

PRACTICAL LEAN ACCOUNTING
Suggested Solutions to Questions and Problems for Students

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PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 1: Why is Lean Accounting Important?

1. Lean accounting ...
A) identifies the financial benefits of lean improvement initiatives.
2. Traditional standard costs ...
D) provide misleading information for decision-making.
3. Product Q is manufactured in a lean production cell that has three processes: Stamping, Fabrication, and Assembly. Stamping requires 1 minute, fabrication requires 4 minutes, and assembly requires 3 minutes. The maximum number of units of product Q that can be produced by this cell in an hour is ...
B) 15 [one every 4 minutes]
4. Product Q is manufactured in a lean production cell that has three processes: Stamping, Fabrication, and Assembly. Stamping requires 1 minute, fabrication requires 4 minutes, and assembly requires 3 minutes. Each unit of Q uses \$10 worth of direct materials. The standard cost for direct labor is \$15 per direct labor hour and the standard rate for overhead is \$45 per direct labor hour. The actual conversion costs associated with running the lean production cell are \$75 per hour. The standard cost of a unit of product Q is ...
C) \$ 18.00 [DM \$10.00 + DL & OH $(\$15 + \$45) / 60 \times (1 + 4 + 3)$]
5. Product Q is manufactured in a lean production cell that has three processes: Stamping, Fabrication, and Assembly. Stamping requires 1 minute, fabrication requires 4 minutes, and assembly requires 3 minutes. Each unit of Q uses \$10 worth of direct materials. The standard cost for direct labor is \$15 per direct labor hour and the standard rate for overhead is \$45 per direct labor hour. The actual conversion costs associated with running the lean production cell are \$75 per hour. If the cell is running at full capacity, the “real” lean production cost per unit of Q is ...
B) \$ 15.00 [DM \$10.00 + Conversion costs $\$75 / 15$]
6. Absorption costing ...
B) encourages overproduction.
7. Which of the following is a flaw associated with traditional accounting performance measures?
B) Traditional measures are primarily financial measures, hiding rather than revealing the drivers of customer value and operational problems.
8. Waste in accounting processes ...
D) cannot be reduced at the expense of financial and operational control.
9. Lean accounting decision-making methods focus on ...
A) flow through the value stream and contribution to value stream profitability.
10. Lean accounting focuses on ...
B) customer value.

Discussion questions and problems.

According to James Womack and Daniel Jones, the principles of lean management are:

- Identify customer **value**
- Identify the **value stream**, the set of inter-connected activities that create value for customers.
- Make value **flow** without interruption through the value stream, at the rate demanded by the customers (**pull**).
- Continually strive for **perfection**.

1. What problems occur when traditional accounting is used with lean management? Why do these problems occur?

Traditional accounting encourages overproduction because: (1) Inventory recorded at full absorption cost pushes current period costs off the income statement and adds them to the balance sheet as an asset. (2) The performance measurement systems focus on optimizing use of individual fixed resources, which encourages larger batches and overproduction. (3) Performance reports are typically too late and too infrequent for operational control, and the measures aren't easily understood by line employees. (4) The control systems rely on costly and wasteful transactions, the equivalent of "inspecting quality in" rather than creating stable and reliable processes. (5) Standard cost information is designed to meet external financial reporting needs and does not identify relevant costs for decision making.

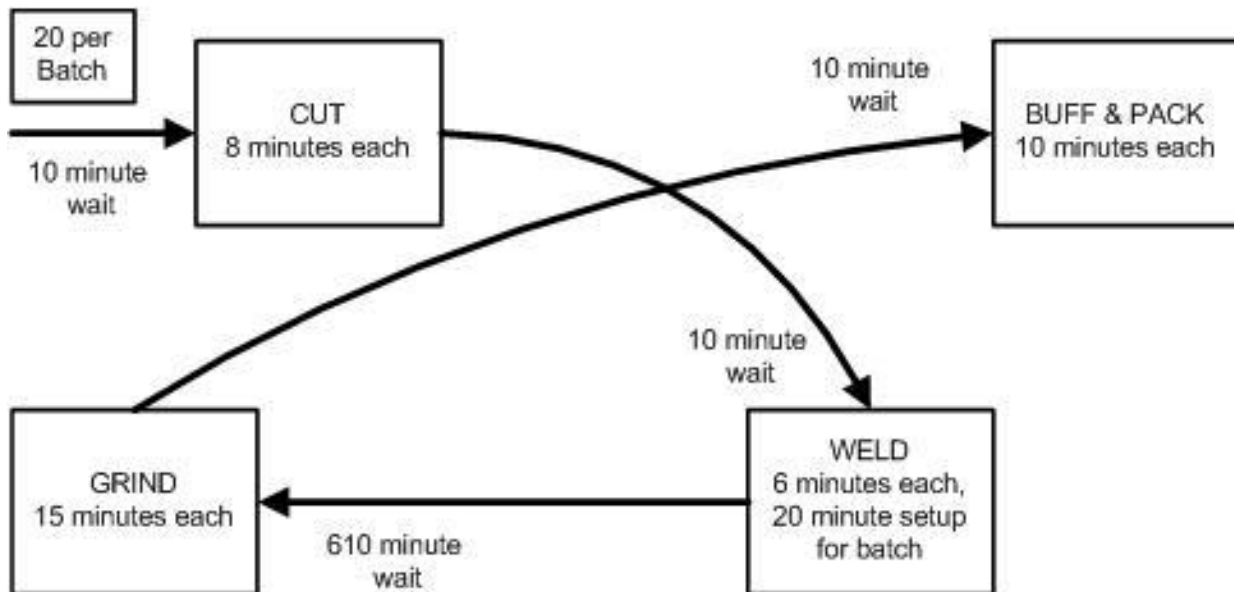
2. How can traditional accounting motivate people to use non-lean procedures?

Traditional accounting focuses on individual and departmental performance. Maximizing the production of individual pieces of expensive equipment and spreading fixed overhead over higher volumes results in more favorable performance reports irrespective of the needs of the customer or the impact other departments.

Decisions are often made based on the how standard costs will affect reported income. In reality, labor costs often cannot be easily adjusted to reflect small changes in volume, and lean companies particularly do not want to make such adjustments (they focus on meeting customer demand, creating flow, and eliminating waste, not reducing direct labor cost). The standard costs and reported expenses do not reflect the real, incremental costs associated with an action choice. Relying on standard costs will therefore often lead to poor decisions.

3. Acme Metal produces gear shafts. Currently, the gear shafts are produced in batches of twenty. Materials necessary to produce one batch of twenty are brought to the cutting department, where they sit for an average of 10 minutes before cutting takes place. It takes eight minutes to cut the materials for each unit. Once the entire batch is cut, it is moved to the welding department. After a ten-minute wait, a computerized welding machine is setup to weld the parts in the batch. The 10-minute wait time includes travel time from cutting and the time to setup the welder. After the entire batch of 20 is welded, it is moved to the grinding department. Due to the backlog in grinding, it takes an average of 10 hours (plus the 10 minute travel time between departments) before work begins on the batch in the grinding department. After grinding is completed, the batch moves to buffing and packing. When the entire batch is completed the parts are shipped to the customer or moved to the finished goods warehouse. At any one time there is usually one batch being worked on in

each department, one batch waiting at the welding department and two batches waiting at the grinding department.



A) What is the lead-time (throughput time) for Acme Metal to produce a batch of 20 gear shafts?

1,440 minutes. $10 + (20 \times 8) + 30 + (20 \times 6) + 610 + (20 \times 15) + 10 + (20 \times 10)$

B) How many gear shafts can Acme Metal produce per hour?

4 per hour. Grinding is the bottleneck process.

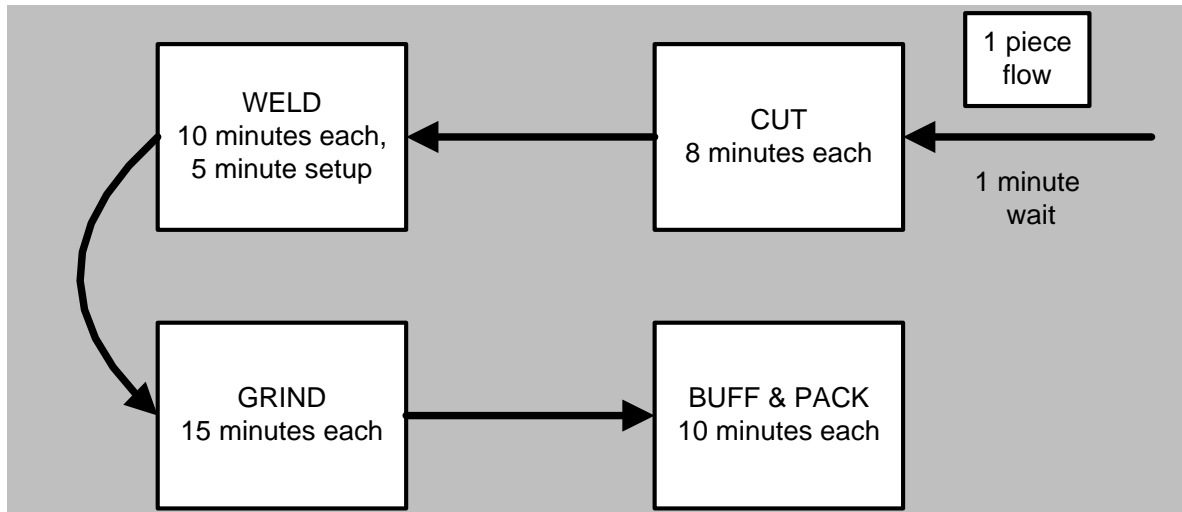
C) How many gear shafts on average are in work in process?

140, one batch in each process, one batch waiting for welding, two batches waiting for grinding.

D) The direct material cost averages \$75 for each gear shaft. Assume that direct labor time equals the process time for each process (e.g., the direct labor time for welding is 6 minutes per unit). If Acme Metal has a standard direct labor rate of \$20 per hour, and they assign overhead at a standard rate of \$180 per direct labor hour, what is the standard cost for each gear shaft?

\$205. $75 + ((20 + 180) \times (8 + 6 + 15 + 10)/60)$

4. Acme Metal has now created a cell to produce their gear shafts. Rather than producing gear shafts in batches of 20, they now produce one at a time in a lean cell. It takes one minute to bring the materials needed to produce each gear shaft to the beginning of the cell. Rather than place the Arc Welder in the cell, Acme Metals has used a smaller welder that requires only five minutes to setup. However, the welding process takes ten minutes per unit on the smaller welding machine compared to six minutes per unit on the old machine. Standard work-in-process in the cell is one gear shaft in each process and one gear shaft each waiting in front of the welding and grinding process.



- A) What is the lead-time (throughput time) for Acme Metal to produce 20 gear shafts?
334 minutes. 49 minutes for the first shaft, one shaft every 15 minutes thereafter.
- B) How many gear shafts can Acme Metal produce per hour?
4 per hour. Grinding (and welding if a setup is needed) is the bottleneck process.
- C) How many gear shafts on average are in work in process?
6 shafts. One for each process, one waiting for welding, and one waiting for grinding.
- D) The direct material cost averages \$75 for each gear shaft. Assume that direct labor time equals the process time for each process (e.g., the direct labor time for welding is 10 minutes per unit). If Acme Metal has a standard direct labor rate of \$20 per hour, and they assign overhead at a standard rate of \$180 per direct labor hour, what is the standard cost for each gear shaft?
\$218.33. $75 + ((20 + 180) \times (8 + 10 + 15 + 10)/60)$
- E) Compare the costs of producing the gear shafts (direct materials, direct labor, and overhead) using the process described in problem three with the costs using the process described in problem 4. Which costs are likely to be lower? Which are likely to be higher? Are the differences likely to be small or large? Which costs remain the same? What do you think the overall change in cost is likely to be?

Material costs should be the same in both cases, except waste and scrap could be reduced in the lean cell in problem 4 because errors and defects may be discovered more quickly and corrected. Direct labor costs will be slightly higher in the lean cell in problem 4 due to the more labor-intensive welding process. Overhead costs should be lower in the lean cell in problem 4 due to material moves being almost completely eliminated, much lower space occupied, and less expensive welding equipment. This may be partially offset by more time on setups if the cell produces many different shafts or products requiring setup in welding.

Overall the conversion cost should be lower for the lean production cell, but the reported standard cost is higher. The standard overhead rate might eventually be adjusted, but unless rates are computed separately for each production cell or value stream, the adjusted rate may not reflect the true costs of production.

5. The following information applies to MissileCo's operations for the past quarter:

	<u>Month 1</u>	<u>Month 2</u>	<u>Month 3</u>
Sales volume (units)	40	40	40
Sales price per unit	3,000	3,000	3,000
Production volume (units)	40	50	?
Direct material cost per unit	1,000	1,000	1,000
Variable conversion cost per unit	200	200	200
Fixed conversion costs (per month)	50,000	50,000	50,000
SG&A expenses (total per month, fixed)	10,000	10,000	10,000

There were no inventories of direct materials or work-in-process.

At the beginning of month 1 MissileCo had 10 units in finished goods inventory at a value of \$24,500 (\$2,450 each). In month 3, MissileCo embarks on a lean transformation and wants to end month 3 with 4 units of product in ending finished goods inventory.

A) Prepare an Income Statement for MissileCo Company for months 1, 2 and 3 based on generally accepted accounting principles (GAAP). Assume the company uses the FIFO method to value inventory.

	<u>Month 1</u>	<u>Month 2</u>	<u>Month 3</u>
Sales	\$120,000	\$120,000	\$120,000
Cost of goods sold	<u>98,000</u>	<u>90,500</u>	<u>109,667</u>
Gross profit	22,000	29,500	10,333
SG&A expenses	<u>10,000</u>	<u>10,000</u>	<u>10,000</u>
Operating profit	\$12,000	\$ 19,500	\$ 333

FIFO calculations:

Beginning inventory (units)	10	10	20
Beginning inventory (cost)	\$ 24,500	\$ 24,500	\$ 44,000
Current production (units)	40	50	24
Direct material costs	\$ 40,000	\$ 50,000	\$ 24,000
Variable conversion costs	8,000	10,000	4,800
Fixed conversion costs	<u>50,000</u>	<u>50,000</u>	<u>50,000</u>
Total production costs	<u>98,000</u>	<u>110,000</u>	<u>78,800</u>
Cost per unit (*rounded)	\$ 2,450	\$ 2,200	*\$ 3,283
Cost of goods sold			
From beginning inventory	\$ 24,500	\$ 24,500	\$ 44,000
From current production (30/40, 30/50 & 20/24)	<u>73,500</u>	<u>66,000</u>	<u>65,667</u>
Total cost of goods sold	\$ 98,000	\$ 90,500	\$109,667
Ending inventory (units)	10	20	4
Ending inventory (cost)	\$ 24,500	\$ 44,000	\$ 13,133

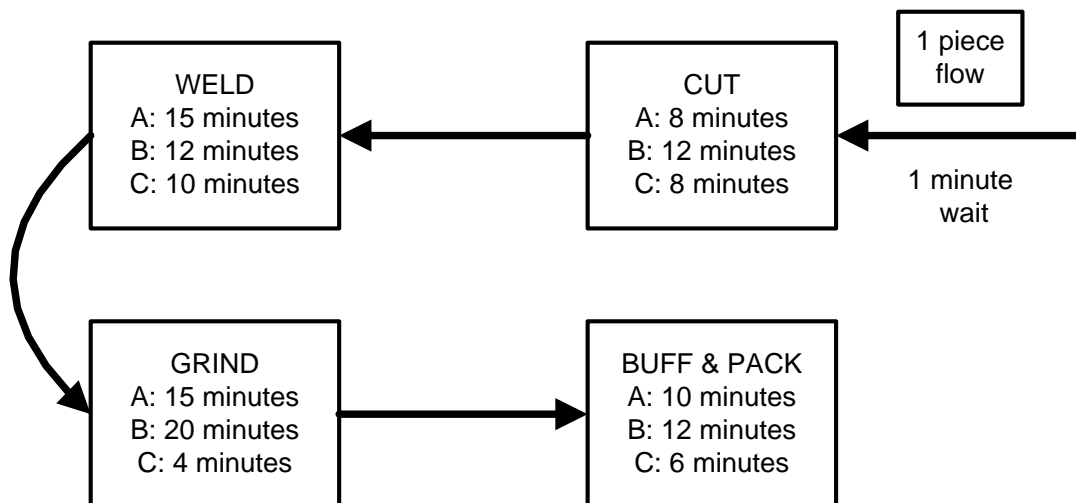
B) Which month was MissileCo's best month? Explain your answer.

Month 2 was best in terms of reported profit. However it had the highest production costs, \$110,000, in support of the same level of sales as Months 1 and 3. Reported profit is higher because Month 2 costs have been pushed out of the income statement onto the balance sheet in the form of higher inventory values. Although it had the lowest reported profit, month 3 could be considered the best month because it had the lowest production costs, \$78,800, and excess inventory was eliminated. Month 2 could be considered the best because production volume reflected current customer needs.

C) Comment on the financial impact of lean improvements as reported under generally accepted accounting principles. Do GAAP statements accurately reflect the costs and benefits of a lean transformation?

Traditional accounting encourages overproduction. In a lean transformation this excess inventory must be removed, and improved production processes with shorter lead times further reduce the amount of inventory needed to support customer demand. This improved performance is not reflected in GAAP statements. Lower inventory levels mean that a greater proportion of current production costs will appear in the income statement as expenses, and prior period production costs that were "stored" on the balance sheet as inventory will also appear as added cost of goods sold. GAAP statements "punish" lean efforts to eliminate the waste of excess inventory with higher reported costs and lower profits.

6. Acme Metal is now producing two types of gear shafts, A and B in the same production cell. They are thinking of adding a third type, C. Acme Metal's management must decide whether they should produce type C in the cell, outsource its production, or not offer type C at all.



The demand for type A and B gear shafts average 60 per week each (12 per day). Type A shafts sell for \$350 and type B shafts sell for \$385. Acme's managers estimate the demand for type C shafts at 20 per week initially, at a selling price of \$220 per shaft. They can contract production of shaft C offshore for \$150 per shaft delivered, but they will have to buy in lots of 200 shafts.

The direct material cost is \$75 per shaft, regardless of type. Acme Metal runs one 8-hour shift. It costs \$500 per hour (\$4,000 per 8-hour day) to run the cell, including direct and

indirect labor. The standard rate for direct labor is \$20 per hour. The standard overhead rate is \$180 per hour.

- A) What are the standard costs per shaft (material, labor and overhead) for types A, B, and C?

Conversion costs are applied at a rate of \$200 per hour.

\$235.00 for type A. \$75 direct materials + $(\$200 \times 48/60)$ for labor and overhead.

\$261.67 for type B. \$75 direct materials + $(\$200 \times 56/60)$ for labor and overhead.

\$168.33 for type C. \$75 direct materials + $(\$200 \times 28/60)$ for labor and overhead.

- B) Based on the material cost and the cost of running the cell, what are the costs of type A, B, and C gear shafts?

It costs \$500 per hour to run the cell and looking at each product individually, hourly production can only proceed at the speed of the most time consuming process.

\$200.00 for type A. \$75 direct materials + $(\$500 / (60/15))$ for labor and overhead.

\$241.67 for type B. \$75 direct materials + $(\$500 / (60/20))$ for labor and overhead.

\$158.33 for type C. \$75 direct materials + $(\$500 / (60/10))$ for labor and overhead.

- C) Which unit costs are more realistic, the standard costs you computed in part A or the costs you computed in part B?

Assigning conversion costs based on throughput through the cell should be more realistic. However, the bottleneck process is not the same for each shaft, so the costs may vary depending on the actual mix of production in the value stream. Value stream conversions costs are joint costs shared by all the products produced in the value stream so any allocation of those costs among the products will be to some extent arbitrary.

- D) Does Acme have the capacity to produce type C shafts in the cell along with types A and B?

Yes. Grinding has the highest time demand, $(60 \times 15) + (60 \times 20) + (20 \times 4) = 2,180$. 2,400 minutes are available in a 40-hour work week.

- E) What recommendation (Produce C, outsource C, not offer C) would you make to Acme management?

Since C can be produced with existing capacity, the marginal cost for each shaft is the \$75 cost of materials. Assuming the demand for A, B, and C are not expected to increase in the producing C in house is the most profitable course of action.

- F) Suppose an additional 3 minutes in welding and an additional 3 minutes in buffing for type B gear shafts would reduce the grinding time by 2 minutes. How would the standard cost of the type B gear shaft change? From an operational perspective, should Acme adopt the proposed process change? Is the signal from the standard cost system consistent with the operational perspective?

The change would add 4 minutes of direct labor time to type B shafts. At the \$200 conversion cost rate the change would add \$13.33 to the standard cost of each type B shaft. At this product mix, grinding is the bottleneck process and the change would free more time in grinding and increase overall capacity, so the change would provide more capacity and flexibility. The

signal from the standard cost system is not consistent with the operational perspective. If demand for type C increased significantly, welding could become the bottleneck process. The key from an operational perspective is reducing bottlenecks to increase potential throughput and improve flow, not reducing direct labor time or cost.

7. What are the benefits lean accounting should provide to a lean organization or an organization engaged in a lean transformation? Why should such an organization adopt lean accounting?

Lean accounting can: (1) Replace measures that encourage non-lean behavior with measures that motivate lean behavior at all levels of the organization. (2) Identify the impact of lean improvements, supporting the lean transformation and helping create a strategy that maximizes the benefits of the lean transformation. (3) Improve understanding of value stream costs and product costs, leading to better business decisions and driving continuous improvement efforts. (4) Eliminate waste from accounting processes, saving money and time for accountants to work on strategic issues. Focus the business on creating value for customers.

8. Does accounting provide value from the perspective of the customer?

Unless the firm is an accounting or bookkeeping firm, accounting does not provide value to customers.

9. Acme Metal had a routing slip to track each batch of 20 gear shafts they were producing in the process described in problem 3 above. A transaction was recorded to issue materials into production, and another transaction was recorded each time the job moved from one production department to another. These transactions were used to ensure information was available on the location of each batch, at any time, and to ensure that the proper quantity and cost of gear shafts was available for financial reporting. Acme Metal has now adopted cellular manufacturing as described in problem 4 above. Describe a way that Acme Metal can change its accounting system to meet its control and reporting objectives at a lower cost.

