wants to boost sales of products. Still others convert their product from a good to a service and add downstream distribution and service activities to their traditional production tasks. And some organizations integrate backwards, upstream, to consolidate previously scattered production activities into a single-piece flow.

Omark Industries announced that the company would not lay off its people through lean production improvement activities. One of Omark’s general managers, for example, diversified into new businesses to utilize his factory’s increased capability from Just in Time (JIT) and total quality management (TQM) activities.

Instilling a “Perfection” Mindset

Creating a mindset that abhors waste and then building it into everything that the organization does is a cultural change. Many organizations still operate as if improvement is solely the business of managers, consultants, analysts, and engineers. The effect of this behavior all but stifles improvement. When employees learn that seeking out and suggesting improvements is the sole responsibility of specialists, they will stop looking for places that need improvement. If they see a problem, they will not tell anyone. Even if they do tell someone, few will listen because “that is not their job.” Organization-wide, the “experts-only” approach to improvement preconditions everyone except the experts not to think about improvement. Since experts make up only a tiny percentage of all employees (near zero in some cases), the realizable potential for improvement becomes minuscule. The most expeditious way to find improvement opportunities is to make seeking improvement part of everyone’s job. No matter what the task or situation, the people doing the same tasks day-in and day-out often see improvement opportunities or alternatives that the experts overlook.

Installing Business Systems to Encourage Lean Thinking

As lessons and improvements in management methods and structures are mastered, attention can turn to creating the physical systems needed to create a reliable, repetitive lean production process. The activities completed during years three and four to achieve this shift are driven by several key objectives:

- introducing lean management accounting;
- implementing transparency; and
- deploying right-sized machines.

Introducing Lean Management Accounting

As the organization changes structure, the information used to guide decisions and evaluate performance also needs to change. The content, format, and frequency of management accounting information need to change to support a system that is now customer-focused.

Information content changes from being predominantly financially-focused to including nonfinancial data that support daily decisions. Customer-focused measures, such as dock-to-dock time (i.e., receipt of raw material to shipping finished product) and on-time delivery, are monitored daily by value stream and cell teams. As inventories reduce to low levels, standard costing and associated reporting (e.g., manufacturing variances, detailed labor reporting) no longer provide useful information. In addition, as resources are dedicated to specific cells or value streams, more costs are able to be assigned directly to these cost objects, and there is less need to allocate across value streams. Indeed there is a concerted effort to not share resources whenever possible.

Traditional production measurements are not only unhelpful, they are actively harmful to the company’s lean transformation. Measurements such as labor efficiency, earned hours, machine utilization, PPV, and overhead absorption variance motivate insidious nonlean behaviors. All these measurements motivate the employees to build high inventory levels by over-producing, batching, “optimizing” machine changeovers, buying economic order quantities, and building inventory to achieve month-end absorption budgets. These must be replaced by measurement systems that actively promote lean thinking and motivate lean action.

As decisions are made by teams rather than by managers and supervisors, the format of information needs to be understandable by all users. Traditional labels such as “volume variance,” “cost of goods manufactured,” and “under-applied overhead,” make it difficult for users to understand what drives these numbers due to allocations and aggregation of data. Consequently, the information has little impact on decision making. Lean management accounting systems provide simple, “plain English” financial information that everyone can understand and use.

Traditional management accounting information is provided on a monthly basis due to the monthly close cycle. In lean systems, information is provided to value streams on a weekly basis and includes reports such as the value stream income statement. This increased frequency prompts changes and decisions on a more immediate basis and enables better control of value stream costs.

If the content, format, and frequency of management accounting information needs to be changed, what specifically do finance professionals need to modify and when? A later section, “The Role of Management Accounting within Lean Organizations,” provides an overview of accounting practices. There are also two Statements on Management Accounting that expand on each of these accounting practices.