Production now takes place in a self-contained cell, lead times are reduced, and the overall amount of work in process is much lower. Cost information is less important because inventory levels are much smaller and inventory is in process for a much shorter time. One approach would be to record one material issue entry for a start, and another entry when the completed gear shaft leaves the cell (either to finished goods or to the customer. Other alternatives are discussed in chapters 7 and 12.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 2: Maturity Path to Lean Accounting

1. Lean organizations achieve control through ...
B) visual controls within stable operating processes.
2. Which of the following is an attribute associated with a manufacturing company that has moved beyond the pilot stage and achieved a widespread lean transformation?
C) Manufacturing is managed by value stream.
3. The earliest stage at which value stream direct costing can replace standard costing is ...
C) the “manage by value stream” stage, when lean production (manufacturing) is widespread.
4. The earliest stage at which value stream costing can be extended outside the company to incorporate suppliers, distributors, and even customers is ...
B) the “lean enterprise” stage, when lean thinking and a continuous improvement culture has spread throughout the organization.
5. Lean performance measurements can be created, displayed and used in production cells ...
D) at the pilot stage, when the lean transformation begins in production.
6. An organization can be described as a lean enterprise when ...
A) lean thinking and a continuous improvement culture has spread throughout the organization.
7. Which of the following statements about target costing is **false**?
D) Target costing computes the budget or standard cost “target” for a product or service.
8. Which of the following statements best characterizes lean accounting?
A) Lean accounting applies the principles of lean thinking to accounting processes and provides the measurements and reporting to support a lean management system.

Discussion questions.

1. If lean accounting reinforces the lean transformation of production and motivates continuous improvement, why can't companies switch to lean accounting before they undertake the lean transformation of production.

With support from management, some lean operational measures could be implemented and use of traditional variance analysis could be eliminated almost immediately. However, other changes require some lean changes to operations before the accounting techniques will be feasible. Value streams must be identified before value stream costing can begin, and value stream costing will be difficult to implement if there are too many shared resources. Transaction-based control cannot be discontinued until processes are stable and visual controls are in place. Simplified inventory calculations must wait for reduced inventory levels and lead times.

2. Describe the three basic stages of maturity for lean manufacturing. Identify two accounting changes that can be implemented at each stage.

In the Pilot Lean Production Stage – There has been extensive training in lean principles for most employees, and some successful lean production cells are in place, with kanban (pull systems, visual control, standardized work and quick changeovers. In Accounting, variance reporting is eliminated,, replaced by lean performance measurements in the cells, operational transactions are being eliminated in the production cells, and the financial benefits of lean improvements are being calculated to counter the negative signals reported using GAAP accounting (see the tables in the chapter for other examples).

In the Lean Manufacturing Widespread Stage – Cellular production now predominates, inventory is low and consistent, production is managed by value stream, and lean has begun to extend to suppliers through certification programs and intercompany kanban systems. In accounting, lean performance measures at the value stream and plant, division, or corporate level are in place and linked to organizational strategy, value stream direct costing replaces standard costing, value stream and features and characteristics costing is being used to evaluate individual products within value streams (see the tables in the chapter for other examples).

In the Lean Enterprise Stage – The company is organized by value streams, lean thinking is part of the organization culture and lean management extends beyond the boundaries of the firm in cooperative relationships with customers, suppliers, and partners. In accounting, most purchasing and inventory control processes are eliminated as material flow is controlled by the pull system, value stream costing extends outside the company and target costing is used in product design and to drive improvements (see the tables in the chapter for other examples).

3. Some writers and consultants make a distinction between lean accounting and accounting for lean. Where a distinction is made, lean accounting refers to applying lean thinking to accounting processes, and accounting for lean refers to measures and reporting supporting lean thinking and motivating continuous improvement of value streams. Consider each of the five bullet points on page 19. Do they refer to lean accounting, accounting for lean, or both? Explain your choices.

- Lean accounting uses visual measurements – accounting for lean, the measures support lean thinking and a lean, continuous improvement culture.
- Lean accounting's value stream focus – accounting for lean, customer value and the interdependent system that creates the value become the focus of the lean enterprise.
- Lean accounting methods motivate continuous improvement – accounting for lean, supporting the continuous improvement culture.
- Lean accounting eliminates waste from control systems – lean accounting, eliminating non-value adding processes.
- Lean accounting provides lean thinking to accounting processes – lean accounting.

4. Is lean accounting a series of methods and tools? Are there any benefits or dangers associated with regarding lean accounting as a series of tools?

Lean accounting is not simply a series of methods and tools. Lean accounting applies lean thinking to accounting processes, recognizing that accounting processes need to support value creation and continuous improvement. The danger of thinking of lean accounting as a series of methods and tools is that one may forget the underlying purpose that led to the development of the tools and continue to apply tools after changes in production and management processes have rendered them obsolete.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 3: Cell Performance Measurements

1. Traditional accounting performance measurements ...
B) motivate overproduction.
2. Lean production cell measures ...
C) are usually presented visually in the production cell.
3. Which of the following measures is **not** part of BMA, Inc.'s starter set of production cell/ process measures?
C) EBITDA
4. The day-by-the-hour report ...
A) shows whether or not production is occurring at the rate of customer demand.
5. Takt time is ...
C) the rate at which product must be produced to meet customer demand.
6. Which of the following is **not** a purpose of the day-by-the-hour report?
A) To motivate the operating personnel to produce at the maximum rate possible.
7. First time through is ...
B) the proportion of products produced from start-to-finish without defects or rework.
8. Aluminum Slugger makes softball bats. In one hour, 50 bats went through production. Two of the bats were misshaped and they had to be scrapped. The remaining 48 bats were sent to final inspection and three of those bats had to be sent back for rework in sanding and buffing before they passed final inspection. The first time through (FTT) rate for Aluminum Slugger is ...
D) 90.00%. [45/50]
9. Natural Tee Company produces T-shirts using all cotton fabric and natural dyes. The T-shirts production cell has three workstations: Dyeing, Cutting, and Sewing. The first time through (FTT) rates for each workstation are: Dyeing 90%, Cutting 98%, and Sewing 97%. The overall FTT rate for the production cell is ...
B) 85.56%.
10. The purpose of the WIP-to-SWIP measure is ...
D) to show whether or not the lean pull system is working correctly.
11. Ideally, the value for WIP-to-SWIP should be ...
A) 1.0, a 1:1 ratio.
12. The metric that tracks the ability of a machine to make a product on time and to the right quality is ...
C) OEE (operational equipment effectiveness).

13. Operational equipment effectiveness is the product of three measures. Which of the following measures is **not** used in calculating OEE?
B) On time delivery
14. Which of the following statements is true regarding cell performance measurements?
D) The measures should be used to reveal and fix problems, not to assign blame.

Use the following information to answer questions 15 – 18

A stamping machine used to produce part P has a rated run speed of 1,000 parts per hour. It is scheduled to run 8 hours per day, five days per week, with all preventive maintenance completed outside the 8-hour shift. During the past week, the stamping machine was unavailable for six hours while changeovers took place. The machine was unavailable for three hours while two unscheduled repairs took place, and adjustments for quality problems stopped production another four times. It took 15 minutes to resolve each quality problem and resume production. While the stamping machine was running, it produced 980 parts per hour, a total of 29,400 parts for the week, but 2,352 parts were defective and had to be scrapped.

15. The stamping machine's availability for the week was ...
B) 75.00%. $[(40 - (6 + 3 + (4 \times .25))) / 40]$
16. The stamping machine's performance efficiency for the week was ...
D) 98.00%. $[980 / 1,000]$
17. The stamping machine's quality for the week was ...
C) 92.00%. $[1 - (2,352 / 29,400)]$
18. The stamping machine's OEE (operating equipment effectiveness) for the week was ...
B) 67.62%. $[.75 \times .98 \times .92]$

Discussion questions and problems.

1. The accounting performance measures traditionally used to evaluate operating performance include machine utilization rates, direct-to-indirect labor ratios, and rate and usage variances from standard material, labor, and overhead quantities and rates. These measures were developed to monitor and control mass production. Why don't they work in lean production environments?

They motivate non-lean behavior, overproduction without regard to customer demand or the effect on downstream processes, and large batch sizes at the expense of long lead times and the risk of obsolete inventory, in order to maximize local utilization of machinery and direct labor.

2. What is the purpose of the Day-by-the-Hour report?

It tracks the degree to which a production cell meets takt time, production at the rate required to meet customer demand.

3. Suppose on a Day-by-the-Hour report there is an hourly period where actual production was significantly higher than the target. Is this a problem? Should we see a problem and an action to be taken described on the report? Why or why not?

Production should meet customer demand. Production higher or lower than the target both indicate problems. When production exceeds the target there should be an explanation and the description of a countermeasure being taken to correct the problem.

4. Digital Design has a production cell producing computer chips. The circuit designs for the chips are etched onto silicon wafers in a fabrication process. Circuits for 200 chips are etched onto each wafer. The circuits are tested, and any that fail are marked. Digital design has a 20 percent failure rate for circuits in its fabrication process. After testing, the wafer is cut into die, each containing the circuits for an individual chip, and the marked die with failed circuits are scrapped. Wire connectors are attached to the good die and they are mounted in a protective housing and tested. The two percent of the chips that fail the mounting test are reworked to correct the problems. Following mounting, the chips are subjected to a final burn-in test. Five percent of the chips tested in burn-in fail the test and they are scrapped. Compute the first-time-through rate for Digital Design's chip production cell.

$$FTT = 74.48\%. [.80 \times .98 \times .95]$$

5. Happy Feet, Inc. makes stockings and hosiery. One production cell has the following workstations: Knitting, Toe closing, Ironing, Packaging and final inspection. All defective stockings are scrapped because rework is too costly relative to the selling price of the stockings. The defect rates for each workstation are: Knitting 2%, Toe closing 5%, Ironing 0.5%, Packaging and Final Inspection 1%. Compute the overall first time through rate for the production cell.

$$FTT = 91.7\%. [.98 \times .95 \times .995 \times .99]$$

6. What is the purpose of the WIP-to-SWIP report? Describe what it means for operations under the following circumstances: the value of WIP-to-SWIP is greater than one, the value of WIP-to-SWIP is equal to one, or the value of WIP-to-SWIP is less than one.

WIP-to-SWIP assesses the effectiveness of the pull system. A value of WIP-to-SWIP equal to 1 means the system is working effectively and all processes are producing at amounts and rates needed to maintain smooth production meeting customer demand. If the value of WIP-to-SWIP is greater than one it means production is taking place in upstream processes before downstream processes need the inventory. The proper signals are not being sent or they are not being followed. If the value of WIP-to-SWIP is less than one it means processes are not getting or following signals to produce at the required rates and times, or there is a breakdown in production.

7. Pa-Ted Spring Company makes springs, multi-slide forms, wire forms and small assemblies. Their NuCoil 400 machine produces springs from a spool of metal wire in a single step process. Pa-Ted operates its machines on eight-hour shifts, five days per week. Preventive maintenance is performed outside the shift. In the most recent week, the NuCoil 400 was set-up to produce six different springs. Together, the set-ups took eight hours. The NuCoil 400 was down twice during the week, once for 15 minutes to clear a coil jam, and once for 45 minutes to repair a wire break. The NuCoil 400 is rated to produce 750 springs per hour. It produced 720 springs per hour during the twenty hours it was up and running during the week. Two percent of the springs produced during the week were defective and had to be scrapped. The machine was idle for 11 hours during the week due to lack of customer demand. Compute the following for the NuCoil 400 for the most recent week:

- A) Availability. 77.5% [$(40 - (8 + 1))/40$]
- B) Performance Efficiency. 96% [720/750]
- C) Quality. 98% [$1 - .02$ defect rate]
- D) OEE (Operating equipment effectiveness). 72.9% [$.775 \times .96 \times .98$]

8. What is the purpose of posting each of the following support measurements in a production cell?

- A) Cross-training chart. The cross-training chart shows the current state of flexibility in the production cell. Cross-trained workers can fill in for absences and they can rapidly adjust resources assigned to different processes to cover demand surges and to recover from production breakdowns. Cross training charts may also indicate the level of employee involvement, as they often show additional training employees have requested.
- B) Five-S audit scores. 5S scores show the ability of the cell workers to maintain visual control and order. They also show adherence to standard work as sustaining 5S is part of standard work. An orderly workplace is also a safer workplace. I
- C) Safety records (accidents, time lost). A key principle of lean is respect for people since lean seeks cooperative, win-win solutions through continuous improvement. A safe workplace is essential, and posting safety records make problems visible.
- D) Set-up or changeover times. Rapid setup times are essential to reducing batch sizes, reducing lead times, reducing inventory, and consequently increasing quality and responsiveness to the customer while reducing costs. Posting setup times can highlight opportunities for improvement and ensure that setup improvements are sustained.
- E) Absenteeism. High absenteeism can indicate poor employee morale and low commitment to lean.

9. How do lean cell measures support lean production and motivate continuous improvement? What do they get “right” that traditional accounting measures do not?

Lean measures are few in number to provide focus. They relate directly to key issues in lean production and are tied to company strategies and goals. They focus on causes of production problems and production outcomes, rather than financial consequences, so they are more directly relevant and pertinent to operating personnel. Data gathering is quick and reporting is visual within the cell, so the employees take ownership of the measures, and they are available when needed. The measures are for the employees – to find root cause and make improvements, not on the employees to assign responsibility and blame.

10. How are lean cell measures used differently than traditional accounting measures? Is the problem with traditional accounting measures in a lean environment more a problem with how the measures are used than the measures themselves? Could we use traditional accounting measures in a lean way rather than changing measures?

Lean measures are for the employees – to find root cause and make improvements. Traditional measures assign responsibility and blame for financial outcomes, and rely on the desire for bonuses tied to favorable outcomes and penalties tied to unfavorable outcomes to pressure employees into delivering the desired results. Traditional measures could be used in a more blame free atmosphere, but because they are primarily financial, they are one step further from the root cause of production problems. They are less understandable and relevant to production employees, and they are often reported too infrequently and too late, so they are less effective than lean measures for supporting continuous improvement.

11. Do the cell performance measures have anything to do with accounting, or are they a concern only for operations? How do the cell performance measures relate to accounting and financial reporting?

Accounting needs to report on past financial performance but accounting also needs to provide information to support planning and executing strategy and decision making. The cell performance measures are primarily operational measures, but operations drive financial performance. Thus the cell measures are leading indicators of future financial performance and they are critical to continuous improvement efforts and the execution of a lean strategy.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 4: Financial Benefits of Lean Manufacturing

1. All of the following are financial results typical for early stages of a lean transformation at a manufacturing company except ...
C) Operating profits are lower due to much higher material costs.
2. The lean box score has three categories. Which of the following is **not** a category presented in the lean box score?
B) Lean measures.
3. All of the following are operational measures recommended for inclusion in a lean box score except ...
C) Operating equipment effectiveness.
4. Tru-Shot makes digital cameras. They are using the circuit board contained in each camera as the control part to measure dock-to-dock days. On September 30, they have 4,200 circuit boards in materials inventory, 2,500 cameras waiting for processing or in process at various workstations and 500 cameras waiting for final inspection. All good cameras are shipped to customers (retail stores) immediately after final inspection. Tru-Shot shipped an average of 400 cameras per working day during September. Tru-Shot's dock-to-dock days for September would be ...
B) 18 days. [$(4,200 + 2,500 + 500)/400$]
5. On-time shipment is ...
B) The proportion of customer orders (or order line items, or units of product) shipped (or delivered to the customer) on time as requested by the customers.
6. Old Burnside Ice Company supplements its ice business by producing beer. The brewery value stream occupies 30% of the space in a 10,000 square foot production area, and kegs and bottles of beer awaiting shipment occupy 50% of a 12,000 square foot refrigerated storage area. Grain and other materials occupy a separate 400 square foot storeroom. A buyer and a marketing/sales person share a 150 square foot office area. The floor space occupied by the Brewing value stream is ...
D) 9,550 square feet. [$(.3 \times 10,000) + (.5 \times 12,000) + 400 + 150$]
7. Old Burnside Ice Company supplements its ice business by producing beer. There are four people directly involved in beer production: two brew-masters, an assistant and a bottler. In addition, a buyer and a marketer/seller work full time on beer, and four delivery people work 75% of the time delivering beer and the balance of the time delivering ice. If Old Burnside's beer sales were \$120,000 for October, the sales per person for October in the Brewery value stream are ...
C) \$13,333. [$120,000 / (4 + 1 + 1 + (.75 \times 4))$]
8. What costs should be included when computing average cost per unit for a value stream?
D) Direct materials, direct labor, and all manufacturing, selling and administrative costs directly associated with the value stream.

9. Which of the following is **not** a recommended item in the **financial** section of the box score?
B) Sales per person.
10. If the value stream box score is being used for planning, the _____ column represents the results if planned improvement initiatives provide the expected benefits.
B) future state.
11. For purposes of capacity analysis, productive capacity is defined as ...
C) time spent creating product or services at the pull of the customer.
12. Brand X Packaging has a folding machine that can produce 1,000 boxes per hour. Although the machine could be run 24 hours per day, Brand X currently runs a single eight-hour shift. During an average eight-hour shift, On average, the folding machine spends two hours in changeovers from one type of box to another, twenty minutes in scheduled maintenance, and forty minutes in unscheduled down-time to correct jams and other problems. Customers demand an average of 4,000 boxes per day. The percentage of unused available capacity for Brand X's folding machine is ...
A) 12.5% [(8 hours - (4 productive + 3 nonproductive)) / 8]

Discussion questions and problems

1. List some financial results that typically occur in early stages of the lean transformation of a manufacturing company.

Revenue stays the same, though there may be some reduced backlog that brings revenue in quicker. Costs stay much the same, although overtime and scrap costs may be lower. Operating profits may be down due to the impact of reduced inventory on cost-of-sales. Cash flow from operations may increase due to inventory reduction, but other financial indicators have not improved, or have worsened. Sales per employee have stayed roughly the same. Average cost per unit may be higher as excess inventory is eliminated.

2. A lean transformation can often lead to dramatic changes in operating performance in a very short period of time while financial performance changes very little. Explain how these seemingly contradictory results can occur together.

By eliminating waste, lean primarily creates additional capacity using the same resources. Profitability won't improve significantly until the excess resources are profitably re-deployed. Eliminating surplus human resources created by lean improvements will kill the lean transformation. In addition, eliminating excess inventory creates an added period expense when using full absorption accounting, so reported financial performance is depressed as inventory is reduced.

3. What is the main purpose of the lean box score?

The box score provides a framework for evaluating the operating and financial effects of lean and provides a structured way to view and speak about the different ways that lean creates value.

4. What operational measures are recommended for inclusion in the lean box score? Describe what the purpose of each measure in evaluating value stream performance.
 - Dock-to-dock days measures flow through the value stream and assesses the agility and responsiveness of the value stream – its ability to quickly respond to customer needs.
 - First time through measures quality of production and the quality of and adherence to standard work throughout the value stream. (Introduced in this chapter, but not one of the “starter set” of value stream measurements.)
 - On-time shipment measures the ability of the value stream to meet customer demands, shipping the right products in the right quantities at the time the customer wants them.
 - Floor space occupied measures the efficient use of space. It encourages inventory reduction and promotes use of visual control.
 - Sales per person measures value created and the productive use of human resources in the value stream. Note that this includes all value stream workers, not just direct labor.
 - Average cost per unit measures the overall efficiency of the value stream.
 - Accounts receivable days outstanding measures cash flow in the value stream. It also promotes better information flow as miscommunication pertaining to orders and billing can contribute as much to delaying payment as quality and delivery problems. (Not introduced in this chapter, but one of the “starter set” of value stream measurements.)
5. Should on-time shipment be based on the date the customer requested or the date the customer was promised? Should the measure be based on number of orders, line items, units, or dollar values of products?

Although customer requests can sometimes be unreasonable (“I want it yesterday”) it is best to use the customer request. This maintains the focus on customer and customer value and prevents the urge to quote longer lead times to ensure on-time shipment. Arguments for and against the basis for the measure may vary depending on the circumstances of the company. It is important that the metric promotes the right behavior, the data for the metric is easy to gather and report, and the basis for the metric is consistently applied so trends will be meaningful. It is important to recognize potential unintended consequences (e.g., if we use dollar values, do small orders get pushed aside?). As performance improves, the basis can be adjusted to a more strict measure (e.g., an entire order is considered late if any single item is late or missing) beginning a new trend in performance following the change in basis.

6. NewEnergy produces a number of products, including windmill rotor blades. The Rotor Blade value stream uses 12,000 square feet of a 30,000 square foot factory floor. Another value stream uses another 12,000 square feet of the factory floor, and the remaining space is currently vacant. Materials for the Rotor Blade value stream occupy 4,000 square feet and finished rotor blades occupy 1,000 square feet in a 20,000 square foot warehouse adjacent to the production facility. The warehouse is 25% vacant. There is a 10,000 square foot office on the floor above the factory. Eight hundred square feet of office space are occupied by sales, engineering, and purchasing personnel assigned to the Rotor Blade value stream, 5,000 thousand square feet are occupied by corporate officers and shared meeting space, and the balance is occupied by personnel assigned to other value streams. Compute the floor space measure for the Rotor Blade value stream.

17,800. [12,000 + 4,000 + 1,000 + 800]

7. What are the five items of data recommended for inclusion in the financial section of the value stream box score? What is the purpose of each item?
- Inventory value measures the end-of-period investment in materials, WIP, and finished goods required for the value stream. The measure encourages inventory reduction and is useful for understanding value stream cash flow and the difference between “real” and GAAP reported value stream profitability.
 - Revenue measures the value delivered to customers during the period.
 - Materials measures the cost of production materials acquired during the period by the value stream.
 - Conversion costs measures all of the costs other than production materials used to run the value stream during the period. (This is a broader classification of costs than the traditional direct labor and overhead definition of conversion costs).
 - Value stream profit measures the difference between value delivered and current expenses for materials and conversion costs.
8. What is the purpose of having a column for the long-term future state on the value stream box score? Is it possible to develop a long-term future state without knowing the specific improvement initiatives that will be required to achieve it?

The long-term future state can represent the performance the value stream will need to achieve to support an intermediate or long term division or corporate strategy, goals and objectives. It can provide clearer sense of direction and purpose to the workers in the value stream. Since the long-term future state is created from a strategic imperative, the specific steps to achieve may not be known and do not have to be currently known. The means will become apparent as continuous improvements are implemented, creating a series of intermediate future states working toward the long-term future state.

If the long-term future state was created within an effective strategic planning process, the long-term future state should prove to be challenging but achievable. In any event it will be reviewed and if necessary, revised, as short-term results and more information become available.

9. Why could reducing excess resource capacity spell the end of lean? What choice other than reducing excess capacity does a company have?

Lean relies on the ingenuity of all workers for continuous improvement. If workers are laid off the moment ideas for waste reduction are implemented, no further ideas for waste reduction will be forthcoming from the workforce. The best way to take advantage of lean improvements is to grow the business – create more value for more customers with the same resources.

10. Faria Corporation produces tachometers. The final assembly step is a manual process requiring 90 seconds per tachometer. Faria has two assemblers working a single eight-hour shift with two paid 15-minute breaks. An unpaid half-hour lunch break divides the shift into two four-hour sections. The workers spend 12 minutes per day in production meetings, 15 minutes per day cleaning their work areas, and five minutes per day completing reports. Four out of every 100 tachometers they produce require an additional 90 seconds of re-work time. Final Assembly produced 1,150 tachometers during the most recent week. Compute the percentage of productive, non-productive, and available time in Faria's current final assembly operation.

Total available time – $(8 - (2 \times .25)) \times 5 \times 2$ workers = 75 hours

Productive time – 90 seconds \times 1,150 = 103,500 seconds, 28.75 hours, 38.3%

Nonproductive time – 32 minutes \times 5 \times 2 = 320 minutes in meetings, cleanup and reports. 1,150 \times .04 \times 90 seconds = 69 minutes on rework. 6.5 hours, 8.7%

(Unused) Available time = 75 – (28.75 + 6.5) = 39.75 hours, 53.0%

11. Caspian Corporation – Motors Value Stream: Current State.

Required:

- A) Using the above information and the information on the current state value stream map, create a current state value stream box score for Caspian's Motors Value Stream. Explain your calculations in a column to the right of your box score.
- Include Dock-to-dock days, First time through, On-time shipment, Floor space, Sales per person, Average cost per unit, and Accounts receivable days as your operational measures. Use working days (20) rather than calendar days to calculate accounts receivable days.
 - Assume the book value of accounts receivable is \$1,551,132.
 - Include Inventory value, Revenue, Material costs, Conversion Costs, Value stream profit, Return on sales percentage, and Cash flow (Value stream profit plus non-cash expenses) as your financial measures.
 - Assume the book value of inventory is \$534,500.
 - Assume all machine costs and 80% of occupancy costs represent depreciation.
- B) Report productive, non-productive, and unused available capacity for Employees and for Machines based on a capacity analysis of Parts Fabrication, Machining, Assembly, and Shipping. You can ignore Sales, Customer Service, Purchasing, and supporting activities (maintenance, etc.). You may want to review Chapter 21 before responding to this requirement.

Caspian Corporation Motors Value Stream

Measure	Current State
Sales per person	19,360
On-time delivery	92.0%
Dock-to-dock time	32.50
First time through	77.9%
Average cost per unit	\$264.04
AR days outstanding	36.00
Floor space occupied	15,000
Labor: Productive	40.3%
Non-productive	62.3%
Available	-2.6%
Machine: Productive	37.8%
Non-productive	56.2%
Available	6.0%
Inventory value	\$534,500
Revenue	\$861,696
Material cost	\$267,516
Conversion cost	\$307,036
Value stream profit	\$287,144
Return on sales	33.3%
Cash flow	\$369,776

Comments

Current state Explanation

(Units sold × Unit Price) / FTE

8% shipped late, in narrative

from value stream map

product of FTT for each process or cell 98%
× 96% × 100% × 91% × 91%

(Material Cost + Conversion cost) / Units sold

AR balance / Daily sales

from cost table in narrative

bottleneck process from capacity analysis
(alt. total 43.4%)

bottleneck process from capacity analysis
(alt. total 50.4%)

bottleneck process from capacity analysis
(alt. total 6.1%)

bottleneck process from capacity analysis
(alt. total 43.5%)

bottleneck process from capacity analysis
(alt. total 42.8%)

bottleneck process from capacity analysis
(alt. total 13.8%)

in requirement A b. i.

Units sold × Unit Price

from cost table in narrative

from cost table in narrative, sum of outside
process, labor, machine & other

Revenue - (material cost + conversion cost)

VS profit / Revenue

VS profit plus depreciation

Reference Data

Units sold 2,176.00

Price per unit \$396.00

FTE in value stream 44.51

Outside process cost \$37,512

Labor cost \$153,724

Machine costs \$13,512

Other costs \$102,288

Accounts receivable balance \$1,551,132

Days per period 20

Occupancy costs \$86,400

Depreciation \$82,632

from narrative

from narrative

from cost table in narrative or VS map
adjusting for shared cells

from cost table in narrative

from cost table in narrative

from cost table in narrative

from cost table in narrative

in requirement A a. i.

from narrative

from cost table

Machine costs + 80% of Occupancy costs

See Chapter 21 solutions, pages 108-111 for details on the capacity analysis.

12. Caspian Corporation – Motors Value Stream: Future State.

Required:

- A) Using the above information and the information on the future state value stream map, add a future state column to the value stream box score you created in problem 11 for Caspian's Motors Value Stream. Explain your calculations in a column to the right of your box score.
- a. Include Dock-to-dock days, First time through, On-time shipment, Floor space, Sales per person, Average cost per unit, and Accounts receivable days as your operational measures. Use working days (20) rather than calendar days to calculate accounts receivable days.
 - i. Assume the book value of accounts receivable is \$1,427,184.
 - b. Include Inventory value, Revenue, Material costs, Conversion Costs, Value stream profit, Return on sales percentage, and Cash flow (Value stream profit plus non-cash expenses) as your financial measures.
 - i. Assume the book value of inventory is \$353,518.
 - ii. Assume all machine costs and 80% of occupancy costs represent depreciation.
- B) Report productive, non-productive, and unused available capacity for Employees and for Machines based on a capacity analysis of Parts Fabrication, Machining, Assembly, and Shipping. You can ignore Sales, Customer Service, Purchasing, and supporting activities (maintenance, etc.). You may want to review Chapter 21 before responding to this requirement.

See the table below. Shaded items in the reference data and explanations are items that changed from the current state.

- C) What is (are) the most significant change(s) in performance from the current state to the future state? Explain your choice(s).

Answers may vary, but arguably the most significant change in operating results is the reduction in dock-to-dock time from 32.5 to 20.5 days. On time delivery, first time through and floor space occupied have also improved. The value stream has freed significant capacity and the bottleneck is now the shared fabrication process rather than machining. Financial performance has improved. A significant one-time savings in cash flow of \$180,982 as inventory is worked down from current state to future state levels is not reflected in the cash flow number in the table.

- D) Do you believe the change in financial performance corresponded to the change in operating performance? Explain your answer.

Again this is a judgment call, but aside from the one-time savings in cash flow, the financial gains are arguably modest compared to the improvement in dock-to-dock time and capacity.

- E) What would you suggest as the next steps the Motors Value Stream should take to further improve operational and financial results? Briefly explain your choices.

To improve financial performance Caspian need to generate demand for the capacity they've freed by insourcing work, increasing sales, adding products to the value stream, or redeploying people to other value streams. The focus for capacity freeing capacity should switch to Parts Fabrication. There are opportunities for further improvement in first time through, dock-to-dock time and on-time delivery.

Caspian Corporation Motors Value Stream

Measure	Current State	Future State
Sales per person	19,360	19,360
On-time delivery	92.0%	95.0%
Dock-to-dock time	32.50	20.50
First time through	77.9%	83.0%
Average cost per unit	\$264.04	\$257.84
AR days outstanding	36.00	33.13
Floor space occupied	15,000	13,500
Labor: Productive	40.3%	50.7%
Non-productive	62.3%	34.9%
Available	-2.6%	14.4%
Mach.: Productive	37.8%	49.1%
Non-productive	56.2%	14.0%
Available	6.0%	36.9%
Inventory value	\$534,500	\$353,518
Revenue	\$861,696	\$861,696
Material cost	\$267,516	\$265,632
Conversion cost	\$307,036	\$295,436
Value stream profit	\$287,144	\$300,628
Return on sales	33.3%	34.9%
Cash flow	\$369,776	\$376,348

Future State Explanations

(Units sold × Unit Price) / FTE
 5% shipped late, in narrative
 from value stream map
 product of FTT for each process or
 cell 99% × 97% × 100% × 95% × 91%
 (Material Cost + Conversion cost) /
 Units sold
 AR balance / Daily sales
 from cost table in narrative
 bottleneck process from capacity
 analysis (alt. totals 43.4 to 43.3%)
 bottleneck process from capacity
 analysis (alt. totals 50.4 to 35.1%)
 bottleneck process from capacity
 analysis (alt. totals 6.1 to 21.6%)
 bottleneck process from capacity
 analysis (alt. totals 43.5 to 43.2%)
 bottleneck process from capacity
 analysis (alt. totals 42.8 to 16.9%)
 bottleneck process from capacity
 analysis (alt. totals 13.8 to 39.9%)
 in requirement A b. i. (one time
 savings in cash flow of \$180,982)
 Units sold × Unit Price
 from cost table in narrative
 from cost table in narrative, outside
 process, labor, machine & other
 Rev. - (material cost + conv. cost)
 VS profit / Revenue
 VS profit plus depreciation

Reference Data

Units sold	2,176.00	2,176.00
Price per unit	\$396.00	\$396.00
FTE in value stream	44.51	44.51
Outside process cost	\$37,512	\$37,512
Labor cost	\$153,724	\$150,764
Machine costs	\$13,512	\$13,512
Other costs	\$102,288	\$93,648
Accts rec. balance	\$1,551,132	\$1,427,184
Days per period	20	20
Occupancy costs	\$86,400	\$77,760
Depreciation	\$82,632	\$75,720

from narrative
 from narrative
 from cost table in narrative or VS map
 adjusting for shared cells
 from cost table in narrative
 from cost table in narrative
 from cost table in narrative
 from cost table in narrative
 in requirement A a. i.
 from narrative
 from cost table in narrative
 Mach. costs + 80% of Occupancy
 costs

See Chapter 21 solutions, pages 108-111 for details on the capacity analysis.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 5: Eliminating Wasteful Transactions

1. Companies converting to lean production while maintaining conventional accounting methods may find ...
B) they have more transactions to record because they receive materials more frequently, produce in smaller batches, and make more frequent shipments to customers.
2. One purpose for tracking each inventory move with transactions is to be able to locate jobs or orders within the production process and expedite late or urgent orders. Which of the following is a characteristic of lean production that eliminates the need for this detailed tracking?
A) Reduced cycle times.
3. Which of the following is **not** a characteristic of the “lean pilots in place” stage of lean implementation?
C) MRP systems have been implemented, to control production and inventory, at least in the pilot cells.
4. All of the following are identified as transaction heavy operational processes to target for transaction elimination at the “lean pilots in place stage except ...
D) tracking all indirect labor to production cells using value stream maps.
5. What must be in place to eliminate detailed labor tracking?
B) Accurate labor routings ensuring reasonably accurate labor hours in standard costs.
6. Labor variance reports ...
D) should be eliminated as soon as possible in the transformation to lean production.
7. Backflushing to the cost of materials using the standard material cost for actual production can replace recording the actual amount and cost of material used at each production step as soon as ...
C) Bills of materials and material routings are accurate, **and** there are accurate records for scrap and rework.
8. What must be in place to replace annual physical inventory counts with cycle counting?
B) Accurate labor routings and bills of materials, **and** accurate records for scrap and rework.

Discussion questions and problems

1. Why are work-order scheduling and detailed material and labor tracking performed in traditional batch manufacturing companies? How will managers know when they can stop using the detailed scheduling and tracking?

Work order scheduling is used on a “push” basis to plan for production so jobs will be completed on time and to try to maximize use of equipment. Detailed material tracking is used to track the location and amounts of material and to have accurate information for inventory valuation and cost of goods sold. Detailed labor tracking is used to try to ensure labor efficiency, (a greater

proportion of worker time on direct labor, and direct labor time per unit at or below standard on each process) and for job costing. The detailed tracking is also used to identify the current status of jobs for internal management and to respond to customer inquiries.

Management can stop using the detailed tracking when their needs are satisfied by other controls. Push scheduling can be replaced by an effective pull system. Cellular manufacturing and reduced cycle times eliminate the need for transactions to report job status. Operational measures promote overall production efficiency. Reasonably accurate bills of materials and labor standards and accurate reporting of exceptions (scrap and rework) will provide sufficiently accurate costs for inventory valuation and cost of goods sold, especially with lower overall levels of inventory.

2. Explain how a lean transformation can lead to an increase in transactions.

To improve flow, lean reduces production batch sizes and order and delivery shipment quantities. If each move is tracked and recorded as a transaction there will be a huge increase in transactions.

3. What key manufacturing characteristics are associated with the “lean pilots in place” stage of maturity?

Flow has begun and standard work and pull systems are in place in pilot cells. Some key suppliers are certified. Some value streams have been identified and mapped and the company is moving toward value stream organization.

4. What key information characteristics are associated with the “lean pilots in place” stage of maturity?

Lean performance measures and visual controls are in place in the pilot cells. Bills of materials and routings are simple and accurate. Engineering (not accounting) is responsible for maintaining accuracy of the BOMs and routings.

5. How can work order scheduling and labor tracking be streamlined in the lean pilot stage?

A pull system can replace work order scheduling in the lean pilot cells. Scheduling and reporting each move from process to process, only starts and completions for the entire cell will need to be recorded. Detailed labor tracking will not be needed in the pilot cells. Lean performance measures will be used to monitor and promote production efficiency. If labor routings and standards are reasonably accurate, a backflush entry to record labor costs on completion will provide sufficiently accurate labor costs for inventory valuation and cost of goods sold.

6. What is backflushing? How does backflushing reduce waste?

Backflushing is a technique to reduce the number of transactions recorded to track and charge product costs. Rather than assigning costs to jobs or batches at each step of production, a single entry is made at a trigger point (e.g., completion of production) assigning standard costs accumulated to that point. Backflushing reduces waste by eliminating the need to record all the detailed transactions by process. If the company has other means of ensuring accurate bills of materials, routings, and standards, detailed labor and material cost reporting (the source data for the product cost transactions by process) can also be eliminated.

7. Some companies use cycle counting to count each inventory item over the course of a year. In lean accounting cycle counts are done repeatedly on a sample of items, and not all inventory items are counted. Compare these approaches to achieving overall inventory accuracy.

Traditional cycle counting spreads the work of an annual physical inventory count over an entire year instead of physically counting every item at year-end. The method is relying on the physical count itself to ensure accuracy. The records are corrected, but there's no guarantee that the cause of the discrepancy has been identified and eliminated. Or, if a cause was identified and a countermeasure put in place, there is no check, until the next year, to see that the countermeasure has been effective.

In the lean approach, the physical count is used to identify root causes of failures of the inventory recording and control process. If the physical count reveals a discrepancy, the root cause of the discrepancy is found and countermeasures are taken. Counting the same item again provides the opportunity to test the effectiveness of the countermeasure.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 6: Lean Financial Accounting

1. Which of the following is **not** a reason for eliminating financial transactions in a company undertaking a lean transformation?
A) Lean companies have a greater appetite for risk.
2. Financial accounting processes that are good candidates for waste elimination early in a lean transformation include ...
D) all of the above.
3. One way to eliminate waste in the purchasing – accounts payable – payment process is to ...
C) Use blanket purchase orders with key suppliers.
4. One way to eliminate waste in the sales – accounts receivable – collection process is to ...
D) encourage automated wire transfer payments for deliveries or actual customer usage based on the kanban system.
5. Reducing the number of cost centers and simplifying the chart of accounts ...
B) helps eliminate waste from the monthly closing process.
6. _____ is a technique to help people understand flow and waste in accounting processes.
B) Process mapping
7. All of the following are recommended steps for mapping accounting processes except ...
A) identify the highest cost variance in the accounting department.
8. All of the following were steps taken to support kaizen in the accounts payable process by the company presented in the chapter except ...
B) start with the customer.

Discussion questions and problems

1. From a lean perspective, are accounting processes completely waste? If so, why not simply eliminate them? Why is so much time and effort spent on accounting processes?

Unless the company is an accounting or bookkeeping firm, the accounting processes do not add value from the perspective of the customer. They are waste. Many of the accounting processes do provide support currently necessary for value creating processes or are necessary (e.g. tax and financial reporting) to sustain the company. The great time and effort spent on accounting processes is partly due to the emphasis on financial measures in traditional management control systems. Lean replaces many of the financial control metrics with visual control built into robust processes and with operating measures.

2. Can lean tools be applied to accounting processes?

Yes. Creating a culture of continuous improvement using the ingenuity and involvement of all workers, 5S, standard work, process mapping (or incorporating accounting process into the value stream maps), reducing batch sizes, creating flow, using visual controls, setting up “production” cells for accounting processes (such as billing and receivables and payables and collection) are just examples of lean tools that can be applied to accounting processes.

3. How is it possible for operational control to lead to financial control?

Financial results are the outcomes of operations. Cash is received for value created. Cash is expended for resources required to perform operations and create value. If operations are stable and reliable (and subject to continuous improvement), financial results will also be stable and predictable.

4. Provide one example of an operational control that reduces or eliminates the transaction records needed for financial control of purchases and accounts payable.

Some examples: Use of blanket purchase orders. Use of P-Cards. Use of a pull system. Containers designed to fit only the quantity specified for the kanban.

5. Briefly describe the progression from a manual three-way match of documents for all payments to an automated system paying on the backflush from the bill of materials.

Introduce supplier certification to identify suppliers that can deliver perfect quality in the right quantity at the right time, eliminating discrepancies between order and receipt quantities. Establish blanket purchase orders that specify terms, eliminating the need to reconcile invoice and purchase order terms. Voucher on receipt of goods eliminating the need for the invoice. With a sufficiently reliable process with short cycle time, payment can be made on backflush at the point production is completed (each product must contain the specified quantities of materials and components specified in the bill of materials).

6. How can the use of purchasing cards eliminate waste in accounts payable?

P-Cards can be used for purchase indirect materials and supplies. These items are numerous but small in dollar value. Having to have a separate purchase request, purchase order, receipt, and invoice for each of these items is costly in time and effort. They create delays and lead to holding excessive inventory of these items, creating **wasted** space carrying cost, and time and effort tracking and maintaining the inventories. P-Cards allow pre-authorized personnel to make needed purchases within pre-established dollar limits (a list of authorized suppliers can also be specified. P-Cards greatly reduce acquisition time and effort and allow supplies inventories to be greatly reduced. A single weekly or monthly transaction based on the P-Card statement can be used to report supplies expense.

7. Why do companies need to close their books on a monthly basis? How can lean accounting satisfy the needs that gave rise to monthly closings while simplifying the closing or completely eliminating the need for the monthly closing?

In most cases, external reporting requires only quarterly, semi-annual, or annual reporting. Companies close on a monthly basis because they want reliable data to track their financial performance internally. They are relying on financial measures to promote operational control

(e.g., actual versus budgeted results on a departmental basis), and they are relying on transaction recording and the review and adjustment process to ensure the reliability of their financial information. Lean accounting relies on operating metrics to support control and improvement of operating processes, improving financial control at the same time. Financial results are evaluated and controlled at the value stream level, which allows for a greatly simplified chart of accounts and fewer account balances to maintain and control. With stable, reliable processes, closing the books is not required to obtain reliable summary financial performance at the value stream level on a weekly or monthly basis.

8. Do accounting processes have customers? Can you identify customers for the following processes: accounts receivable, accounts payable, monthly reporting?

The users of accounting information (internal and external) can be viewed as customers. Customers, the company treasurer, and possibly sales people and customer service representatives may be customers of the accounts receivable process. Suppliers, the company treasurer, and buyers or purchasing agents may be customers of the accounts payable process. Investors, company executives and managers are customers of the monthly reporting process.

9. Identify lean two tools that can be applied to improving accounting processes, and briefly explain how the tools work together.

The two lean tools emphasized in the chapter are mapping (value stream mapping & process mapping) and Kaizen (lean continuous improvement). Value stream mapping focuses on the material and information flows for production processes in the value stream, many of the information flows are inputs to or outputs from accounting processes. Process maps depict individual processes in greater detail. Mapping is used to better understand the process and to make waste visible. Once waste is made visible, improvements can be planned to eliminate the waste. Kaizen is a disciplined, evidence-based approach to continuous improvement. Improvements that can be immediately implemented are tested, and if they have the desired effects they are incorporated into standard work. Improvements that will take longer to implement are incorporated into future state maps providing a vision for the future of the process that can be incorporated into planning.

10. Why did the example company in this chapter create a box score for the accounts payable process? How did the box score contribute to the improvement process?

The box score highlights the operational and financial impact of planned improvements on the process. Actual results can be compared to the planned future states to ensure the anticipated gains are realized. The future state box scores also aid in planning, as managers can anticipate when excess capacity will be created and plan to redeploy resources.

11. The accounts payable process at Brand X Corporation – Current State.

Required:

- A. Create a current state for the accounts payable process at Brand X Corporation. Include the following:
- Operational Metrics
 - Throughput** – (essentially dock-to-dock time) measured in business days
 - First time through** – assume all tasks except matching are error free.
 - Outside Managers' Time** – the time spent by outside managers the treasurer, and the treasurer's secretary.
 - Productivity** – Invoices per person (the accounting clerks and the fractional time the mail clerk devotes to the accounts payable process).
 - Labor Capacity utilization (Ignore the Approve Payment and Print & Sign Checks processes performed by the treasurer, the treasurer's secretary, and managers outside accounting). You may wish to wait until chapter 21 is covered to complete this requirement.
 - "Productive"** – Percentage of time spent on invoice processing tasks other than mismatches, even though invoice processing itself is non-value added from a customer perspective. Exclude paid breaks from your calculation of total available hours.
 - Non-productive** – Percentage of time spent on mismatches and tasks other than invoice processing.
 - Available capacity**
 - Financial Metrics
 - Employee compensation** – Including the Supervisor's salary and benefits.
 - Discounts not taken**
 - Other costs**
 - Total cost** – The sum of the above three costs.
 - Cost per invoice**

Brand X Corporation Accounts Payable Process

Measure	Current State
Lead throughput time	5.3
First time through	88%
Outside Managers' time	8,604
Productivity	952.4
Labor: "Productive"	95%
Non-productive	4%
Available	0%
Employee Compensation	\$15,120
Discounts not taken	\$2,000
Other costs	\$3,400
Total cost	\$20,520
Cost per invoice	\$5.13

Current State Explanation

WIP/Invoices per day or lead time from process map

100% - 12% mismatches

4,000 @ 2 min. + 4,000 @ .15 min + 4 min setup

Invoices processed or checks issued / Clerks

Bottleneck process, or 59% overall total

Bottleneck process, or 31% overall total

Bottleneck process, or 10% overall total

4.2 @ \$3,600 each

per narrative

\$1,000 other costs + \$.60 per invoice
postage printing & stationery

Total cost / 4,000 invoices

See chapter 21 solutions, page 112 for details of the capacity analysis.

- B. Brainstorm. Suggest ways that Brand X Corporation could improve their accounts payable process.

A wide variety of suggestions are possible here. Some examples: Reduce the number of invoices using P-Cards. Blanket purchase orders with monthly invoicing from certified suppliers (reducing invoices) or payment on receipt reducing the matching. Route cause analysis to discover the root causes of most mismatches. Eliminate outside review for routine purchases or purchases from certified suppliers. Electronic payments to certified suppliers. Reduce batch sizes of check printing runs to cut lead times.