Implementing Transparency

Truly lean plants have in place a system for detecting defects that quickly traces each problem, once discovered, to its ultimate cause. This in turn means teamwork among line workers and a simple but comprehensive information display system that makes it possible for everyone in the plant to respond quickly to problems and to

understand the plant’s overall situation. In old-fashioned mass production plants, managers jealously guard information about conditions in the plant, thinking this knowledge is the key to their power. In a lean plant all information—daily production targets, units produced, equipment breakdowns, personnel shortages, overtime requirements, and so forth—are displayed on visual boards. Often the information is created and displayed by the people in the cells or departments using the boards. Sometimes andon boards (lighted electronic displays) that are visible from every workstation can be helpful when the data are difficult to obtain by hand.

Deploying Right-Sized Machines

The functional or process-oriented layout in which operators focus only on their own production efficiency is one of the major obstacles to developing a smooth production flow in the factory. This and other problems can be resolved by changing to a product-oriented layout. Machine improvement, automation, and machine selection also play important roles in tying each operation to the total production system. Lean manufacturers ask themselves what types of machines would permit them to switch instantly between products so there would be no need to make batches.

Criteria for machines traditionally consider the trade-off between a machine’s production rate or multipurpose capability and cost. For plants with focused factories, traditional acquisition criteria need to be rethought since they can lead to results opposite those intended, such as a multipurpose machine that decreases the plant’s flexibility or a special high-speed machine that increases production lead times. For lean organizations, the alternative to costly multipurpose or special-order machines is having many inexpensive, slower, and fewer-purpose machines. Every

work cell that needs one gets one and can then function autonomously. Although a multipurpose machine offers high flexibility through quick changeover and rapid production rate, all else being equal, conventional fewer-purpose machines provide even greater flexibility when employed in a number of manufacturing cells. Conventional machines are also simpler for workers to operate and less costly to maintain.

Similar considerations apply in service processes. While these are not usually driven by machines, there is often a narrow focus for each person's work. Service organizations also cross-train people and create flexible, team-based organizations. Individual offices are abandoned in favor of rooms where people work together with a focus on customer needs and where information flows (using single-piece flow) through the cell.

Completing the Transformation

Having completed the structural, management, and process changes required to implement lean production, attention turns to sustaining the process. As such, by the end of the fifth year, key objectives of the implementation typically include:

- convincing suppliers and customers to implement lean production methods; and
- converting from top-down leadership to bottom-up initiatives.

Convincing Suppliers and Customers to Implement Lean Production Methods

Extending the education of the lean organization beyond its current boundaries of time and space and enabling a lean global strategy through bottom-up initiatives are the hallmarks of sustainable growth. It is a rare organization whose internal activities account for more than a third of the total cost and lead-time needed to get its

products to market. Each company is constrained by other companies, even when it comes to improvement efforts. Potential cost and lead-time savings and quality improvements at an organization can be easily outweighed by the cost, lead time, and defect increases of its suppliers. Therefore, organizations will get only so far along the path to lean production unless they persuade their suppliers and customer organizations to adopt lean production as well.

To make this approach feasible, lean organizations narrow down their upstream and downstream partner list and are prepared to work with them a long time. Extending improvement beyond an organization requires that managers take a new look at the costs and trade-offs of working with suppliers and that customer and supplier companies adopt new ways of working together. Instead of charging for help, savings are shared. For example, Porsche and its suppliers decided on a three-way split in which the suppliers kept a third of the cost savings and Porsche got two-thirds, with Porsche agreeing to pass half of its savings on to the customer in lower prices. Differences between a partnership relationship approach and the traditional adversarial customer-supplier relationship are illustrated in Exhibit 5.

Converting from Top-Down Leadership to Bottom-Up Initiatives

The final change to making every line manager and line employee a proactive process and product engineer, coach, and learner creates a sustainable structure not dependent on one manager or one set of insights. The improvements become sustainable because they are part of the culture of the organization, arising from shared vision, knowledge, and views.