12. The accounts payable process at Brand X Corporation – Future State.

Required:

- A. Add a column showing the future state measures to the Box Score you created in problem 11 for the accounts payable process at Brand X Corporation. (If you did not do problem 11, create a scorecard for the future state). Include the following:
- a. Operational Metrics
 - i. **Throughput** – (essentially dock-to-dock time) measured in business days
 - ii. **First time through** – assume all tasks except matching are error free.
 - iii. **Outside Managers' Time** – the time spent by outside managers the treasurer, and the treasurer's secretary.
 - iv. **Productivity** – Invoices per person (the accounting clerks and the fractional time the mail clerk devotes to the accounts payable process).
 - b. Labor Capacity utilization (Ignore the Approve Payment and Print & Sign Checks processes performed by the treasurer, the treasurer's secretary, and managers outside accounting). You may wish to wait until chapter 21 is covered to complete this requirement.
 - i. **"Productive"** – Percentage of time spent on invoice processing tasks other than mismatches, even though invoice processing itself is non-value added from a customer perspective. Exclude paid breaks from your calculation of total available hours.
 - ii. **Non-productive** – Percentage of time spent on mismatches and tasks other than invoice processing.
 - iii. **Available capacity**
 - c. Financial Metrics
 - i. **Employee compensation** – Including the Supervisor's salary and benefits.
 - ii. **Discounts not taken**
 - iii. **Other costs**
 - iv. **Total cost** – The sum of the above three costs.
 - v. **Cost per invoice**

Brand X Corporation Accounts Payable Process

Measure	Current State	Future State
Lead throughput time	5.3	3.3
First time through	88%	86.7%
Outside Managers' time	8,604	1,740
Productivity	952.4	571.4
Labor: "Productive"	95%	36%
Non-productive	4%	26%
Available	0%	39%
Employee Compensation	\$15,120	\$15,120
Discounts not taken	\$2,000	\$1,000
Other costs	\$3,400	\$2,440
Total cost	\$20,520	\$18,560
Cost per invoice	\$5.13	\$7.73

Future State Explanation

WIP/Invoices per day or lead time from process map

10% mismatches on 1600 routine, 20% on 800 non-routine

800 @ 2 min. + 800 @ .15 min + 20 min setup

Invoices processed or checks issued / Clerks

Bottleneck process, or 37% total

Bottleneck process, or 25% total

Bottleneck process, or 39% total

4.2 @ \$3,600 each

per narrative

\$1,000 other costs + \$.60 per invoice postage printing & stationery

Total cost / 2,400 invoices

See chapter 21 solutions, page 112 for details of the capacity analysis.

- B. Comment on the changes in the metrics. Do you believe the scorecard metrics accurately reflect the change in the accounts payable process at Brand X Corporation? Explain and support your reasoning.

Brand X has improved their throughput time and considerably reduced the time required by outside managers. The overall cost of the accounts payable process has dropped slightly due to lower use of postage and supplies and a reduction in discounts lost. The use of P-Cards has freed additional capacity.

First time through has declined slightly, the invoices processed per person are lower and cost per invoice is higher. An argument could be made that these metrics do not accurately reflect the improvement that has been made. After all, the overall cost is lower, and the accounts payable function is servicing the same level of purchasing activity. Why should eliminating the need for 1,600 invoices per month lead to a negative signal in invoices per month, cost per invoice, and first time through?

However, the case can also be made that the numbers as reported are helpful. The cost for processing the remaining invoices is \$7.73 each. One of the reasons it is higher is because the more complex cases remain, but another is that the excess capacity created has not been redeployed. If Brand X has planned further improvements and/or they do not anticipate an increase in invoices due to business growth, one of the accounting clerks recording and matching invoices could be redeployed to more productive activity.

The metrics are designed to provide information about the process to motivate and support continuous improvement and elimination of waste. Their purpose is not to reward or blame the workers for the level of achievement on each metric. There is no single proper interpretation. If Brand X finds that one or more metrics are being misused, misinterpreted or misunderstood and are not motivating continuous improvement, they should change the metrics to ones that are better understood and properly used.

C. How could Brand X Corporation take better advantage of the improvements they have made in the accounting payable process?

They could take better advantage of the excess capacity created by redeploying one of the accounts payable clerks to more productive activity.

D. Suggest a way Brand X Corporation could improve the future state accounts payable process.

A number of suggestions could be made here. Some examples: Have invoices emailed with routine and non-routine invoices going to separate addresses or sorted by filter to eliminate the need for manual sorting. Increase the number of certified suppliers (or items purchased from existing certified suppliers that are subject to routine processing. Implement electronic funds transfer for routine purchases. Use blanket purchase orders with certified suppliers, and pay on receipt to eliminate the need for invoicing and matching. Perform root cause analysis on the reasons for mismatches and create countermeasures to eliminate the most common causes. Examine the reasons for non-routine purchases and see if more can be handled in a routine fashion.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 7: Managing by Value Stream

1. A value stream is ...
D) a set of related activities performed to create and deliver value to a group of customers.
2. An order-fulfillment value stream ...
B) encompasses activities focused on producing and delivering existing products and services to current customers.
3. A set of activities to design and develop new products or services is ...
C) a new product development value stream.
4. A set of activities to get new customers for existing products and services is ...
D) a customer development value stream.
5. Focus in the context of managing an order-fulfillment value stream means that ...
B) a team or manager is responsible for the entire value stream.
6. Value stream management simplifies performance reporting because ...
A) reporting is organized around a small number of units (value streams) of manageable size with clear lines of responsibility.
7. When organizing by value stream, the problem of an individual with unique skills required by many value streams can be best addressed by ...
C) cross training people.
8. In value stream management a monument is ...
D) a machine that serves more than one value stream.
9. Which of the following is **not** a factor to consider in identifying value streams?
A) The current location in the plant of the equipment used to produce the products or services.
10. Which of the following is **not** a recommended action to aid in identifying value streams?
B) Prepare a sales matrix and group products into value streams by sales volume.

Discussion questions and problems

1. Why can departmental organization be an obstacle to lean improvement?

Departmental organization can make it difficult to see flow and may encourage local optimization of performance without considering the impact on related processes or the end use customer.

2. Do conventionally managed companies typically focus on value streams?

No. Most conventionally managed companies are organized by departments specializing in a process (e.g., welding, stamping assembly) or function (e.g., sales, purchasing, accounting).

3. Why do lean companies focus on value streams?

Focus on value streams puts the emphasis and accountability on the whole system of value creating activity rather than on the individual parts. This minimizes the chance improvements in one area will cause problems in another, avoids the pursuit of sub-goals and local optimization at the expense of value creation for the customer, and avoids buck-passing and blame games, as the team accepts responsibility for performance of the entire value stream.

Focus at the value stream level also simplifies performance measurement because the need for detail level of individual person, machine, or small cost center is minimized. Performance reporting is focused on units of manageable size, avoiding unnecessary complexity without becoming unwieldy. More importantly, the focus is at the level appropriate to delivering value to customers.

4. How do focus and accountability apply to value stream management?

Focus and accountability in the context of lean management means the value stream team focuses on the performance of the entire value stream and acknowledges and accepts responsibility for the performance of the entire value stream.

5. As technological advances enable more complex products and services, can we simplify organization and reporting? Is simplification a danger or a necessity? Is simple easy?

Oversimplification is always a danger, but complexity is also a danger. Because computers make the capture, storage and reporting of detail possible there can be a tendency to demand more and more detailed information in the mistaken belief that adds more precision and control. The apparent precision can be an illusion, because greater complexity and detail increases by an order of magnitude the chances for measurement error, classification error, and the necessarily arbitrary allocation of shared resources. Complex organizational structures may create confusion and loss of focus while encouraging local optimization and pursuit of sub-goals.

Simple is not synonymous with easy. For example, consider the goal of producing a mathematical proof or writing computer code for a program. The fastest path to a proof that works or a program that runs is not likely to be the shortest and least complicated. It is much harder to write a short elegant, clear proof, or a compact clear, efficient program. The same is true for management. To get to a workable solution that is also simple requires great effort and continuous improvement, but the result is more powerful than the easier, complex solution.

6. Associated Alloy has a Chemical Engineer whose skills are required by each of its four value streams. How should Associated account for the engineer in its organization?

There is no one correct answer for this problem. If one value stream used most of the engineer's time, the engineer could be assigned to that value stream. If the engineer's time is divided between a few value streams with service to no one dominant, the salary and expense of the engineer could be shared in rough proportion to the anticipated time expended (the proportions would only be revisited whenever there were major changes in one or more value streams affecting chemical engineering). Or the company could consider Chemical Engineering a support function for all the value streams and exclude the cost from all the value streams. Tracking the engineer's time for purposes of cost allocation should be avoided.

We want to use direct costs as much as possible and allocate as few costs as possible, avoiding complex and costly allocations. The goal is to get a reasonable measure of value stream performance to use to promote continuous improvement. Complex allocations waste time and effort and too many allocations detract from the clarity of the performance measures and may lead to more concern and effort expended on the allocations rather than on improving real performance and creating value.

7. Main Street Metal Works has a heat treatment oven used by three of its four value streams. How should Main Street Metal Works account for the heat treatment oven in its organization?

The heat treatment oven is a monument and the treatment options are similar to those for the Chemical engineer in question 6. If one value stream used most of the heat treatment capacity, the oven could be assigned to that value stream. If heat treatment time is divided between a few value streams with service to no one dominant, the oven could be shared in rough proportion to the anticipated capacity used by each value stream (the proportions would only be revisited whenever there were major changes in one or more value streams affecting heat treatment volumes). The company could consider heat treatment a separate value stream providing service to internal customers, or the company could consider heat treatment a support function for all the value streams and exclude the cost from all the value streams. Detailed complex allocations for purposes of cost allocation should be avoided.

8. The production flow matrix for Superior Metal Parts is shown below. Arrange the product families into three value streams.

This is one suggestion. The key points to recognize are: (1) we want to minimize variation within the value streams to improve flow, (2) there will rarely be a perfect fit, (3) the production flow matrix is just one tool to help organize product families into order—delivery value streams.

		Production Steps															
		Order Entry	Schedule	Lathe	Grind	Shape	Hob	DeBurr	Heat Treat	ID Grind	OD Grind	Ctr Grind	Surface Grind	Outside Plating	Test	Pack & Ship	Invoice
Product Families	148	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x
	561	x	x	x	x		x	x	x	x	x	x	x		x	x	x
	917	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x
	204	x	x		x		x				x		x			x	x
	629	x	x		x		x				x		x	x		x	x
	872	x	x		x		x				x		x			x	x
	369	x	x	x	x				x			x	x	x	x	x	x
	603	x	x		x			x	x			x	x	x	x	x	x
	738	x	x	x	x			x	x			x	x		x	x	x

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 8: Value Stream Performance Measurements

1. The purpose of value stream measurements is to ...
A) motivate efforts to continuously improve the performance of the entire value stream.
2. One of the “starter set” measures recommended for value stream level performance is ...
D) dock-to-dock time.
3. The sales per person measure for a value stream (for a week) should be computed by ...
A) dividing weekly value stream sales by the number of employees assigned to the value stream that week.
4. The measure that shows the percentage of products or services produced without defects or rework is ...
D) first time through.
5. The measure that shows the rate of material flow through the value stream is ...
B) dock-to-dock time.
6. Terra Cotta Company’s Clay Pot value stream shipped 1,200 pots last week. At the end of the week they had sufficient clay on hand to produce 2,800 pots. They had 1,600 pots in work in process, and 2,000 finished pots awaiting shipment. The Clay Pots value stream works a five-day week. The dock-to-dock time for the Clay Pot value stream is ...
D) 26.7 days. [$(2,800 + 1,600 + 2,000) / (1,200 / 5)$]
7. Excelsior Manufacturing’s small component value stream has four cells with the following first time through rates: Cutting, 85%; Fabrication, 90%; Assembly, 90%; Finish, 95%. The first time through for the value stream (to the nearest whole percent) is ...
B) 65%.
8. The purpose of the average cost per unit is to measure ...
C) overall process improvement in the value stream.
9. Average cost per unit is measured by ...
B) dividing total value stream costs by units shipped.
10. The purpose of the accounts receivables days is to measure ...
C) the speed of cash flow in the value stream.
11. Hi-Value Heater Company’s Portable Heater value stream had sales of \$47,000. There were twenty working days in the month. The accounts receivable balance at the end of the month was \$63,000. Accounts receivable days (as measured in working days) for the Portable Heaters value stream is ...
C) 26.8 days. [$63,000 / (47,000 / 20)$]
12. Which of the following is **not** suggested as supporting information often reported at the **value stream** level?
B) Five S scores

13. An approach many companies have used to help ensure value stream measures promote continuous improvement is to ...
A) create a no-blame environment.

Discussion questions and problems

1. Why develop separate value stream metrics? Why not simply use corporate/organizational level measures?

Although the value stream contributes to the corporate goals, and the value stream measures should be linked to achieving corporate goals, the corporate measures themselves at the value stream level may not provide meaningful information for value stream improvement. For example, a corporate market share goal may not be relevant to a single value stream, but maintaining or increasing sales may support the market share goal. Even if “traditional” corporate measures or objectives are not included, we still want to make sure the value stream measures are focused on driving improvement in the value stream.

2. List the six measures in the value stream starter set. Describe how each measure is computed, and list the purpose of each measure.

- i. Sales per Person – The sales per full time equivalent employee (production and non production) assigned to the value stream

$$\text{Sales per person} = \text{Total Value Stream Sales} / \text{FTE employees}$$

Purpose: Sales per person is a measure of value stream productivity.

- ii. On Time Delivery – The proportion of units or invoice line items or complete customer shipments that are delivered on time per customer request.

$$\text{On time delivery} = (\text{Number of units}^* - \text{Number of late units}^*) / \text{Number of units}^*$$

*or invoice line items, or shipments.

Purpose: On time delivery measures the ability of the value stream to meet customer demand.

- iii. Dock-To-Dock – The amount of time from material receipt to shipment of finished product to the customer.

$$\text{Dock-To-Dock} = \frac{(\text{Raw material} + \text{WIP} + \text{finished goods Inventory})}{(\text{Products shipped this week/ hours or days in the week})}$$

Purpose: Dock-to-dock measures the flow of materials through the value stream, the speed of conversion of raw materials or components into finished products for the customer.

- iv. First Time Through – the proportion of products or services completed start to finish without defect or rework.

$$\text{First Time Through} = (\text{Total Units} - \text{Total rejects}) / \text{Total Units}$$

Purpose: First time through is a measure of product or service quality and also a measure of the overall effectiveness of and adherence to standard work in the value stream.

- v. Average Cost Per Unit – The average cost of value stream units shipped as measured by the total value stream costs for the period.

Average Cost per Unit = Total value stream cost / Units Shipped.

Value stream costs include very few if any allocated costs, but include all direct costs (production and nonproduction) of the value stream.

Purpose: Average cost per unit is used to assess the overall efficiency (and the rate of improvement of cost efficiency) in the value stream.

- vi. Accounts Receivable Days Outstanding – The amount of accounts receivable outstanding as a multiple of average daily sales of the value stream.

Accounts Receivable Days Outstanding = $\frac{\text{Accounts Receivable}}{\text{Sales} / \text{Business Days}}$

Purpose: Accounts Receivable Days Outstanding is used to measure the speed at which cash is received from the value stream's customers.

- 3. Acme Monaco's Medical Products Value Stream produces precision wire and spring apparatus and instruments for use in medical and orthodontic procedures. Eight machinists, one manager/supervisor, one production engineer, one salesperson, and two maintenance people are assigned to the value stream. All value streams at Acme Monaco share the efforts of company executives, design engineering, IT support, and accounting personnel. Acme Monaco's sales of medical products were \$186,000 in May, representing thirty percent of Acme Monaco's sales for the month. What are the sales per person for May in the Medical Products Value Stream at Acme Monaco? Should Acme Monaco allocate the cost of employees shared by all value streams to each value stream?

Sales per person = $\$186,000 / (8 + 1 + 1 + 1 + 2) = \$14,308$ per person.

If the level of work were sufficient for an individual design engineer, or IT person, or accountant to be dedicated to supporting the value stream they could become part of the value stream team but not allocating a portion of the support personnel that are shared by the value stream simplifies accounting and provides clear results. The goal is not to develop a measure that precisely identifies the total amount of resources used by the value stream, the goal is to get a measure that reasonably reflects the financial performance of the value stream, that is easy to compute and understand and that will drive continuous improvement of the value stream and aid in decision-making and planning. Any choice to allocate people or costs needs to be supported by a case that the allocation better promotes continuous improvement, planning and decision making.

- 4. What is the difference between on-time shipment and on-time delivery? Should on-time shipment/delivery be measured based units of product, dollars of sales, line items of orders, or total orders with 100% of items shipped/delivered on time? Does it matter? Is there any potential for adverse behavior depending on how on-time shipment/delivery is measured?

On-time shipment is based on when the product leaves a production facility or warehouse. On time delivery is based on the time the customer receives the product. If delivery is 100% reliable of the responsibility of the customer there's no difference between the two. Shipment may be more easily captured and measured, but delivery is what the customer cares about. Some companies may use shipment rather than delivery because the shipping may be performance by a common carrier, and they are focused on improving internal processes (at early stages of the lean transformation). They should remain aware of the limitation of the shipment measure from the customer perspective if delivery problems occur.

The strictest measure of on-time delivery considers the entire order a failure if any unit or item on the order is missing or not delivered on time. These choices are a matter of scale, and ease of capturing and reporting the measure can be a deciding factor, but scale can affect perceptions. Companies should choose a measurement method and apply it consistently so that trends of actual results will be useful. They should also be alert to potential dysfunctional consequences (for example, a measure based on sales dollars causing low dollar orders to be set aside to expedite large dollar orders). As performance improves, the company can switch to a stricter measure to avoid complacency regarding high on-time shipment or delivery rates.

5. Horst Engineering makes precision metal parts. Their Large Diameter Value Stream had enough bar stock in their raw materials inventory to produce 12,000 parts. They had 2,600 parts in work-in-process, and 1,000 in finished goods inventory. The Large Diameter Value Stream sells an average of 400 parts per day. Compute the dock-to-dock time for the Large Diameter Value Stream.

Dock-to-dock = 39 days. $[(12,000 + 2,600 + 1,000) / 400]$

6. What is a representative part for a value stream? Why is using a representative part preferable to using the total value of inventory from the accounting records in calculating dock-to-dock days?

A representative part is a component purchased from a supplier that is used in every stage of manufacture, and is present in the finished products. The representative part must be integral (a mainstream component) to products produced in the value stream because it is used to represent the entire material flow of the product. The preference for operational measures in the value stream is to rely on visual inspection and physical counts gathered by the workers in the value stream so the workers take ownership of the data. Dock-to-dock is a measure of flow, not value, so the use of a representative part eliminates waste and distortion of counting all the parts and the distortion and lack of clarity that the use of aggregate inventory values could create.

7. Johnsbury Manufacturing's Thermal-Shield Value Stream has four cells with the following first-time through rates in the month of September: Stamping 99%, Machining 95%, Assembly 90%, Finishing 88%. Compute the first time through that would be reported for the Thermal Shield Value Stream in September.

FTT = 74.5%. $[.90 \times .95 \times .90 \times .88]$

8. Gopher Lawn Equipment's Hand-held Value Stream has a balance in Accounts Receivable of \$639,437 as of November 30. They had sales of \$430,117 during November, a month with 20 working days. Compute the day's receivables outstanding for Gopher Lawn Equipment's Hand-held Value Stream.

Accounts receivables days outstanding = 29.7 days. [$639,437 / (430,117 / 20)$]

9. Most financial analysis sites measure accounts receivable days based on a thirty-day month. The measure could also be calculated using working days, four five-day weeks per month for many companies. Does it matter whether calendar days or working days are used in the calculation?

The choice of business days versus calendar days is merely one of scale. Financial analysts looking at company level data are interested in the length of time it takes a company to convert receivables to cash. Lean companies produce to customer demand so a business day worth of sales is the sales value of the average amount of production that must occur daily to satisfy customer demand. The key is for the company to choose either calendar days or business days and apply the metric consistently so that trends in performance will be meaningful.

10. Name three supporting measures frequently reported at the value stream level. Describe the purpose of each of the measures.

Safety Cross – It is important to maintain a safe working environment for the health and welfare of the employees and also from a cost savings perspective. A safety cross is a way of making safety incidents visible. Each day in the current month is shown as incident free, or the number of incidents is reported, with incidents categorized by severity. There is usually space below the chart to provide a brief explanation of each incident and describe countermeasures being taken to prevent reoccurrence.

Cross training matrix – Cross training is an important means of providing flexibility and balance in the value stream as it responds to variation in customer demand. The extent of cross training, and employees' desiring additional training is an indication of employee involvement. The matrix generally has rows for value stream employees and columns for key skills. Color coding is often used to show the level of training or expertise, providing a quick visual assessment of the overall level of cross training.

Improvement project participation – The level of improvement project participation can be a key indicator of the extent of employee involvement, and the extent to which lean culture is taking hold. There area variety of ways to display participation, from aggregate totals and percentages, to having a row on a chart for each employee showing participation in projects, improvements suggested or initiated, etc.

11. Describe four ways companies help ensure that the operational measures they report at the value stream level will motivate continuous improvement.

Have a no blame environment. Employees generally want to do a good job and don't like wasting their time. The purpose of the operational measures is to help employees eliminate waste and improve processes, not to assign blame for past performance.

Avoiding competition and comparisons between value streams. Competition can lead to value streams keeping improvements secret to get or maintain an advantage in the competition. Lean companies want value stream teams to cooperate and learn from each other.

A structured, evidence-based continuous improvement process (such as PDCA, six Sigma's DMAIC) should be followed. Employees need the empowerment, training, and tools, to continuously improve processes. Improvement must be systematic and continuous rather than haphazard.

Performance measures need to be linked to the company business strategy. Value stream performance and improvements must support the overall company strategy, or conflict will be created.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 9: Value Stream Costing

1. An advantage of value stream costing over standard costing in a lean organization is that value stream costing ...
C) eliminates most of the transactions associated with cost accounting.
2. Standard costing creates problems in a lean organization because it ...
B) encourages over production, building inventory, and large batch quantities.
3. In value stream costing total costs assigned to the value stream ...
C) includes all costs directly associated with the value stream including direct materials and direct and indirect (with respect to products) labor, but few if any allocations of shared costs.
4. Value stream costing is used to ...
A) create a value stream P & L (income) statement, and provide financial results for the value stream box score.
5. Value stream costing simplifies accounting by ...
D) reducing the number of cost centers to a few mostly self contained value streams.
6. Which of the following is **not** a condition that must be satisfied before value stream costing can be effectively implemented?
A) Reporting needs to be by departments or individual products.
7. In value stream costing, the cost of performing activities outside the value streams (such as financial accounting) should be ...
A) treated as a sustaining cost of the business and not assigned to any value stream.
8. When using value stream costing, managers evaluate make or buy decisions by ...
C) comparing the effect on the overall value stream results of buying a product to making it in the value stream.
9. If a reasonably accurate value for the total cost of inventory can be calculated, individual product costs are not necessary for inventory valuation. Which of the following is **not** a condition that must be met before simplified inventory valuation methods can be used?
B) A computerized perpetual inventory system is in place.
10. How do value stream profit and loss statements usually report the effect of changes in the overall inventory levels on operating income?
C) The change in overall inventory across all value streams is reported as a single adjustment to the combined value stream profits to arrive at an adjusted division profit. The effect of inventory change is not included in the reported value stream profits so those measures will send the proper signal about inventory reduction.

11. Able Manufacturing had material costs of \$250,000 and conversion costs of \$380,000 in their most recent month containing twenty working days. At the end of the month Able Manufacturing had raw material on hand equal to eight days worth of production, work-in-process equal to four days worth of production, and finished goods equal to six days worth of production. The value for ending inventory using the “days of stock” method is ...
 A) \$ 377,000. Materials $[(8 + 6 + 4) \times (250,000 / 20)] +$
 Conversion cost $[(4 / 2) + 6] \times (380,000 / 20)$]
12. Wiremold tracks the direct materials in inventory. At the end of their most recent month, the direct material cost of their inventory (raw materials, work-in-process and finished goods) was \$603,210. During the most recent month, their value streams had material costs of \$920,000 and conversion costs of \$552,000 in twenty working days. At the end of the month, Wiremold had raw material on hand equal to seven days worth of production, work-in-process equal to two days worth of production, and finished goods equal to eight days worth of production. The value for ending inventory using the “material cost plus days of conversion cost” method is ...
 B) \$ 851,610. Materials \$603,210 + Conversion cost $[(2 / 2) + 8] \times (552,000 / 20)$]
13. Baker Production had \$260,000 in material costs and \$418,000 in conversion costs during their most recent month. They manufactured 24,000 units during the month, in twenty working days. They had 16,000 parts in finished goods inventory at the end of the month. Using either the “quantity of finished goods” method or the “average cost” method, the cost of ending finished goods inventory for Baker Production is ...
 B) \$ 452,000. $[(260,000 + 418,000) / 24,000] \times 16,000$ or $678,000 \times (16,000 / 24,000)$]
14. Charlie Company’s had a total material cost in inventory 1,953,000 on December 31st. During January, Charlie Company Precision purchased material costing \$468,000. They scrapped \$22,000 worth of material in production January. The material content of Charlie Company’s December shipments was \$457,000. The raw material cost in Charlie Company’s January 31st inventory was ...
 C) \$ 1,942,000 $[1,953,000 + 468,000 - 22,000 - 457,000]$]
15. Issues to take into account when selecting an inventory valuation method include all of the following except ...
 A) the presence or absence of an inventory tracking module in the company’s ERP system.

Discussion questions and problems

1. How does value stream costing simplify the accounting system?

The focus of reporting is at the value stream level rather than at the level of the individual job or product. Detailed cost reporting on individuals (labor classifications), machines, small cost centers or departments is not needed.

2. Why is standard costing inappropriate for lean organizations?

Standard costing motivates non-lean behavior by assigning all overhead to products, encouraging overproduction and providing misleading information for decision-making. The detail data distinguishing between direct and indirect labor, costing individual operations and

processes, and measuring machine and labor utilization is wasteful and can be an obstacle to continuous improvement in the value stream.

3. Why is the information reported using value stream costing better for a lean organization than the information reported by a standard cost system?

Value stream costing provides summary cost information at the value stream level supporting and encouraging the improvement of the value stream as a whole. It provides real value stream costs relevant for day-to-day decision-making and reports the costs in a clear, understandable manner.

4. What is the advantage of using material purchases as the measure of material cost for the value stream? How does this differ from traditional costing? What conditions have to be in place for the purchase amount to be a valid measure for material cost?

Using material purchases as the measure of material cost eliminates the need for a transaction to record the move of materials from storage into production. It also discourages stockpiling excess raw materials because the materials are immediately charged to the value stream as an expense. For this material cost to be valid, raw materials and work-in-process inventories must be low, and under good control. If the inventories are low, the materials brought in during the week will be used quickly and will accurately reflect the material cost of the product manufactured during the week.

5. Identify the conditions that must be in place before an organization can implement value stream costing and briefly explain why the condition is important for value stream costing to be successful.

- Reporting needs to be by value stream, not departments.
- Most people in the company must be assigned to value streams with little or no overlap. There should be few or none shared services and few monuments. If these conditions are not met, the direct costs of the value stream will not provide a meaningful measure of value stream financial performance.
- Production processes must be reasonably under control with low variability. There must be thorough tracking of out-of-control situations and exceptions like scrap and rework. Inventory must be relatively low and consistent. If these conditions are not met, more transaction recording and reporting will need to be retained for financial control.

6. Should costs associated with sustaining the entire organization be allocated to the value streams? Explain why or why not.

The usual arguments for allocating organization sustaining costs to units are to make the units aware of the costs that must be covered, and to use pressure from the units to help control the organization sustaining costs. The value stream reports are used to motivate performance improvement in the value stream. An arbitrary allocation of organization sustaining costs is not likely to motivate improving value stream performance, and it may lead to blame games. Target rates of return can be adjusted to ensure value streams are focused on achieving sufficient profitability to cover support costs. In lean organizations organization sustaining costs will be controlled by focusing on continually eliminating waste and improving organization sustaining processes rather than by outside pressure for financial outcomes.

7. Identify three reasons why managers may want to know the costs of individual jobs or products. Explain how the needs can be addressed using value stream costing.

The chapter identifies seven reasons why managers typically want individual job or product costs.

- Pricing decisions – Pricing should be based on a thorough understanding of customer needs and value, not on product costs. In any event, aside from direct materials, most of the costs of producing a product are joint costs of all the products produced in the value stream.
- Profit margins on product lines and customer orders – Since the costs of producing a product are joint costs of all the products produced in the value stream, allocations of conversion costs to individual products are arbitrary. Profitability of any job or product should be considered in the context of all the products produced in the value stream. The correct level for evaluation is the value stream, not the individual product or job.
- Performance measurement of the factory and Process improvement – Lean uses cell and value stream operational measures and value stream box scores to measure performance and motivate continuous improvement. Individual job or [product costs are not needed.
- Make/buy decisions and Product/Customer rationalization – As with pricing decisions and determining profit margins, the appropriate level of analysis is the value stream. The impact of outsourcing or insourcing production, or adding or dropping orders, products, or customers is made by assessing the impact of the decision alternatives on the overall performance of the value stream. This is called relevant cost analysis in traditional accounting, and relevant cost analysis has long been recommended rather than standard costs as the appropriate cost information for decision making. In value stream costing relevant costs are more easily identified and reported than in traditional systems oriented toward reporting standard costs for external financial reporting.
- Inventory valuation – Financial accounting requires a value for inventory in total, not a value for each individual item. If production processes and physical inventories are under control, a fair value for value stream inventory can be obtained easily using a number of different methods discussed in the chapter.

8. Universal Valve Company – Value Stream Profit & Loss Statements.

Required:

- A. Based on the above information, prepare a division profit and loss report for Universal Valves. Use the report in figure 9.7 as a model for formatting your report.

See below.

- B. Should support costs be allocated to the value streams? Explain your answer.

The support costs should not be allocated to the value streams. Any allocation would be arbitrary, would add complexity and extra work, would detract from the clarity of the reported results, and would do little if anything to motivate additional improvement in the value stream or in the support operations. In the answer to requirement A, sales commissions are assigned to the value streams even though sales people are not assigned to the value streams because the commissions can be directly attributed to the sales in each value stream.

Universal Valve	Plastic	Alloy	Brass	Large & Manifolds	Admin & O'head	Division
Revenue	\$458,300	\$675,000	\$1,408,300	\$525,000		\$3,066,600
Material costs	205,800	562,500	765,000	362,500		1,895,800
Conversion costs	139,226	153,180	422,046	130,980		845,432
Value stream profit	<u>\$113,274</u>	<u>\$(40,680)</u>	<u>\$221,254</u>	<u>\$31,520</u>		<u>\$325,368</u>
Value stream ROS	24.72%	-6.03%	15.71%	6.00%		
Employee costs					\$60,400	60,400
Expenses					70,600	70,600
					Prior period inventory	1,772,500
					Current period inventory	1,723,400
					Inventory change	(49,100)
Division operating profit						<u>145,268</u>
Division return on sales						4.74%

Detailed calculations

Sales

commissions	9,166	13,500	28,166	10,500	-
Operators	89,300	79,900	267,900	75,200	4,700
Prod. controllers	5,200	5,200	10,400	-	-
Purchasing agents	5,200	5,200	5,200	-	-
Engineers	7,700	7,700	15,400	7,700	-
Other salaries	-	-	-	-	55,700
Other materials	-	-	-	-	44,500
Machine depreciation	6,500	5,500	20,000	6,000	-
Occupancy cost	3,760	3,480	11,580	3,180	8,000
Energy costs	6,400	25,000	45,000	20,500	5,200
Supplies expense	5,000	6,500	16,200	7,100	4,300
Travel costs	1,000	1,200	2,200	800	8,600
Conversion costs	<u>139,226</u>	<u>153,180</u>	<u>422,046</u>	<u>130,980</u>	
Employee costs					60,400
Expenses					<u>70,600</u>

9. Bristol Brass has a single value stream. In September, there were twenty working days and the value stream had material costs of \$850,000 and conversion costs of \$880,000. At the end of September, Bristol Brass had raw material on hand equal to ten days worth of production, work-in-process equal to three days worth of production, and finished goods equal to four days worth of production. Calculate a value for ending inventory using the "days of stock" method.

Material costs: $850,000 / 20 = 42,500$ per day. $(10 + 3 + 4 \text{ days}) 17 \times 42,500 = 722,500$.

Conversion costs: $880,000 / 20 = 44,000$ per day. $(1.5 + 4 \text{ days}) 5.5 \times 44,000 = 242,000$.

Inventory value = \$964,500. $[722,500 + 242,000]$

10. Acme Medical Supplies is required to track direct materials in inventory so they can identify the shipment lot should there be a problem with any of their products. At the end of October, the direct material cost of their inventory (raw materials, work-in-process and finished goods) was \$237,000. During October, there were twenty working days and their value streams had material costs of \$424,700 and conversion costs of \$526,000. At the end of October, Acme Medical Supplies had raw material on hand equal to five days worth of production, work-in-process equal to three days worth of production, and finished goods equal to six days worth of production. Calculate a value for ending inventory using the “material cost plus days of conversion cost” method.

Material costs: \$237,000.

Conversion costs: $526,000 / 20 = 26,300$ per day. $(1.5 + 6 \text{ days}) 7.5 \times 26,300 = 197,250$.

Inventory value = \$434,250. $[237,000 + 197,250]$

11. Pegasus Manufacturing manufactured 17,000 parts during November. They had \$350,000 in material costs and \$258,000 in conversion costs during the month of November. At the end of November, they had 12,500 parts in finished goods inventory at the end of November. Calculate the cost of ending finished goods inventory for Pegasus using either the “quantity of finished goods” method or the “average cost” method.

$(350,000 + 258,000) / 17,000 = \$ 35.76$ average cost per part (rounded to the nearest penny)

Inventory = \$447,000. $[35.76 \times 12,500]$

or \$ 447,059. $(12,500 / 17,000) \times (350,000 + 258,000)$

12. The total material cost in Precision Steel’s inventory on November 30 was \$3,687,000. During December, Precision purchased material costing \$624,000. Precision scrapped \$12,000 worth of material during December and the material content of December’s shipments was \$637,000. Calculate the raw material cost in Precisions Steel’s inventory on December 31st. How could precision Steel calculate the total cost of inventory on December 31st?

$3,687,000 + 624,000 - 12,000 - 637,000 = \$3,662,000$.

13. Identify two issues that should be considered when selecting an inventory valuation method and briefly describe the significance of each issue to the choice of inventory valuation method.

- The quantity of inventory – If inventory is low valuation differences are immaterial and simpler methods can be used.
- Visual control – Effective visual control makes it easy to apply a simple valuation method to an overall physical count.
- Need to track on computer (too many part numbers for simple visual control and a need to view on-hand quantities from a distance) – Inventory costs based on average product costs adjusted using relatively simple cost models based on product features and characteristics (see chapter 11) can be used.
- Inventory mix and sales mix differ – This also precludes use simpler methods and a reversion to Inventory costs based on average product costs adjusted using relatively simple cost models based on product features and characteristics (see chapter 11).

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 10: Using the Box Score

1. Which of the following is **not** an example of a use of the value stream box score?
A) Employees in the production cells using the box score to manage daily performance.
2. Which of the following is a purpose of the value stream box score?
B) Showing the planned effects of lean improvements in the value stream.
3. The box score measures three dimensions of performance in the value stream. The dimensions include all of the following except ...
D) strategic.
4. A good way to use the box score to report on actual value stream performance is to ...
A) display actual box score results for all the weeks in a quarter to show the trend in performance.
5. A good way to use the box score to support strategic decision making is to ...
C) display current state performance and future states based on the expected results of pursuing different strategy alternatives.

Discussion questions and problems

1. How is the box score used within a lean organization? Who uses it and how do they use it?
 - Value stream managers use the box score to plan and evaluate lean improvements.
 - The value stream continuous improvement team uses the box score to design improvement programs and kaizen events that will have the greatest impact on financial and operating results.
 - Plant and division managers use the box score to understand value stream improvement plans and to evaluate performance.
 - Other executives use the box scores as the basis for simulating the potential impacts of product-market and capital investment plans.
2. Briefly explain how the box score can be used to: (a) report on value stream performance; (b) show the planned effects of lean improvements; (c) support tactical decision making, such as make or buy decisions, (d) plan strategic changes such as future capital investments or product rationalization.
 - a) A series of box scores for the most recent weeks or months of actual value stream performance can be presented in columns (Table 10-1 is an abbreviated example) revealing the trend in actual performance and showing the results of implemented improvements.
 - b) Current state and future state value stream box scores showing the expected results of planned improvements can be displayed in columns (Tables 10-3, 4 & 5 are examples). If desired, a difference column can be used to highlight the changes.

- c) The current state box score can be shown in a column next to future state box scores created to show the impact on the value stream of each alternative being considered. If desired, a difference column can be used to highlight the changes.
- d) The current state box score can be shown in a column next to future state box scores for the periods when major investments will be made, existing products are dropped, and new products are introduced, etc. (Table 10-6 is an abbreviated example).

3. Alloy Value Stream Special order – Scenario 1.

The Alloy Valves Value Stream has received a special order for 1,000 valves from Bristol Pumps. Bristol Pumps is willing to pay only \$14.00 per valve

Required:

- A. Complete a future state box score column for the Alloy Valves Value Stream assuming they will accept the order.

Alloy Valves Value Stream		Current State	Future State
Operational	Productivity	\$32,143	\$32,810
	On-time shipment	88%	88%
	Inventory days	22	22
	First time through	86%	86%
	Average cost/unit	\$11.51	\$11.47
Capacity	Productive	47%	51%
	Non-productive	30%	31%
	Unused available	23%	18%
Financial	Revenue	\$675,000	\$689,000
	Material Costs	479,167	488,667
	Labor Costs	87,417	87,417
	Machine costs	35,417	35,417
	Other costs	4,083	4,083
	VS profit	68,916	73,416
	VS return on sales	10.2%	10.7%

- B. Should the Alloy Valves Value Stream accept the special order from Bristol Pumps? Why or why not?

Although the standard cost of the valve ordered by Bristol Pumps exceeds the price they are willing to pay, accepting the order will improve the results of the Alloy Valves Value Stream because they have excess capacity to produce the order. Arguments against accepting the order should center on the possibility of committing capacity to a marginally profitable order and then not having capacity available to for a more profitable order that might appear, or diminishing the perceived value of valves for future purchases by Bristol Pumps or other existing customers.

4. Alloy Value Stream Special order – Scenario 2.

The Alloy Valves Value Stream has just received a special order for 1,000 valves from Bristol Pumps. Bristol Pumps is willing to pay only \$14.00 per valve. Hiring another operator at a cost of \$4,204 per month and accepting the order will change productive capacity utilization at the bottleneck process to 54% and non-productive capacity utilization will drop to 30%. A local producer that needs work and is willing to produce the valves for Universal Valve for \$12.75 per valve.

Required:

- Complete a future state box score column for the Alloy Valves Value Stream assuming they will accept the order and hire an additional operator to produce it in house.
- Complete a future state box score column for the Alloy Valves Value Stream assuming they will accept the order and outsource production to the local producer.

Alloy Valves Value Stream		Current State	Future State Make	Future State Outsource
Operational	Productivity	\$32,143	\$31,318	\$32,810
	On-time shipment	88%	88%	88%
	Inventory days	22	22	20
	First time through	86%	86%	88%
	Average cost/unit	\$11.51	\$11.55	\$11.53
Capacity	Productive	64%	54%	64%
	Non-productive	34%	30%	34%
	Unused available	2%	16%	2%
Financial	Revenue	\$675,000	\$689,000	\$689,000
	Material Costs	479,167	488,667	479,167
	Labor Costs	87,417	91,621	87,417
	Machine costs	35,417	35,417	35,417
	Other costs	4,083	4,083	16833
	VS profit	68,916	69,212	70,166
	VS return on sales	10.2%	10.0%	10.2%

- What should the Alloy Valves Value Stream do, accept the special order, and make it, accept the order and outsource production, or decline the order? Explain the reasoning behind your choice.

A case can be made for each of the three alternatives. The order could be declined as too marginal. Hiring an additional operator increases profit slightly but hurts return on sales, productivity, and average cost per unit, indicating the marginal nature of the order. However, adding capacity in the bottleneck process also adds flexibility and the makes some capacity immediately available to handle a more profitable order, should one materialize. Outsourcing yields slightly higher profit and the productivity measure would increase lightly, however, average cost also increases slightly. Outsourcing provides a slight increase in profits with some affect on support operations. Is it worth the effort? That depends on the expected impact on future sales. Will satisfying Bristol Pumps lead to more profitable future business? Will

establishing a relationship with a local supplier allow the value stream to offload more marginal business and leave capacity for more profitable orders?

5. Brass Value Stream – Insourcing – Scenario 1.

The Brass Value Stream producing in house a housing they currently buy from a supplier for \$62,400.

Required:

- A. Complete a future state box score column for the Brass Valves Value Stream assuming they will insource the production of housings.

Brass Valves Value Stream		Prior State	Current State	Future State
Operational	Productivity	\$22,354	\$22,354	\$21,338
	On-time shipment	82%	87%	91%
	Inventory days	14	14	12
	First time through	88%	92%	95%
	Average cost/unit	\$15.97	\$15.97	\$15.83
Capacity	Productive	62%	53%	60%
	Non-productive	32%	19%	22%
	Unused available	6%	28%	18%
Financial	Revenue	\$1,408,333	\$1,408,333	\$1,408,333
	Material Costs	765,000	765,000	801,000
	Outsourced costs	62,400	62,400	-
	Labor Costs	267,083	267,083	279,983
	Machine costs	59,433	59,433	62,493
	Other costs	11,833	11,833	11,833
	VS profit	242,584	242,584	253,024
	VS return on sales	17.2%	17.2%	18.0%

- B. Should the Brass Valves Value Stream insource housing production? Why or why not?

Insourcing the production of the housing increases profit, return on sales on-time shipments, inventory turns and first time through while reducing average cost per unit. Productivity would go down due to the necessity of hiring two additional workers and adding two machines. The argument for insourcing would focus on the marginal improvements in profitability and operations. The arguments against insourcing production would focus on the reduction in unused available capacity despite adding three people and two machines for relatively marginal improvements in operations and profitability. The decision might hinge on the flexibility of the hired workers and the new machinery and the relationship with the supplier of the housings. How easily could the value stream return to acquiring the housings if more profitable uses for their internal resources were developed? Is the supplier of the housings a reliable partner or a problem supplier? How important is this order to the supplier?

6. Brass Value Stream – Insourcing, Capital Equipment, and New Orders – Scenario 2.

The Brass Valves Value Stream is considering insourcing housings they currently from a supplier for \$62,400. They also received an order for 2,500 additional valves per month. The customer is willing to pay \$18.00 per valve. The Brass Valve Value Stream Team is also considering leasing a new machine to automate a manual production task. The machine costs \$4,000 per month and would free up two assembly operators.

Required:

- A. Complete future state box score columns for the Brass Valves Value Stream assuming:
 - I. They will insource the production of housings (done in requirement A, problem 5).
 - II. They will accept the new order, but not insource production of housings.
 - III. They will insource the production of housings and lease the additional machine freeing two operators but turn down the new order.
 - IV. They will insource production of housings, accept the new order, and lease the additional machine freeing two operators to work on the housing.

Brass Valves Value Stream		Current State	Future State Insource	Future State New Order	Future State Ins+Mach	Future State Both+Mach
Operational	Productivity	\$22,354	\$21,338	\$23,069	\$22,005	\$22,708
	On-time shipment	87%	91%	87%	91%	91%
	Inventory days	14	12	14	12	12
	First time through	92%	95%	92%	95%	95%
	Average cost/unit	\$15.97	\$15.83	\$15.90	\$15.77	\$15.71
Capacity	Productive	53%	60%	57%	55%	60%
	Non-productive	19%	22%	21%	18%	20%
	Unused available	28%	18%	22%	27%	20%
Financial	Revenue	\$1,408,333	\$1,408,333	\$1,453,333	\$1,408,333	\$1,453,333
	Material Costs	765,000	801,000	800,000	801,000	836,000
	Outsourced costs	62,400	-	62,400	-	-
	Labor Costs	267,083	279,983	267,083	271,583	271,583
	Machine costs	59,433	62,493	59,433	66,493	66,493
	Other costs	11,833	11,833	11,833	11,833	11,833
	VS profit	242,584	253,024	252,584	257,424	267,424
	VS ROS	17.2%	18.0%	17.4%	18.3%	18.4%

- B. What course of action would you recommend to the Brass Valves Value Stream team? Explain your answer.