EXHIBIT 5. CUSTOMER-SUPPLIER RELATIONSHIPS

	TRADITIONAL	PARTNERSHIP
Purchase criteria	Lowest bid	Competency, ability, capacity, and willingness to work with customer to improve price, quality, and delivery.
Design source	Customer	Customer and supplier
Number of suppliers	Several for each item commodity group	One or a few for each item or commodity group
Customer business volume per supplier	Limited: multiple suppliers share business	High: one or few suppliers get all of the business
Type of agreement	Purchase order; contracts to meet immediate requirements	Contract plus agreement about working relationship
Terms of Agreement:		
Duration	Short-term, or as needed by customer	Long-term, multiple years
Price/cost	Lowest bid, inefficiencies and waste keep prices/costs high	Negotiated price/cost savings from supplier improvements shared with customer
Quality	Variable; customer relies on incoming inspection	High; quality at the source; supplier uses SPC, TQM, etc.
Shipping frequency/size/location	Infrequent/large/dock or stockroom	Frequent/small/point-of-use
Order mechanism	Mail or phone	FAX, phone, EDI, or kanban
Customer-supplier interaction	Formal information exchange limited to customer requirements; no teamwork; supplier service limited to minimal requirements	Frequent formal and informal exchange of plans, schedules, problems, ideas; teamwork and mutual commitment based on trust; cooperation to resolve problems and improve supplier's products and processes. This often results in joint improvement projects and sharing of information.

Source: Nicholas, 1998: 680.

To this end, lean organizations give their employees ownership over process data (data they record and use themselves to monitor and improve the workplace) and reward them in ways commensurate with their contributions (pay, prizes, stocks, job opportunities, public recognition, or a simple thank you). To erase the old distinction between white-collar and blue-collar workers, some lean organizations have abolished the word “worker” or even “employee.” Frontline employees are sometimes called associates, and managers and staff are called facilitators or Team Leaders. For example, at Electronics Control Company, anyone caught uttering “employee” is fined \$1.

VI. CHALLENGES TO IMPLEMENTING LEAN PRODUCTION

When examining the issues and obstacles that stand between today’s operations and future implementation of lean concepts, several key concerns emerge. Macroeconomic or social issues that may impede future progress include:

- lean thinking is counterintuitive for managers steeped in traditional mass production or bureaucratic service and administrative processes.
- cyclical patterns in key industries, such as seasonality requiring companies to build up inventory, run counter to the lean philosophy and approach; and
- North American notions of careers are often incompatible with lean production’s key emphasis on teamwork, incentives for learning, continuous improvement, and the reliance on action versus results measurements and rewards.

Counterintuitive Methods

Managers—especially senior executives—within Western manufacturing companies are often

experts in traditional manufacturing methods. They have usually built their career success on the application of traditional mass production. The paradigms of mass production can be deeply engrained into the people and processes within a company. It is difficult for these people to truly embrace the principles of lean thinking because they are counterintuitive to Western management.

One important aspect of the traditional paradigm is the command and control management methods used in American companies for many years. It is very difficult for traditional managers to understand the benefits of team-based empowered improvement. They are concerned about loss of control.

Single-piece flow is very difficult for managers and supervisors at every level of the organization to grasp. They can grasp the ideas intellectually, but it is a major challenge to apply it consistently.

Developing cooperative relationships with customers and (particularly) suppliers is the opposite of the policies adopted by traditional manufacturers. Sadly, this has become quite clear in the recent setbacks suffered by the Big Three U.S. automobile manufacturers. All three have attempted—with some success—to apply lean manufacturing methods in their plants. But all three have taken a policy of harsh actions to force their suppliers to reduce prices. These methods are sometimes graced with euphemisms like “strategic procurement,” but they result in hostile and combative relationships with their suppliers. Far from cooperating, this has led to poor quality, poor service, and suppliers failing financially.