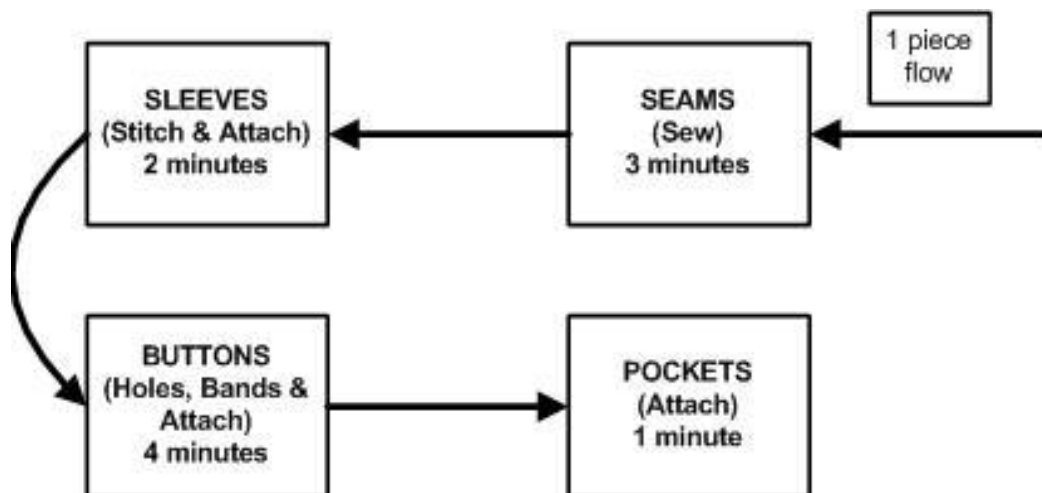
The potential advantages and disadvantages of the insourcing option were discussed in problem 5 requirement B. Assuming insourcing is considered desirable, acquiring the additional machine and redeploying two operators rather than hiring two operators appears to be a much better option than hiring two additional operators. Once the machine is added, also accepting the order marginally improves performance while retaining sufficient unused capacity for future orders. If insourcing production of the housing would damage a long-term relationship with a desirable reliable supplier, accepting the order marginally improves profitability using excess capacity, while leaving sufficient capacity for more profitable work that may become available.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 11: Calculating Product Costs – Features and Characteristics

1. Although individual product costs are generally not necessary when managing by value stream there are a few instances where individual product costs may be useful, including ...
B) calculating a price for transferring products from one division to another.
2. The primary driver of conversion cost for a product in the value stream is ...
D) the rate of flow per unit of product in the value stream.
3. The bottleneck process or cell in a value stream ...
C) determines the maximum possible rate of flow through the value stream.
4. The average product cost per unit for a value stream is computed as ...
A) total value stream costs divided by the number of units shipped to customers.
5. The average cost per unit reported using value stream costing discourages overproduction and encourages inventory reduction because average cost per unit is calculated ...
C) with all conversion costs for the period in the numerator and the number of units sold rather than the number of units produced in the denominator.
6. Analyzing the capacity utilization of processes in a value stream, the bottleneck process in the value stream is usually ...
C) the process with the lowest unused available capacity (or highest negative unused available capacity, where demand exceeds capacity for some processes).

Use the following diagram and information for questions 7, 8 and 9.



The Shirts value stream for Jacmel Apparel consists of a single production cell, depicted in the diagram above. Excluding the cost of direct materials it costs \$800 per week to run the Shirt value stream, and it currently produces and sells 540 shirts per week.

Jacmel Apparel's managers have identified a feature affecting processing time in the Shirt bottleneck process and have classified their shirt styles into one of three categories on the feature: low, medium, or high. Using the same productive time it currently takes to produce their current output, the Shirt value stream would be able to produce 360 shirts if it produced only "high" intensity styles during a week. If total available time were 100% productive (non productive and unused available capacity were zero) The Shirt value stream could produce 400 high intensity style shirts per week.

7. The bottleneck process is ...
C) Buttons
8. Given the process depicted in the diagram above, which of the following features of shirts produced in the Shirts value stream would be used to adjust the amount of conversion cost assigned to a particular style shirt?
B) The number of buttons and button holes in the shirt design, affecting time in the Button cell.
9. The conversion cost per shirt (rounded to the nearest penny) for a "high intensity" style shirt should be ...
A) \$ 2.22. [$\$800 / 360$]

Discussion questions and problems

1. Why are individual product costs generally not needed when managing by value stream? What information do value stream managers usually use to replace in place of individual product costs and gross profit margins?

Managing by value stream, managers seek to improve the performance of the value stream as a whole, not the performance of individual products or services produced in the value stream. Aside from direct materials, most of the costs of producing a product are joint costs of all the products produced in the value stream. Value stream managers use the value stream box score to assess the impact on the value stream of decisions relating to individual products. Operating measures and the summary financial measures in the value stream box score are used to assess the performance of value stream processes and motivate and evaluate continuous improvement efforts. Pricing is based on an understanding of customer needs and customer value, and the market, not individual product costs. Overall inventory values can usually be based on simple methods that do not require individual product costs.

2. Even if individual product costs are not needed to support tactical decisions why might it still be helpful to know what product features create costs and how much cost particular features add to products? How could this information be useful to managers?

It can be very useful to understand the cost of providing various product features and characteristics relative to the value they create for customers. This knowledge can help identify process improvement priorities critical to future performance, and guide product redesign efforts. It can also guide suggest areas of the market to where the value stream may be able to deliver high value to customers at low cost.

3. How does the rate of flow drive cost in a lean value stream? How is this assumption different from assumptions made in standard costing?

Standard costing assumes that direct labor time can be immediately adjusted to match the current production level, and that overhead is primarily driven by the quantity of direct labor time or machine time. So direct labor time and possibly machine time on individual products is assumed to drive costs.

Under lean, the cost of a value stream is determined by the current state of its processes and the amount of productive capacity made available. Once the commitment is made to provide a certain level of capacity, the cost (other than direct materials) of running the value stream for a short period (week or a month) does not vary significantly with the actual volume of production unless there is a large change in anticipated demand for an extended period causing the company to significantly increase or reduce capacity made available. Since the cost of running the value stream is mostly fixed, the rate of flow through the value stream determines the conversion cost per unit of production in the value stream.

4. What determines the rate of flow through the value stream?

The bottleneck process or operation determines the rate of flow through the value stream. The entire value stream can only go as fast as the slowest process or operation. It can only produce at the volume of the process or operation with the smallest capacity in the value stream.

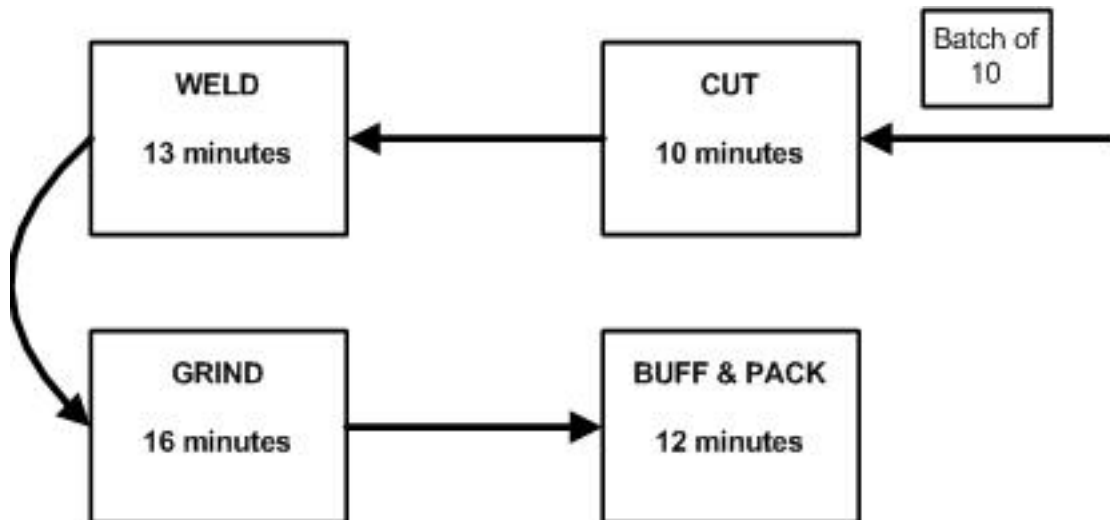
5. How is the average cost per unit calculated in value stream costing? What costs are included in the numerator and what measure of units is used in the denominator? How does this measure drive lean approach to inventory?

Average cost per unit is computed by dividing total costs (material purchases, and direct production and nonproduction costs of the value stream with very few if any cost allocations) assigned to the value stream by units sold. Using units sold rather than units produced discourages overproduction. Using material purchases rather than the direct material content of cost of goods sold (or even materials used) discourages the purchase of excess inventory. Added inventory will increase average cost and reduce reported income for the period. This is the desired signal. Overproduction in a standard cost system leads to lower average reported costs and higher income in the period when production takes place.

6. How can the bottleneck process in a value stream be identified? What characteristics does it have?

The bottleneck process is generally the process with the least capacity and the longest cycle time (adjusting for parallel processing). The bottleneck process generally has inventory stacked in front of it (because it is the bottleneck if an effective pull system is not in place, or buffer stock to prevent problems in upstream processes from starving the bottleneck process if an effective pull system is in place).

7. Acme Metals has a Connectors value stream that produces metal connectors for mining and oil drilling industries. Excluding the cost of direct materials, the Connectors value stream costs \$20,000 per week to run and it produces and sells 1400 connectors per week. The processes are depicted in the diagram below.



The processing times shown in the process boxes are the average machine process times to produce a batch of 10 connectors. It takes one minute to set up for each batch in cutting and grinding and two minutes to set up for each batch in welding. Buffing and packing does not require any setup time. Setups take the same amount of time regardless of the type of connector being produced. Acme Metals runs one weekly shift of five eight-hour days.

The Connectors Value Stream Team identified the following connector features that may potentially affect the conversion cost for a connector in the value stream:

- **Connecting Rod Diameter** – affects the cutting time. Small diameter rods require 8 minutes per batch, average rods require 10 minutes per batch, large diameter rods require 12 minutes per batch.
- **Number of Welds** – affects the welding time. A small number of welds require 10 minutes per batch, a medium number of welds require 12 minutes per batch and a large number of welds require 15 minutes per batch.
- **Hardness of the Metal** – affects the grinding time. Soft metal requires 7 minutes per batch, average metal requires 15 minutes per batch, and hard metal requires 20 minutes per batch.
- **Connecting Rod Length** – affects the buffing and packing time. Short connectors require 6 minutes per batch, medium connectors require 12 minutes per batch, and long connectors require 14 minutes per batch.

Required:

- A. Identify the bottleneck process in the Connectors value stream.

Grinding is the bottleneck process. It has the longest cycle time.

- B. Identify the feature or features of the connecting rods affecting the bottleneck process.

Hardness of the metal is the product feature that affects the grinding time.

- C. Create a cost table showing the conversion cost per connector for each level (or combination) of features that affect the bottleneck process. In computing the costs, assume that the total time available per week to set up and produce batches of connectors, is the time currently being used to set up 140 batches and produce 1,400 connectors in the bottleneck process. All remaining available time (if any) in the bottleneck process is taken up by nonproductive activity other than setups.

Minutes available for setup and production in grinding $140 \times 16 = 2,240$ for production, + 140 minutes for 140 setups = 2,380 total minutes. (2,400 minutes could be used in this case. The key is to avoid including non-productive time (e.g., down time, cleanup, etc.) that would not be available for setup and production regardless of the product mix.)

Metal hardness	Soft	Medium	Hard
Setup	1	1	1
Grinding	7	15	20
Total batch time	8	16	21
Proportion of medium time	-50%	100%	131.25%
Available minutes	2,380	2,380	2,380
Theoretical batches*	298	149	113
Theoretical units*	2,975	1,488	1,133
Conversion cost per unit*	\$6.72	\$13.45	\$17.65
Proportion of medium cost	-50%	100%	131.25%

*Rounded

The current state production uses 2,380 minutes to setup and produce 140 batches of 10 connectors each. The conversion cost is \$20,000 to operate the value stream. Based on the differential time to setup and grind a batch of connectors made with soft, medium, or hard metal. We have a cost table with conversion cost of \$13.45 per connector for medium metal, soft metal conversion costs are 50% of the medium cost, or \$6.72 per connector, and hard metal conversion costs are 131.25% of the medium cost, or \$17.65 per connector.

- D. Based on your answer to requirement C, do you believe the difference in conversion cost is great enough to warrant using features and characteristics costing, or can the Connectors value stream simply use the average conversion cost for all connectors in the value stream?

The difference seems significant enough to warrant using the different costs, but that depends on how the cost data is being used. The company needs to look at the value that grinding provides to the customer and the value that harder metals provides to the customer. If inventory mix differs significantly from production mix, than the product costs determined using features and characteristics may be used to compute inventory values.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 12: Eliminating More Wasteful Transactions

1. Once lean manufacturing is widespread in an organization all of the following attributes are usually in place except ...
C) Lean thinking is applied throughout the entire organization.
2. In traditional manufacturing _____ are used to schedule production, follow jobs through the production process, accumulate actual costs on jobs and track inventory.
D) work orders
3. Once lean manufacturing is widespread in the lean enterprise, kanbans can be used to ...
A) signal production based on customer orders.
4. Companies where lean manufacturing is widespread can eliminate tracking actual labor to work orders or job cost sheets because ...
B) cell performance measures are used to control production and labor costs are tracked at the value stream level.
5. Most support functions are carried out within each value stream rather than by employees in specialized support departments when lean manufacturing is widespread. The procurement function can usually be moved within the value stream because ...
D) all of the above.
6. Most support functions are carried out within each value stream rather than by employees in specialized support departments when lean manufacturing is widespread. Manufacturing engineering can usually be moved within the value stream because ...
A) manufacturing engineering will be focused on process improvements and continuous improvement teams are focused on improvement of entire value streams, not isolated processes.
7. All of the following are steps that should be in place before the use of work orders for tracking materials can be completely eliminated except ...
C) The procurement function is automated.
8. Companies where lean manufacturing is widespread ...
C) expense materials on receipt and use a month-end adjustment to value inventory for reporting purposes.
9. When lean manufacturing is widespread, cycle counting of inventory ...
B) can be eliminated because inventories are low in value and controlled through visual means.
10. Which of the following is an example of lack of process control that conventional management addresses by adding transaction controls to minimize the likelihood of material misstatements of financial statements?
C) Poor factory organization.

11. Which of the following is ***not*** an example of a process control that minimizes the chance of errors that would lead to material misstatements of financial statements?
- D) Frequent expediting to satisfy customer delivery demands.

Discussion questions and problems

1. What characteristics in place when lean manufacturing is widespread allow companies to eliminate the use of work orders to schedule production and follow jobs through the production process? What replaces the use of the work orders?

Cellular manufacturing is widespread. Cells are linked end-to-end in the value stream to enable a flow of production. There is extensive use of visual systems and an effective pull system that controls production flow. Work orders are no longer needed to initiate and control production. Kanban signals initiate production and visual control is used to follow jobs through the production process.

2. Identify three reasons companies require detailed labor reporting by job, and describe how companies where lean manufacturing is widespread satisfy these needs without detailed labor reporting by job.

Traditionally managed companies require detailed labor reporting for process control (direct labor cost should not exceed the standard for each process). Lean companies use standard work subject to continuous improvement, not standard costs, and operating measures at the cell and value stream levels are used to assess the effectiveness of standard work and continuous improvement efforts.

In the traditional company, direct labor reporting is also used to monitor labor performance (workers are encouraged to spend more time on direct labor activity, and less on indirect labor activity). Lean companies do not distinguish between direct and indirect labor. Cell and value stream operational measures and summary financial performance measures at the value stream level are used motivate and track elimination of waste and continuous improvement.

In the traditional company, detailed labor reporting is also used to assign conversion cost (labor and overhead) to jobs and products. Lean companies do not assign conversion costs to jobs and products. Profitability is assessed at the value stream level, inventory for the entire value stream is valued in aggregate using a simple evaluation model and adjustment for financial reporting. If individual job or product costs are computed as needed using simple models based on product features and characteristics.

Detailed labor reporting can also be the source of job tracking information in traditionally managed companies. In lean companies jobs are produced in linked production cells. Cycle times are shorter, reducing the need for tracking, and there is less material movement so any tracking can be accomplished by visual means within the production cells.

3. At conventionally managed companies, personnel in specialized departments perform many support functions. Briefly explain how companies where lean manufacturing is widespread satisfy their needs for the following support: production control, inventory movement and management, procurement, and manufacturing engineering.

Production control: The signal to start production comes from a customer order that pulls production at the pacemaker cell. Cell performance measurements, such as the Day-by-the-

Hour report are used to keep track of cell production and ensure the cell team focuses on the rate of production achieved in relation to the rate required.

Inventory management: Inventory movement is minimized by organizing production in cells rather than specialized departments. Kanban signals govern the movement into and out of the production cells. Kanbans are managed within the value stream.

Procurement: Lean companies reduce the number of suppliers they deal with. Key materials are purchased with blanket purchase orders from certified suppliers. The job of procurement changes from centralized processing requisitions and negotiating individual purchases to working in the value stream, facilitating its relations with suppliers, and ensuring the on-time delivery of items pulled from the supplier. If commodity specialists do continue work outside the value streams, their role is supplier relationships and contract negotiation. They are not involved in the daily pulling of requirements from the supplier; people within the value stream do it.

Manufacturing Engineering: In a lean value stream, continuous improvement is the responsibility of the value stream itself, based on the trends in value stream performance measures. Manufacturing engineers are often dedicated to value streams.

4. Identify three reasons companies require detailed material cost and quantity reporting by job, and describe how companies where lean manufacturing is widespread satisfy these needs without detailed reporting on material costs and quantities by job.

Traditionally managed companies require detailed material cost and quantity reporting for process control (direct material cost should not exceed the standard for each process). Lean companies use standard work subject to continuous improvement, not standard costs, and operating measures at the cell and value stream level are used to assess the effectiveness of standard work and continuous improvement efforts. Detailed tracking of scrap and defects are maintained at the cell level.

Detailed material cost and quantity reporting is used to track inventory quantities and values. In lean companies inventory levels are low and stable, and are maintained using visual control, kanbans, and operating measures such as WIP-to-SWIP.

Detailed material reporting is also used for product and job costing. Lean companies assess profitability the value stream level, so they have much less need for product costs. If material costs are needed for individual products they can be calculated from the bills of materials, using the current material prices as long as bills of materials are accurate.

5. Why do companies maintain perpetual inventory systems? How do companies where lean manufacturing is widespread eliminate the need for perpetual inventory systems without losing needed information?

MRP production and materials planning processes require accurate inventories. Scheduling is based on forecasts and existing balances. With large inventory balances, perpetual inventory is used for resource control and for inventory valuation. It is also used to respond to inquiries about the availability of finished products and materials.

In lean companies, pull systems replace MRP production scheduling. Inventory levels are low and well organized allowing for visual control. Availability or lack of availability can be quickly

determined by looking at kanbans and bins. Overall valuation can be calculated using simple inventory valuation models.

6. How can process controls substitute for transaction controls? Is this substitution a second-best solution motivated by the desire to eliminate waste and save money?

If a process is stable and reliable, the outcome can be predicted. We do not need to record each sunrise to verify that the sun rose thirty times in June. Process controls maintain the stability and reliability of the processes. They are preventive controls, or controls that provide immediate detection, allowing for root cause to be discovered while the evidence is still fresh. Transaction controls adjust for unexpected outcomes, and may detect problems but detection is often delayed and causes are harder to determine because outcomes (effects) not causes, are reported.

Which is the more effective control, accurately assessing the damage from a fire and submitting a well documented insurance claim, discovering a fire at the first sign of smoke and flames and quickly extinguishing it, or by designing and executing operations in ways that prevent conditions that cause fires?

7. Identify three process controls that are characteristic of companies where lean manufacturing is widespread, and identify a transaction control that can be reduced or eliminated due to the presence of the process control.

- Cellular manufacturing and one piece flow – recording material moves can be greatly reduced because processes are in close proximity to one another and total time in production is greatly reduced so status of work-in-process is less important.
- Kanban – pull systems – eliminate the need for work orders.
- Supplier certification programs (and blanket purchase order relationships with a smaller number of suppliers) – reduces purchase and payables transactions recorded, and can eliminate three way matching (order, receiving report, and invoice), and transactions related to material variances with standard cost.
- Production managed by value stream, extensive use of visual systems and standard work – eliminates detail labor reporting, all transactions related to variance with standard costs.

8. Why might managers resist the elimination of transaction controls?

Managers may be used to relying on the transaction controls and eliminating them takes the managers out of their comfort zone. They may not understand or not trust the process controls replacing the transaction controls. Managers may feel a loss of power or influence as workers assume more responsibility for process controls.

9. Apex Manufacturing.

Apex Manufacturing makes precision parts for OEMs (original equipment manufacturers) of home appliances. The accounting department is very proud of their control system. A description follows ...

Required:

- A. Which of the accounting and recording activities in Apex's current system add value and which are waste?

None of them add value from the perspective of the customer.

- B. Assume that lean manufacturing becomes widespread at Apex. Describe the accounting and record-keeping processes that would be in place. What current activities would be eliminated and what would replace them?

Some customer orders (those from a set of regular customers) could be replaced by shipments under blanket sales order at the signal of the customer.

The production scheduling and materials requirement planning currently done with the MRP system would be replaced by production and purchasing signaled by kanbans. Material requisitions would be eliminated.

Cost of workers would be drawn from the payroll records. Other than hours worked per day and perhaps some coding for paid time off (vacation, sick time, personal leaves) no detailed labor reporting would be required. Control will come from standard work, operational performance measures at the cell and value stream levels, and summary value stream financial results reported in the box scores.

Production, good and defective, would be tracked hourly within the cells. Scrapped material would be recorded as the scrap occurs. Weekly meeting would discuss production problems, scrap, and progress on continuous improvement efforts rather than variances from standard costs.

Materials would be expensed on receipt. Inventory would be monitored visually based on kanbans. Production could be recorded upon shipment to customer, or on completion of production. Depending on cycle time, production starts might also be recorded. If physical counts were needed, they would be repeated cycle counts of the same representative parts to reveal any problems in inventory management.

- C. Respond to the bulleted list of questions raised by the accountants.

- How under the new system are we going to control material costs and encourage lower costs? By continually improving processes to reduce defects and scrap, working with suppliers who can provide quality materials in the right quantity on time, and avoiding excess inventory that may become obsolete or damaged.
- How are we going to control labor costs and ensure workers are working hard? By engaging employees, rewarding teams that improve value stream performance, creating standard work, giving employees the operational measures they need to engage in continuous improvement, and assessing overall value stream performance.
- How are we going to schedule production? The customer will signal what needs to be produced. We need to respond to customer demand, producing to order or replacing customer withdrawals from (a small) finished goods inventory.
- How are we going to track the progress of jobs to respond to customer inquiries? Cycle times and lead times fall and the level of work in process is greatly reduced as we approach one piece flow, and production steps occur close to each other in cellular production. Thus products spend less time in process, and when they are in process we can see their status by visual inspection.
- How are we going to get values for inventory and cost of goods sold? We can treat all current costs as period costs, and then adjust inventory value (and cost of goods sold) using

a simple calculation to value overall inventory. Valuation is easier and as inventory levels fall, the overall value of inventory is less material or immaterial from a financial reporting perspective.