Focusing on customer value is another aspect of lean thinking that eludes traditional executives.

Many American companies have professed “lean initiatives” that are supported by everyone in senior leadership, yet the executive team spends much of their time focusing on Wall Street, the stock price, and the achievement of monthly and quarterly goals. While these issues are important to any company, they reflect a focus on value to the owner rather than value to the customer.

To transform an organization—large or small—from traditional management to lean thinking requires the commitment, understanding, vision, and active involvement of the senior executives of the organization. This is a major challenge to many American companies, particularly larger public companies. The senior leadership is trying to pursue a lean transformation but is unknowingly undermining lean progress by continuing to measure, manage, and motivate using traditional methods.

Cyclical Patterns in Key Industries

Lean production emphasizes the identification and pursuit of smooth, balanced production that results in roughly the same number of units per day. Balance and synchronization of flows is difficult when demand is uneven and sporadic. Lean production is inherently a system of reciprocal obligation. Workers share a fate with their employer. Suppliers share a fate with the assembler. When the system works properly, it generates a willingness to participate actively and to initiate the continuous improvements at the very heart of leanness. Management of the macro economy may have a dramatic long-term effect on the fundamental quality of the domestic production system.

While cyclical patterns may seem alien to some lean enterprises, this is not the case for many of the organizations that have adopted lean successful-

ly. Cyclical sales make the flexibility and responsiveness of the lean production process even more important. In fact, the removal of buffer inventories from the system and the movement away from marketing- and sales-induced bulges in sales demand may reduce the cyclical nature of the North American economy. Many effective lean organizations such as Danaher Corporation, The Wiremold Company, and Toyota Motors have successfully used the methods of lean thinking to overcome—and even profit from—the cyclical nature of their industry. Energizer Corporation was able to significantly improve their operations with certain customers by moving to manufacturing products based on point-of-use sales information rather than the previous MRP-driven warehousing and distribution processes. This customer-pull approach eliminated the huge swings in demand and also mitigated seasonality because the level of seasonality was lower at the final customer level than the MRP-driven supply-chain-level planning.

North American Notions of Careers

The concept of lifetime employment, loyalty to an organization that is experiencing trouble and may need to cut wages, and the desire to speed up career progression by changing companies all combine to create an unstable basis for the knowledge capital integral to lean production and its successes. If individuals are not rewarded on the basis of team and entity performance, their incentive to share knowledge and reduce their personal visibility and success may be limited.

Making changes to the incentive structure of the organization is essential if lean production is to be implemented effectively. If long-term performance improvements are needed, then at least some element of each individual's performance and reward package must incorporate long-term metrics. If team efforts are a central element of

the production strategy, then team rewards have to supersede or match those provided for individual performance. The experience of successful lean producers such as Caterpillar shows that, in order for a U.S. company to gain the benefits of lean production, it must create and modify incentive systems to generate the appropriate motivation needed to support the lean philosophy. U.S. companies can overcome these cultural barriers by incorporating directly into their management structure new incentives that will once again marry the goals and objectives of the individual with those of the entity and its core process teams. Recognizing that financial improvement comes from thousands of small continuous improvements throughout the processes, many lean companies provide bonuses to their employees through simple profit sharing rather than focusing on detailed outcomes.

Politics on a National Level

Few managers would be surprised to hear that politics reigns supreme within any change process. What sets lean production apart, however, is the fact that macroeconomic policies and politics have to be accounted for in the implementation of the new management model. Key issues that will need to be addressed include:

- green-field versus brown-field models;
- transplants;
- unions; and
- pressure on the supply chain.

Green-Field versus Brown-Field Models

Some Japanese companies do not attempt to migrate traditional mass production facilities to the lean model—every new launch or initiative is by definition a green-field effort. In North America, closing existing facilities and creating new ones causes instant tension and stress within the affected communities. During the height of the plant closing phase of North

American manufacturing turnarounds, there was more than one reference to the potential intervention of government in the decision process. Local, state, and federal government representatives began to lobby for placing restrictions on a company's freedom to move. At the same time, many management teams felt that abandoning the existing workforce and community to implement a green-field solution would earn them the dubious title of "poor citizen." Concerned with both the internal cultural impact and external threat of sanctions if green-field solutions were pursued, Western companies have tried to migrate their mass facilities to lean concepts. It is a much slower process, and it that can put the future of the organization at risk.

Transplants

State governments are making it increasingly simple and attractive for foreign producers, such as the Japanese and German automobile manufacturers, to locate in the United States. These transplanted lean structures place even more pressure on domestic organizations as they avoid the tariff and currency translation problems, further increasing their competitiveness. The time to respond is shortened as the competition is moved closer to home.

Unions

Existing organizations have legacy relationships with labor that new lean producers often can avoid. Large unions such as the United Auto Workers (UAW) often make it much more difficult for a company to implement the multi-skilled, multitasking work structures that the lean enterprise relies on to create flexibility and responsiveness. In many industries, though, unions are beginning to understand and accept that the future health of the organization, and, hence, that of the people the union represents, depends on abandoning old methods and old assumptions.

Pressure on the Supply Chain

A lean enterprise is constantly putting pressure on its supplier base to help identify and implement process improvements and cost reductions. It may be easy to supply an organization with its required materials, but if this comes at a greatly reduced price, the result of more volume of sales may be fewer dollars of profit. This phenomenon is being experienced in the retail market as Wal-Mart continues to push its suppliers for price concessions. At a certain point, organizations are either forced out of an industry or withdraw voluntarily when profits disappear.

While these barriers and concerns remain, there is increasing evidence that lean production concepts can be used to turn around existing mass production facilities. In addition, it appears that incentive systems can be used to overcome cultural barriers and that integrated supply-chain management can improve the profits and performance of the entire trading alliance.

VII. THE ROLE OF MANAGEMENT ACCOUNTING WITHIN LEAN ORGANIZATIONS

Some years ago, one of the U.S. Big Three automakers pilot-tested ways to reduce waste by producing solely to demand in small batches and changing layouts to reduce material-handling costs. There were many positive results, including decreased inventories and greater plant flexibility. The problem was that the company's management accounting system, which measured results solely in terms of their effects on standardized financial criteria, showed only bad results, such as increased indirect-to-direct labor ratios, nonproductive labor time (workers not producing), and decreased overhead absorption. Since the system had no way of accounting for the improvements, the experiment was considered a failure.

Today virtually all companies utilize standard cost accounting systems for measuring and reporting performance, but these systems, from an operations perspective, rely on criteria that often are outdated and worth little in gauging important areas of organizational performance. Worse, the criteria used can give a distorted view of performance and, as in the automaker example, discourage attempts to reduce waste, continuously improve, or otherwise heighten competitiveness. Guided by traditional criteria, managers may make decisions that look beneficial but in actuality are detrimental to the organization's immediate well-being and long-term viability.

Typically the management accounting system that an organization chooses for gauging its performance reflects the organization's general management philosophy, culture, and practices. To the extent that an organization measures only what its management holds most dear, a manufacturer that actively adopts lean management accounting principles is more likely to be one that has also embraced the goals, philosophy, and practices for attaining competitive advantage. That is, it produces products better, faster, and cheaper using processes that are leaner and more agile than the competition's. The company is certainly also customer focused and driven to keep improving.

As the structure of the manufacturing system changes, the numbers used to guide decision makers and evaluate performance should be modified. It falls to management accounting to ensure that the right numbers are available, at the right time, to support the management process.

The role of the financial practitioner in lean production extends far beyond the development, maintenance, and reporting of new cost and performance metrics. Serving as part of the initial

implementation team, financial practitioners help to quantify the costs and benefits of alternative approaches and solutions. Once a lean manufacturing design has been chosen, attention shifts to ensuring that the plans are executed effectively and within time and cost budgets. Financial practitioners provide the insight and knowledge required to track the implementation and ensure that it meets its defined goals.