- Are we still going to have jobs? We will have more valuable and more interesting jobs. Instead of spending most of our time recording and checking transactions, we can be performing target cost analysis, value stream cost analysis and creating future state box scores to support planning, continuous improvement, and decision-making.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 13: Sales, Operational, and Financial Planning (SOFP)

1. The purpose of lean sales, operations, and financial planning is ...
D) to anticipate future customer needs, establish the capacity to meet those needs and provide flexibility to cope with the unexpected.
2. Traditional budgeting processes do not help lean organizations because ...
C) they focus on financial outcomes, not operational inputs and customer demand.
3. The monthly SOFP planning process begins with ...
B) value stream demand planning.
4. The SOFP team for each value stream should be ...
B) a cross-functional group mostly from within the value stream.
5. Separate demand forecasts should be prepared for ...
B) each product family for each month or period of the planning horizon.
6. A good way to determine the length of the planning horizon is by ...
A) the lead time required for a major capital investment.
7. The outcome of the _____ is a new set of monthly sales forecasts covering the planning horizon.
A) value stream demand planning.
8. If the sales force is not part of the value stream ...
B) the sales people provide product family demand forecasts for the value streams.
9. Inaccurate demand forecasts can be addressed by ...
C) working to understand the causes of variability in forecast error and continually improving the forecasting process.
10. Value stream operations planning relies on all of the following to estimate future value stream capacity except ...
B) benchmarking analyses of best-in-class companies.
11. A capacity shortfall in the near future could be met by ...
B) scheduling overtime or getting help from another value stream.
12. Which of the following is an example of a short-term action resulting from the SOFP operations planning?
A) creating level scheduling plans.
13. Ideally, the cycle time of the production process
C) should be less than the takt time.
14. Capital acquisitions should be evaluated based on ...
D) flexibility, ease of use, the match of added capacity with immediate needs, and cost.

15. Which of the following is **not** an output of value stream operations planning for materials and components?
C) Calculating new economic order quantities for materials and components.
16. A source of financial information for the SOFP financial reports is ...
A) the sales and production information from SOFP spreadsheet.
17. Which of the following is **not** a purpose of the SOFP planning meeting?
C) Discuss budget variances and make plans to eliminate unfavorable variances.
18. Which of the following is **not** an outcome of the SOFP planning meeting?
A) A target cost analysis of key products.
19. The purpose of the Executive SOFP meeting is to review the plans and budgets, ...
B) make decisions outside the scope of the value stream teams, and authorize execution of the plan.
20. All of the following are keys to successfully implementing a lean SOFP process except ...
A) Senior management should not be involved in the process. It should be delegated to value stream employees.

Discussion questions and problems

1. What is the principal purpose of the lean SOFP process?

The purpose of the lean SOFP process is to anticipate future customer needs and to establish sufficient capacity to meet those needs and have sufficient flexibility to cope with the unexpected.

2. Is the lean SOFP process waste? Why can't lean companies simply react to actual customer demand?

The lean SOFP process is waste in that the planning activities do not themselves add value from the perspective of the customer. However, the extent of customer needs must be understood before they can be satisfied. Companies want the flexibility to be able to respond to immediate changes in demand, but as time periods are extended, product and service offerings change, external conditions change, and the likelihood of demand change and the size of the changes increases. Acquiring capacity (whether through acquisition or continuous improvement) takes time, and achieving flexibility in the right areas takes planning and time. SOFP puts the company in the position to be able to add value to customers.

3. List three reasons why conventional budgeting processes may not be useful to lean organizations. How does the lean SOFP process overcome the problems with conventional budgeting?
 - By the latter half of the budget year the budget estimates will be dated if the budgeting process is an annual process (some conventionally managed companies do have rolling budgets).

- Conventional budget processes can be wasteful. Detailed estimates and projections painstakingly calculated can be manipulated in budget games or adjusted by wishful thinking to meet top management's financial targets.
 - The emphasis is on financial outcomes, not customer value and the operational requirements needed to produce customer value. For example, across-the-board cuts will appear to satisfy financial goals, but value-creating capability may be cut across-the-board along with waste. Cuts must come from specifically identifying and targeting waste.
4. Should the SOFP team for each value stream be people who will also be responsible for executing the plan? Why or why not?

The SOFP planning team may have some people from outside the value stream, but the people responsible for the SOFP planning process. For the plan to be successful, the team responsible for executing the plan must take ownership of the plan. It must be their plan, not a mandate forced on them.

5. For each of the following planning processes, list the major issue or issues addressed (looking at it another way, what question or questions does the process try to answer?):
- a) Value stream demand planning. Provides estimates of monthly demand for each product family produced in the value stream.
 - b) Value stream operations planning. Identifies bottlenecks and process and inventory problems that may threaten or prevent the company from meeting the estimated monthly customer demands in time for countermeasures to be planned and executed. Forecasts capacity availability and utilization for the planning horizon.
 - c) Value stream financial planning. Provides an accurate gauge of current financial performance to support current operations. Provides a longer-term budget updated on a rolling basis for external purposes (reporting to or negotiating with lenders, providing earnings guidance to actual and prospective investors if publicly held) and internal purposes (cash management, planning future capital acquisitions).
6. How should a company determine the length of their planning horizon?

The planning horizon should be at least as long as the time required to add significantly to productive capacity (major equipment acquisition or significant hiring). Beyond that the choice will be affected by the volatility and technological change in the markets being served by the value stream and the company, and the preferences of the top management team.

7. Are sales forecasts the same as sales targets? Should the demand forecast used in SOFP planning be pessimistic, realistic, or optimistic? Explain your reasoning.

Forecasts are estimates or predictions of what is likely to occur. Sales targets are goals, outcomes the company is actively striving to achieve. In lean, SOFP is being used as a planning tool. A realistic forecast will help reduce waste. If forecast sales are below target performance, efforts should be devoted to generating more business, but that does not change the current reality. If the efforts to generate more business are successful, realistic forecasts will reflect that success in future months, and the rolling budget will change accordingly.

8. Identify two short-term actions arising out of SOFP operations planning and explain their purpose in meeting customer demand through lean production.

Some examples: establishing production cycle times to match customer demand, creating level scheduling plans, recalculating kanban quantities, or determining staffing levels for cells and value streams. All of these are designed to ensure production can occur at the rate of customer demand (takt time). Part of finalizing product introduction plans is ensuring capacity is available to satisfy demand for new products as well as the existing products. Final plans for continuous improvement projects may be affected by their capacity impact relative to the coming needs of the value stream.

9. Identify two long-term actions arising out of SOFP operations planning and explain their purpose in meeting customer demand through lean production.

Some examples: changes in staffing levels to meet expected future demand, purchase or redeployment of capital equipment, outsourcing decisions, and establishing long-term continuous improvement plans. All of these create capacity to satisfy demand or redeploy existing capacity, but they take some time to implement. Long-term in this case may be a matter of months, not years.

Other long-term actions arising from SOFP operations, such as developing new market strategies and establishing new product development programs are designed to take advantage of excess capacity.

10. How can sales policies and incentives create unevenness and variation? Suggest a sales policy change or incentive that would reduce rather than increase unevenness and variation.

Some examples: Sales policies such as quantity discounts encourage batch purchasing and large orders. Special promotions can create demand surges and troughs. Sales commission terms can also create demand surges. Special promotions could be limited to and targeted for slack times to smooth demand. Quantity discounts can be eliminated or based on annual sales instead of individual orders or shipments.

11. Precision Manufacturing's demand forecasts and capacity analysis show that by the end of the next fiscal year, they will exceed the capacity of their current equipment on a lathe operation. Precision's Managers in the Stainless Steel Value Stream are evaluating a new state-of-the-art CNC Lathe. The lathe has the fastest cycle time of any lathe on the market. It would have the capacity to serve Precision's future demands as well as replacing two existing lathes. What questions should Precision's Managers be asking and answering before they decide whether purchasing the new lathe is the best solution to their capacity problem?

Can the needed capacity be created by eliminating waste and/or redesigning products or processes to reduce the demand for the lathe operation? Has the possibility of using existing equipment for an added shift or overtime period been explored? What are the operating and maintenance costs and training costs for the CNC lathe compared to smaller, simpler lathes? Does this value stream need the entire capacity of the lathe? How flexible is the lathe compared to other alternatives if demand changes? How would acquiring the lathe affect quality and flow in the value stream, compared to alternatives? What is the acquisition cost compared to the cost of smaller simpler lathes? The key points are (1) to fully explore all alternatives, and (2) that acquisition cost and the cycle time of the lathe itself are only two of

many considerations and probably not the most important to the final decision. The final decision should be made based on the short and long-term impacts on overall value stream performance.

12. How are SOFP financial reports typically presented? Can SOFP financial reports reduce the importance of the monthly reports of actual results? Briefly explain your answer.

SOFP financial reports are typically in the box score format. In other words, summary reporting of key financial results along with capacity utilization and operating measures, rather than detail on the cost of every resource. Because the SOFP financial results for the current month are based on realistic estimates and projections developed in the previous month, the estimates are very accurate (like predicting tomorrow's weather, compared to forecasting the weather weeks or month's in advance). There is less of a need to rely on the actual financial statements at after the close of the month to see how the value stream performed. Based on the estimates and the actual sales data immediately available managers will have an accurate picture of financial performance well before actual monthly financial are available.

13. What are the reasons for having an SOFP planning meeting? Who participates? Is the meeting restricted to short-term issues?

The SOFP planning meeting is attended by value stream managers and key people from each value stream to coordinate plans and discuss issues beyond the scope of any single value stream. They make decisions on how each value stream will work to match customers' demand and production capacity, resolve conflicts and resource issues, particularly when there are shared resources (monuments), create recommendations for the game plan to be presented to the SOFP executive meeting, identify issues requiring decisions from the executive team, and agree on an agenda for the SOFP executive meeting. Short and long-term issues are discussed. The meeting is for overall planning.

14. What are the reasons for having an executive SOFP meeting? Who participates? Is the meeting restricted to short-term issues?

The executive meeting is for senior managers to review and approve the plans (as presented, or with modification) made by the value stream teams and to make decisions that are outside the scope of the value stream managers. The meeting will include both short and long term issues. Top management has greater responsibility for long-term decisions – strategic decisions are generally longer term in nature. One purpose of SOFP is to raise issues well in advance so that appropriate thought and planning can be given to them.

15. What are the keys to successful implementation of SOFP?

As with most effective processes, senior management must be committed to and support the process. There has to be tenacity by all participants to work through the rough spots and problems in the process that will inevitably occur at early stages of implementation.

A formal, standard methodology should be followed. Essentially this becomes a part of standard work (especially for managers) making it easier to identify root cause of problems and continually improving the planning process.

Planning must be done by value stream so the focus is on meeting customer demand and achieving flow.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 14: Lean Financial Accounting II

1. Companies can ensure that appropriate payments are made to certified suppliers when lean manufacturing is widespread by ...
C) automatically paying for materials upon receipt, or upon use.
2. If companies where lean manufacturing is widespread are certified suppliers for their customers they can ...
A) request payment on receipt of material rather than issuing invoices.
3. One way lean companies reduce the number of accounts they track in their general ledger is by ...
B) organizing by value stream and assigning costs to value streams rather than departments
4. Conversion costs reported for each value stream would include ...
C) all costs that are directly incurred by the value stream except material purchases. a
5. The recommended approach for accounting for expenses when lean manufacturing is widespread is to ...
A) charge all expenses, including material purchases, to the period when they were incurred.
6. Which of the following best describes the preferred lean approach to inventory accounting?
B) Record all production costs as period expenses and use a simple end-of-period adjustment to account for the overall change in inventory.
7. Lean companies close their books to prepare financial statements ...
C) Annually, or quarterly if SEC reports are filed quarterly.
8. The difference between the conventional approach to control and the lean approach to control is ...
B) the conventional approach emphasizes inspection and correction, while the lean approach emphasizes mistake-proofing and prevention.
9. Which of the following is a problem of the conventional control approach relying on monthly comparisons of actual financial results to budget targets?
C) Financial measures are effects. They provide little information about causes.
10. In terms of control, what is the role of the accountant in a lean company?
B) Accountants become involved in operations and continually assess the effectiveness of cell and value stream measures and the SOFP process.

Discussion questions and problems

1. What is the purpose of the three-way match in the accounts payable process? How is this purpose satisfied without the three-way match when lean manufacturing is widespread?

The purpose of the three-way match between the purchase order, the receiving report, and the invoice, is to ensure that the type and quantity of material and parts received matches what was ordered, that the quantities for which the company is being billed matches the quantities ordered and received, and that the prices match what was agreed to in the purchase order. When lean manufacturing is widespread, most materials and parts will be covered by blanket purchase agreements. Prices are established and not subject to change with each delivery. Quantities will be delivered in fixed kanban amounts as needed. If the pull system is working properly the amount received will equal the amount needed. The quantity received is easy to determine by counting kanbans. If process cycle time is fast enough, payments can be made based on quantity used (production based quantities based on bills of materials plus any scrap or defects).

2. How can companies where lean manufacturing is widespread speed collections of amounts owed them while eliminating the need to issue invoices?

They ask for the same terms from their key customers that they offer to their key suppliers. They can promise to deliver in the quantities needed at the time needed at a price governed by a blanket sales (purchase) order, with payment due on receipt rather than on invoicing. The kanban (or possibly a shipping document) makes invoicing superfluous.

3. Why do conventional companies have such extensive charts of accounts? If lean companies will greatly reduce the number of general ledger accounts, what will be lost? How will lean companies replace the function that detailed ledger accounts perform for conventional companies?

Conventional companies are organized by functional area and department and they are relying primarily on financial data for cost control. They track individual resources to each department to exert pressure on departments to control costs and in the belief that the detail will enable them to identify the source of cost overruns. The dozens of accounts for each department are required to provide this level of detail. Lean companies do not track or allocate costs below the value stream level. The detail cost reporting is lost, but lean companies rely on operational metrics to control activity (the cause of the costs) below the value stream level. The operational data is more timely and more relevant than detailed financial data to diagnosing the causes of waste and obstacles to flow that lead to poor cost performance.

4. Does having a more detailed chart of accounts provide more control or less control?

A more detailed chart of accounts creates the impression of greater accuracy and control. Whether the impression is fact or illusion depends in part on whether cost assignments are accurate and allocations are meaningful at the departmental level is questionable. Even if cost assignments are accurate and allocations reflect either actual usage or the reasons for making resource capacity available, the financial reports are the effect of operations and decisions, not the cause. The financial data is of limited use for discovering root cause. The detailed financial data may provide some added control, but at great cost. The detailed cost data may also encourage local optimization at the expense of overall value stream performance.

5. Describe what does it mean to use the “cash basis” of accounting for expenses. Can a company where lean manufacturing is widespread use a cash basis of accounting for expenses when generally accepted accounting principals require an accrual basis?

Lean companies do not use a cash basis in the strict sense of the term. Sales are recorded when the product or service is provided to the customer, not when cash is received. Expenses are charged to the period when the resource is used, not when payment is made. The reference to cash basis refers to lean companies charging inventory to the period when it is acquired. This is a departure from conventional accounting, which records inventory as an asset and records the expense only when the inventory is sold.

Lean companies charge inventory to the period when it is acquired so that internal measures of profitability will discourage overproduction and encourage eliminating waste. In addition when lean production is widespread and effective pull systems are in place material acquisition and the material portion of cost of goods sold are approximately equal. A simple adjustment can be used to record inventory at the value needed for external financial reporting.

6. Can a lean company treat production expenses as period costs and still report income in conformance with generally accepted accounting principles? Explain your answer.

Yes. A simple adjustment can be used to record inventory at the value needed for external financial reporting. A simple method can be used at the end of each reporting period to calculate the value of overall inventory for full absorption costing.

7. What does “closing the books” mean? Why do companies close their books? How often should lean companies close their books?

Companies that close the books freeze the balances of the ledger accounts at the close of business (or the end of the day) on the last day of the accounting period on which they want to report. The accounts balances are examined and adjusted to correct for errors, for delays in receiving information on events that occurred at month end, and to properly apportion costs like insurance that may cover more than one period. Entries covering events in the subsequent period are not recorded in the ledger until the accountants are confident the period end balances are correct and the books are reopened. In most cases, lean companies will only need to close their books when preparing external financial statements. Monthly closings will not be required for internal statements because the SOFP estimates and the actual unadjusted financial numbers will be sufficiently accurate for internal purposes. The simplified value stream organization and stable, reliable operating and accounting processes eliminate most of the errors that would make unadjusted results unreliable.

8. How can a company have valid month-end information before the end of the month?

Lean companies use the SOFP process for planning rather than to create pressure to achieve results. The SOFP numbers are realistic estimates of what will occur rather than wishful thinking. The budgets are updated monthly, so estimates for the following month are based on the most current information. With realistic estimates based on nearly current conditions, stable processes and reliable operational and daily financial information, month-end results can be projected in advance with a high level of accuracy.

9. Which is the more cost effective way to improve quality, inspecting quality in or prevention through process improvement (e.g., 5S, mistake-proofing, root-cause analysis, and continuous improvement of standard work)? Does your answer apply to accounting processes and services as well as production of products and other services?

Finding the root cause of errors and changing processes to prevent their re-occurrence is much more cost effective. This is true for support processes as well as for production processes.

10. What are the problems with conventional budget-based control?

The feedback loop is usually too long and measures are taken too infrequently. Using budget-based variance reports to drive operational control and improvement uses data days (if variances are reported weekly) or weeks (if variances are reported monthly) removed from the events that gave rise to the variances.

The focus is on optimizing individual or departmental performance rather than performance of the value stream.

Financial measures are outcome measures. Process improvement requires understanding root cause. Measures of the effects provide little insight into their cause.

11. What role should accountants play in achieving control once lean process controls are in place?

Lean accountants need to be involved in all aspects of lean accounting—costing, features and characteristics application, and target costing, and they need to be continuously evaluating the effectiveness of the cell and value stream measures and the SOFP process. Much of the need for accounting occurs at the value stream level rather than the division or corporate level.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 15: The Lean Enterprise

1. Which of the following is not a characteristic of a lean enterprise?
B) A command and control culture is adopted to enforce lean principles and methods.
2. Lean methods are tools, methods and procedures that ...
C) yield best results when an organization adopts a cooperative, continuous improvement culture.
3. Which of the following is an example of a lean method?
D) TPM (total productive maintenance).
4. Which of the following is an example of evidence suggesting lean culture is being established?
A) Managers staying with lean methods in the face of pressure to meet conventionally measured profit targets.
5. The main motivation for lean enterprises to establish partnerships is to ...
C) add value to end-use customers and reduce waste throughout the wider value stream.
6. Communications and transactions between customers and suppliers ...
B) are often the source of a duplication of efforts by the customer and supplier.
7. Macromapping is a tool used ...
D) to show the flow of the wider value stream across two or more organizations (for example, supplier and customer).
8. _____ is a method used by lean enterprises to understand customer value and ensure that products or services delivering that value can be produced and delivered at a reasonable cost.
A) target costing.

Discussion questions and problems

1. What does it mean to be a lean enterprise? What are the most important ways a lean enterprise differs from a conventionally managed enterprise and a company embarking on a lean transformation?
 - Lean enterprises use lean methods to execute and improve processes. They focus on creating customer values, eliminating waste, creating flow, and creating stable processes as the foundation for evidence-based systematic continuous improvement.
 - Lean enterprises have cooperative, continuous improvement cultures. Employees are respected and encouraged and empowered to make continuous improvements. Failure is accepted as an inevitable occasional outcome of continuous improvement efforts. The focus is on fixing and improving processes, not assigning blame. Problems are made visible, not hidden.

- The organization seeks cooperative, win-win, long-term relationships with customers, suppliers, partners, and investors, rather than seeking to maximize short-term profit from individual transactions.

Reasonable arguments can be made for the importance of a number of differences. The goal of the question is to encourage thought and discussion on the differences between lean enterprises and conventionally managed enterprises and to identify important differences, not to establish a definitive most important difference. Some possibilities are: continuous improvement versus meeting the budget; focus on process improvement and tolerance of experiments with failed results in the pursuit of continuous improvement versus emphasis on results; respect for people versus people as a cost to be minimized; emphasis on cooperative win-win relationships versus adversarial competitive relationships; focus on creating customer value versus focus on shareholder wealth maximization; focus on one piece flow versus batch production; focus on value stream system wide improvement versus local optimization; focus on teams versus focus on the individual.

2. Identify three characteristics of a lean culture and describe how they differ from the culture at conventionally managed companies.

Most of the differences mentioned in the response to question 2 above apply. Continuous improvement versus meeting the budget; focus on process improvement and tolerance of experiments with failed results in the pursuit of continuous improvement versus emphasis on results; respect for people versus people as a cost to be minimized; command and control versus employee empowerment; emphasis on cooperative win-win relationships versus adversarial competitive relationships; focus on creating customer value versus focus on shareholder wealth maximization; focus on value stream system wide improvement versus local optimization; focus on teams versus focus on the individual.

3. Give three examples of lean methods. Can an enterprise that does not have a lean culture implement lean methods?

Some examples of lean methods are: quick changeover, 5S workplace organization, production cells, shop floor supermarkets, kanban, TPM, single-piece flow, visual management, use of PCards, blanket purchase orders, target costing, and value stream costing. Many of these techniques can be implemented at companies without lean cultures.

Certainly most companies that embark on lean transformations transform methods before their culture has been transformed. Adopting lean methods is a necessary part of the process of transforming from conventional management to lean management. However, there are also many companies that adopt some lean methods with no understanding of lean as a management system and no intention of changing their culture. Many of these companies get improved performance using the lean methods, but the improvements tend to be isolated and improvements tend to be one-time rather than continuous.

4. Briefly describe the characteristics of a partnership a lean enterprise would have with its suppliers. Explain why a lean enterprise would partner with its suppliers. Isn't it better to encourage competition among suppliers?

Lean enterprises expand their view of the value stream to the macro level and work with their key suppliers to eliminate waste and share the benefits. There are generally great opportunities to eliminate waste from boundary spanning activities because most organizations are internally

focused and they pay very little attention to activity outside their organizational boundary. The ideal is a long-term sustainable relationship where the supplier provides perfect quality and delivery at a fair price (a price that may be continually reduced as waste is eliminated) with both supplier and buyer growing and prospering as they create more value for more customers. There may be some tension about the sharing of cost savings, but the lean enterprise wants its suppliers to be financially successful over the long term.