The involvement of the finance professional spans the entire life of the lean production initiative, from initial design through its ongoing use on the plant floor. Finance plays a vital role in each of the following:

- *Value stream management* requires taking a more relevant and holistic view of how material, information, and costs flow through the organization. Traditional management by department inhibits progress because it focuses on optimizing the performance of the unit rather than the performance of the whole.
- *Performance measurement changes* not only include strategic alignment with company goals but also specific linkages among the cells, value stream, and facility that highlight the key purposes and drivers of success at each level.
- *Decision making* that concerns special orders, outsourcing, and insourcing incorporates throughput and capacity as key considerations to optimize resource usage rather than using traditional standard costs as a basis.
- *Features and characteristics* that require a varying amount of process time at the bottleneck process become the basis for calculating differential product costs.
- *Target costing* drives the creation of customer value by establishing the maximum cost allowable within the value stream followed by an action plan to increase customer value and achieving value stream profitability.
- *Budgets and planning* move away from the complex and arcane annual budgeting process to monthly rolling budgets incorporated into the company's Sales, Operations, and Financial Planning (SOFP) process.
- *Transaction elimination* becomes possible as Operations demonstrates better process control through lower inventories, better customer service, shorter lead times, and visual and updated metrics. Areas typically affected include inventory tracking, purchasing and receiving, labor tracking, and standard cost maintenance.
- *Sales and Marketing* price products based on the value they create for the customer and attempt to level orders from the customers by eliminating demand distortion caused by large batch orders and month-end-driven sales pressure. Sales bonuses and commissions—when used at all—are designed to motivate lean flow and increased customer value.

Each of these topics relevant to finance professionals is discussed in two other SMAs. *Accounting for the Lean Enterprise: Part 1* includes discussion of value stream management, decision making, features and characteristics costing, lean budgets and planning, transaction elimination, as well as providing guidelines for implementation. *Part 2* discusses applications beyond manufacturing and includes applying the lean accounting concepts in accounting organizations, service organizations, sales and marketing, and product development. It also outlines a strategic mapping process to facilitate establishing performance measurements for all types of lean enterprises.

As this list of topics suggests, the measurement expertise of financial practitioners places them in the center of the lean initiative. Many design and implementation choices need to be made as the

organization migrates to lean processes. Without relevant economic and performance metrics, these decisions can deteriorate to personal judgments and intuitive guesses. Also, the failure to change performance metrics to reflect the objectives and assumptions of lean production can actually destroy a lean enterprise initiative.

The changes initiated by lean concepts extend to all corners of the organization. Understanding what lean processes are and how best to utilize them to improve the performance of the organization is essential knowledge for the financial practitioner. This new environment requires the finance function to increase their involvement with the rest of the organization as a business partner rather than retaining the role of strict financial historian.

VIII. CONCLUSION

Lean production takes time to master. Organizations with prior experience in total quality management, Just in Time, or total productive maintenance—strategies that build effective work cultures—will probably require at least three years for successful implementation. Organizations without significant experience in those strategies will require at least five years to become a full lean producer. Organizations with fewer than 500 hundred employees may require less time.

Lean production is a model for the future—it may well become an essential element of a sustainable global strategy. As Henry Ford so aptly noted, “Customers cannot be expected to pay for waste, nor can a worker be paid very much for producing waste.” To be lean is to optimize the use of resources to create value for customers and stakeholders. It is a formula for success that is as old as it is new, as Western as it is Eastern.

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.

CYLCLE 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.

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 flow through the value stream.

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.

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 multi-skilled 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 where low inventory 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 value-creating 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.
- 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 is 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.

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facturing support network with local offices nationwide to support lean manufacturing and other improvement efforts.

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