Competitive relationships may lead to lower invoice prices but higher transaction costs and other costs as each order must be negotiated after receiving and evaluating bids from several suppliers. Multiple suppliers introduce added record keeping and complexity, variability of quality (even if within tolerances) parameters, and generally, increased quality and delivery problems. Overall the total cost of ownership is likely to be higher in a competitive procurement environment than in one built on cooperative relationships with certified suppliers.

5. Why would suppliers agree to a partnership with a lean enterprise? What's in it for them?

Suppliers to lean enterprises have to deliver near perfect quality and 100% on-time delivery in the specified quantities. In addition they will be pressed to reduce cost. To meet these conditions profitably, the suppliers themselves must also become lean enterprise. What's in it for them is a long-term and very likely growing source of business and participation in shared efforts to reduce overall costs. They can devote more of their efforts to eliminating waste and creating value and less to submitting quotes and negotiating orders to replace existing business.

6. Are boundary-spanning transactions (transactions and interactions between organizations rather than within organizations) fertile ground for eliminating waste? If so, which organization will reap the benefit?

There are generally great opportunities to eliminate waste from boundary spanning activities because most organizations are internally focused and they pay very little attention to activity outside their organizational boundary. Improvement opportunities aren't seen until the activities are considered in the context of the macro value stream. It is important that both parties share the benefits of improvement. If either the supplier or the buyer takes all the benefit, the party that doesn't benefit will have less incentive share information and cooperate in continuing efforts to reduce waste.

7. If the lean enterprise is organized and managed by value streams, don't these value streams exist entirely within the organization?

The value stream for a product or service is generally defined as beginning with the materials that become part of the product and ending with the end use customer. The concept can be extended further to consider after purchase service to the end use customer, and ultimately, disposal and recycling of materials, a value loop rather than a value stream. Since so many value streams are interconnected it is usually almost impossible to consider the whole, but great benefits can be achieved by extending the view of the value stream outside the company to one or two enterprises upstream and or downstream. The extent of the macro level will depend on the complexity of the products or services and where and on what length of the value stream the company operates, but there will almost certainly be benefit to looking beyond the boundaries of the enterprise.

8. What are macromaps? Can macromaps be used to (a) eliminate waste, to (b) add value? Provide brief explanations or examples to support your answers.

Macromaps are value stream maps that depict the value stream process across more than one organization. As with value stream maps, macro maps help people understand the entire value creating process depicted as an interdependent system, and they help make waste visible. Macromaps are mostly used to eliminate waste but they can also be used to add value. eliminate waste and to add value. The cost reduction can come from elimination of duplication of efforts. For example supplier and buyer discover they both track shipments in transit. The unpacking and repacking of orders received that was mentioned in the chapter is another example. The value-adding comes from collaboration, as upstream participants apply their expertise to identify ways to create value for downstream enterprises beyond their immediate customer. For example, material supplier suggests a redesign of its part that will reduce the processing time for the customers of its immediate customer.

9. Briefly describe target costing.

Target costing begins with a thorough understanding of customer needs and the value (what the customer is willing to pay) of meeting those needs. A cross functional team then determines how to design and produce a product of service (or improve design and production of existing products or services) to deliver value at a cost that yields an acceptable profit and to drive continuous improvement.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 16: Target Costing

1. The purpose of target costing is ...
C) to make value created for the customer the driving force of the business.
2. In target costing, the selling price is based on ...
A) the value of the product or service to the customer.
3. In target costing, allowable cost is calculated by ...
B) deducting required profit (as determined by the company's business plan) from the selling price.
4. In target costing the cost gap is ...
D) the difference between the allowable cost per unit and the average value stream cost.
5. Target costing is used ...
D) with currently existing products and with new products.
6. The first phase (the first three steps) in the target costing process is designed to ...
B) understand the needs of the customers and match the needs to product features and characteristics.
7. What is the customer value weight measuring?
B) The importance of a feature in satisfying overall customer needs.
8. NeverPaint, a manufacturer of vinyl siding, identified seven customer needs. The needs were rated for their importance to the customer on a five-point scale (1 = low, 5 = high). The sum on the ratings for the seven customer needs was 25. One of the most important customer needs, durability, was rated 5 in importance. Features were given ratings of 1, 3, or 5 based on their importance (low moderate, or high) to satisfying a customer need. The "thickness" feature was rated highly important in providing durability, but it did not contribute to satisfying any of the other customer needs. The customer value weight for "thickness" would be ...
A) 0.2 [5 / 25]
9. The feature of a product that creates the most value for customers is ...
A) the feature that has the highest customer value weight ...
10. NeverPaint, a manufacturer of vinyl siding, rated customer needs on a five-point scale (1 = low, 5 = high) for their importance to the customer. Using the same scale, they also rated customer satisfaction with NeverPaint's current product, customer satisfaction with the best available product from competitors, and the perception among NeverPaint's managers of the importance of each customer need. Customers ranked resistance to fading a 4 in importance, a 2 in satisfaction with NeverPaint's siding and a 3 in satisfaction with the best product from competitors. NeverPaint's manager's rated resistance to fading a 3 in importance. Which of the following is a valid conclusion to draw from the ratings?
B) Customers are not very satisfied with the resistance to fading of NeverPaint's nor its competitors' siding, and NeverPaint trails its competitors in satisfying this need.

11. The second phase of the target costing process (steps 4 through 6) involves ...
C) specifying customer needs and determining the customer value of the product or service.
12. A company should determine the value of an improved product or service by ...
C) Finding the best alternative currently available in the market and adding (deducting) estimated value where the improved product will (will fail to) better satisfy customer needs.
13. The Customer Value for Business Processes Matrix (figure 16.9) shows ...
A) the significance of value stream business processes to the product features that produce customer value.
14. NeverPaint, a manufacturer of vinyl siding created a Customer Value for Business Processes Matrix (like the one in Figure 16.9). One process, Curing, was judged to have a high contribution (value weighting 5) to color quality but no impact on any other value creating product feature. The customer value rating (weight) for color was 16%. If the customer value apportioned to all NeverPaint's processes summed to 12, what is the equivalent percentage for the Curing process?
B) $6.67\% [(5 \times .16) / 12]$
15. The purpose of the third phase (steps 7 through 9) of the target costing process is to ...
B) calculate target costs for the product (or service) and for major components.
16. Andover Overhead Doors calculated an average customer value of \$2,200 for their security door line after they implement planned improvements. However, after consultation with their sales people and key customers, they've decided the selling price will need to be \$2,000. The current average cost in the Security Door Value Stream is 1,200 per door. If the required profit margin for the Security Door Value Stream is 48%, what is the target cost per security door?
C) $\$1,040 [2,000 - (.48 \times 2,000)]$
17. Required profit margins and target costs for the product or service should be based on ...
B) the overall revenue and cost impact of the product on the value stream.
18. Andover Overhead Doors calculated an average customer value of \$2,200 for their security door line after they implement planned improvements. However, after consultation with their sales people and key customers, they've decided the selling price will need to be \$2,000. The current average cost in the Security Door Value Stream is 1,200 per door. If the required profit margin for the Security Door Value Stream is 48%, what is the average cost gap per security door?
C) \$160
19. The purpose of the fourth phase (steps 10 through 12) of the target costing process is to ...
A) develop a value-to-cost strategy and product and process improvement targets.
20. Andover Overhead Doors examined their process costs along with their Customer Value for Process Cost Matrix and identified high cost processes that were adding very little customer value. If Andover applies the generic cost-value strategies, they would ...
B) eliminate the features and the related process steps that make the process costly.

21. Olde English Kitchenware has a Pots and Kettles Value Stream. The Pots and Kettles Value Stream is trying to reduce the cost gap for a tea kettle. An improvement in a ceramic coating process is expected to reduce the overall process cost in the value stream by \$80,000. Apportioning the cost savings among all the products in the value stream, \$10,000 of the ceramic process savings would apply to the tea kettle. How much of the cost savings should be counted toward closing the cost gap and meeting the target cost for the tea kettle?
- D) \$80,000, the overall value stream savings helps meet the target return for the value stream.

Discussion Questions and Problems

1. What is the purpose of target costing? How does target costing relate to lean management?

The purpose of target costing is to drive the enterprise from the value created for the customer. Target costing begins with a thorough understanding of customer needs, so the focus is on the customer rather than the product, or profits. Customer value and value creation is the first principle of lean thinking.

2. Could a conventionally managed company use target costing?

Yes. Target costing is an example of a lean tool that has been adopted by some conventional companies as well as lean companies. At conventional companies it is typically used to streamline and improve the effectiveness of new product introduction and product re-design. The process at a conventional company will differ from the process described in this book because most conventional companies have not identified value streams. They will use cross-functional teams, assess the contribution to value creation of product features, and assess the importance of processes and product components in delivering those value-adding features. The cost targets are likely to be developed on an individual product basis and will focus on materials, direct labor, and most likely overhead costs based on some allocation.

3. Explain why the initial design stage for a product or service is the ideal starting point for target costing.

Decisions made at the design stage limit the feasible set of production processes. It's estimated that 80-90% of the downstream production and service costs are locked in by decisions at the design stage, and production and process improvements short of product redesign can reduce costs by 10-20% at best. Improving process efficiency can have limited impact if a product is designed that is difficult to produce and filled with costly features that are of little value to most customers. Target costing, is in effect, a means of preventing waste from occurring in the first place rather than waiting to discover it and eliminate it after the design is completed and production begins.

4. How can target costing be the principal driver of value stream improvement? Think about what you have learned about lean management. How else might value stream improvement be driven? What usually drives improvement at conventionally managed companies?

Target costing requires a cross-functional focus on customer value so it is an excellent vehicle for improving value creation and waste elimination from a total value stream perspective. Value stream improvement can also be driven by value stream mapping and by identifying obstacles to flow and costly non-value-adding support processes. In the early stages of a lean

transformation there is a lot of “low hanging fruit” and clearly wasteful practices to be eliminated or reduced. The gains may seem so large it is hard to imagine these as “only” marginal improvements of existing products and processes with limited flexibility for change because they were locked-in using a design process with marketing, product design, process design, and production largely working in isolation; and with insufficient understanding of and regard for customer value.

At conventionally managed companies, improvement efforts typically focus on reducing direct labor per unit, reducing material cost per unit, increasing direct labor and machine utilization, and maximizing gross profit margin by emphasizing sales of high margin products. Pressure may be created to reduce overall costs or overhead costs by imposing across the board reduction targets. Customer value is rarely directly addressed. Marketing may assess customer satisfaction but these results are not typically integrated with establishing improvement plans and targets in production.

5. Many internet-based companies offer information or services to users free of charge. How do they make money? Who are their customers?

Most commercially successful internet companies that offer “free” services are actually either offering other commercial enterprises access to the users of the free services in the form of ads or links they might be interested in, or they are getting a segment of the users of free services to pay for premium services. In the former case, a major feature of the service they offer to their “real” customers, the commercial enterprises, is a free service that satisfies the actual and prospective customers of the commercial enterprises.

6. Therma-Clear, makes windows for residential construction. Their Custom Value Stream focuses on providing windows for custom home construction and major renovations. Therma-Clear windows may be recommended by architects designing the houses, or by the general contractor. The homeowner has the final decision, but often the homeowner relies on the recommendation of the architect or contractor. The general contractor installs the windows or hires a subcontractor to do the installation. Who should Therma Clear’s Custom Value Stream regard as their customer?

Certainly Therma-Clear will have to consider the end use customer, the homeowner. They should also either also consider the architects and general contractors customers or treat them as business partners in the macro value stream that provides value to the homeowners.

7. Describe basic features, performance features, and excitement features, and explain how they relate to customer needs and customer value.
 - Basic features are minimum requirements to be in the market. Adding more or enhancing the feature doesn’t add value but if the product or service is missing these features customers will not consider this a comparable product or service.
 - Performance features are satisfying expressed customer needs and desires. Enhancing these features increase value to the customer, reducing these features reduces the value to the customer.
 - Excitement features satisfy latent customer needs. Their presence can greatly enhance customer value. Their absence does not reduce value because the customer in essence, doesn’t know what they are missing

8. What is the purpose of a Customer Needs – Product Features matrix such as the one presented in Figure 16.4? What does customer value weight measure?

The Customer Needs – Product Features matrix maps the customer needs into the product features that play a role in satisfying those needs. The customer value weight measure is a subjective measure of the relative importance of each feature's contribution to overall customer value based on the number of needs each feature has a role in satisfying, the strength of the associations between the features and the needs, and the importance of these needs to the customer.

9. Based on the Customer Needs – Product Features matrix in Figure 16.4, which of the following two features is feature is more important in creating value for the customer, the “rechargeable battery and power supply” feature or the “component density” feature? Briefly explain your answer.

The component density has a customer value weight of 5.6%, while the rechargeable battery and power supply has a customer value weight of 4.5%. The weightings suggest the component density is a slightly more important contributor to overall customer value. They are each strongly associated with one customer need but small size, the need customer density satisfies is more important to the customer than rechargeable battery. The rechargeable battery also has a small contribution to ease of use, but not enough in this weighting scheme to overcome the difference in importance between small size and rechargeable battery.

10. Refer to the customer satisfaction diagram (figure 16.5). On which need(s) did ECI most underestimate the importance to the customer? On which need(s) did ECI most overestimate the importance to the customer? Where does ECI's failure to understand customer needs appear to have the greatest impact? Briefly explain your answer.

ECI most underestimated the importance of small size (3 vs. 5), ease of use (3 vs. 5), and short lead time (2 vs. 4). ECI overestimated the need for flexibility 5 vs. 4). A number of reasonable arguments for greatest impact are possible. One view is the failure to understand the importance customers place on small size has the greatest impact because competitors are far ahead of ECI at satisfying this need (see the customer satisfaction and competitor ratings on small size).

11. Refer to the customer satisfaction diagram (figure 16.5). On which need(s) does ECI currently have the greatest competitive advantage? On which need(s) does ECI have the greatest competitive disadvantage? On what customer need is improvement most critical for ECI? Overall, who is currently providing greater customer satisfaction, ECI or the competition? Briefly explain your answer.

ECI's biggest competitive advantage is the rechargeable battery (5 vs. 1). ECI is at a competitive disadvantage in satisfying two needs: ease of installation (2 vs. 5) and small size (3 vs. 5). One way to make an overall comparison is to weight the customer ratings for satisfaction with ECI and its competitor by the customer importance for each need. On this basis, ECI edges out its competitor 90 – 88. Given the subjective nature of the measures, the difference is probably insignificant.

12. What is the distinction between understanding customer needs, the first phase of target costing, and specifying customer needs, occurring in step 4?

Customer needs must be specified and quantified in terms of performance that can be delivered by product or service features. Customers want their coffee hot. How hot should coffee be to satisfy that need? 40° Celsius (104°F)? 50° Celsius (122°F)? 60° Celsius (140° F)? The need must be translated into performance specifications to be delivered.

13. Therma-Clear is doing a target cost analysis for a picture window it has been selling for \$550. Its toughest competitor offers a similar window for \$500. Therma-Clear plans improvement to its window that will match the competitor's ability to satisfy customer needs in every respect. In addition, the Therma-Clear window will have a higher R-Value than the competitor's window. Therma-Clear estimates the net present value of the energy savings to the customer over the life of their window (25 years) is \$150. What is the customer value of the new window? Do you think Therma-Clear's selling price for the new window will be equal to the customer value you calculated? Briefly explain your answer.

The customer value would be $\$500 + \$150 = \$650$. The valuation seems reasonable but the value of the higher R factor could obviously vary depending on estimates of the appropriate discount rate and expectations about fuel prices. Customers, even if they accept those estimates, and the 25 year life, may be unwilling to finance the 25 year payback, because they believe they won't be in the house that long and won't get the added value in a higher sales price, or because they are unwilling or unable to pay that much up front for future savings. Other customers may be willing to pay more for the satisfaction of being green and reducing their carbon footprint. The higher R-Value could also reduce drafts by the window, making the house more comfortable. Therma-Clear needs to price so that its target market perceives the product as a good value, but willingness and ability to pay also factor into the decision.

14. Refer to the Customer Value for Business Processes matrix (figure 16.9). What does the equivalent percentage represent? Which value stream process contributes most and which contributes least to creating customer value?

The equivalent percentage is a subjective estimate of the proportion of customer value created by business processes based on their role in delivering the product features important to satisfying customer needs. In the Customer Value for Business Processes matrix in figure 16.9, design engineering contributes the most value (21.4%) and accounting contributes the least value (0%).

15. Therma-Clear has decided that the selling price for its new high R-Value picture windows should be \$600. The value stream's required profit margin is 54%. They expect to sell 120 windows per month at the \$600 selling price. The value stream will have \$21,600 per month in material costs and \$18,800 in conversion costs. Compute the target cost per window, the monthly cost gap, and the current average cost per window.

Target cost = $72,000 \times (1 - .54) = 33,120$ value stream / 120 = \$276.00 per window.

Current cost = $21,600 + 18,800 = 40,400$ value stream / 120 = \$336.67 per window.

Monthly cost gap = $40,400 - 33,120 = 7,280$ value stream / 120 = \$60.67 per window.

16. Therma-Clear examined their process costs along with their Customer Value for Process Cost Matrix and identified high cost processes that were adding very little customer value. Can they simply eliminate the low value high cost features produced by these processes?

No. Basic features will appear as low value features and these must be provided. Therma-Clear will need to find lower cost ways to provide the features if they are basic features. They can consider reducing or eliminating some performance features that are low value/high cost, and they can eliminate high cost excitement features that are not creating much excitement.

17. When a product is produced in a value stream along with several other products, how should target costs and cost gaps be computed?

The cost gap should be computed for the entire value stream and the cost gap per unit should be based on the average product cost in the value stream. Performance is managed by value stream and we want to improve value stream performance and value stream return rather than focusing on the performance of individual products. Process improvements will affect many products in the value stream.

18. Target Costing at XYZ Industries

Required:

- A. Who are the customers of the HC-OEM Value Stream of XYZ Industries? Is the value stream task force talking to the right people?

The HC-OEM value stream considers the OEMs their customers and they are talking to a cross-functional group of people at key customers. They appear to be talking to the right people. The HC-OEM value stream team could adopt a macro value stream perspective and also talk to the customers of the OEMs. This could help them generate ideas for excitement features or less costly ways to deliver performance features.

- B. Following Figure 16-4, create a table matching the HC-OEM Value Stream's customer needs to product and process features and compute a customer value weight for each product and process feature. Which product or process feature creates the most value for customers?

Customer Needs	Importance to customer	Product & Process Features											
		Machining		Threading		SPC		Inspection		Pull system		Delivery schedule	
Precise machining	4	●	1.05	●	1.05	▲	0.63	■	0.21				
Perfect quality	4	▲	0.63	●	1.05	●	1.05	▲	0.63				
Low price	5					■	0.26			●	1.32		
Short lead times & flexibility	3					▲	0.47			●	0.79	●	0.79
Reliable delivery	3					■	0.16			●	0.79	●	0.79
Total of importance	19												
Specifications		1.68		2.11		2.58		0.84		2.89		1.58	
Customer value weight		14.4%		18.0%		22.1%		7.2%		24.8%		13.5%	
Legend: High correlation = ● Medium correlation = ▲ Low correlation = ■													

The Pull system (24.8%) and SPC (22.1%) contribute the most to creating value.

- C. Create a customer satisfaction diagram for the HC-OEM Value Stream similar to the one shown in Figure 16-5. How did the perception of the importance of customer needs held by members of the HC-OEM Value Stream team differ from those expressed by OEM representatives? What are the HC-OEM Value Stream's greatest strengths and weaknesses in providing customer satisfaction? What are the HC-OEM Value Stream's greatest competitive advantages and disadvantages?

Customer Needs	Importance to customer as perceived by XYZ				Importance to customer				Performance ratings by customers											
									XYZ Industries				Competitor A				Competitor B			
Precise machining				5				4				4			3					5
Perfect quality				5				4				4			3				3	
Low price			3					5			3				5					4
Short lead times & flexibility	2						3			2				1				2		
Reliable delivery				4			3				4			2					3	

Compared to the actual importance expressed by the customer, the HC-OEM value stream members believed precise machining, perfect quality, and reliable delivery were more important, short lead times and flexibility less important, and low price considerably less important. Customers want precise machining and perfect quality, but they place highest importance on low price. The HC-OEM value stream team thought precise machining and perfect quality were valued most highly and that low price was only moderately important.

In actual performance, the HC-OEM value stream has a 4-3 advantage over both competitor A and B on perfect quality, and 4 -2 and 4-3 advantage over competitors A and B respectively, on reliable delivery. Their greatest weakness is price, where they trail competitor A 5-3 and competitor B 4-3. They also trail competitor B on precise machining 5-4.

- D. Consider the calculation of customer value summarized in Table 4. If the HC-OEM Value Stream task force has calculated the value of their hydraulic connectors to be \$63.20 after planned improvements, why aren't they planning to charge \$63.20? Does this mean the calculation is wrong? What is the most significant change the HC-OEM Value Stream is planning to make from a value perspective? What implication does your answer have for the improvements the HC-OEM Values Stream will need to make to meet its target cost?

Although customers value the other performance attributes, price is most important. The HC-OEM value stream could have chosen to offer slightly lower performance and meet the \$59.00 price with a product valued at \$59.00. The HC-OEM value stream wants to meet the customers' price point with a higher value product. They want to meet the price point and be seen as offering great value. They want to exceed their competitors in overall value.

The most significant change is price reduction. Although they are planning to enhance precision and quality and reduce lead times, the HC-OEM value stream team needs to focus more on waste reduction while maintaining value than on enhancing value.

- E. Using a value weighting of 5 for high association, 3 for medium association, and 1 for low association in Table 5, determine the customer value apportioned to each process and express the value as a percentage of overall value, following Figure 16.9. Which process contributes most to creating value? Leaving management aside, which process contributes least to creating value?

As shown below, Engineering (33.2%) contributes the most and Inspect & Pack (4%) contributes the least to creating customer value.

Product and Process Features	Processes and Cells									
	Customer value weighting	Machining	Threading	SPC	Inspect & pack	Shipping	Customer service	Maintenance	Engineering	Management
Machining	14.4%	● 0.72							■ 0.14	
Threading	18.0%		● 0.90						▲ 0.54	
SPC	22.1%			● 1.11				■ 0.22	▲ 0.66	
Inspection	7.2%				● 0.36					
Pull system	24.8%						● 1.24		● 1.24	
Delivery schedule	13.5%					■ 0.14	● 0.68	● 0.68	▲ 0.41	
Customer value apportioned to process		0.72	0.90	1.11	0.36	0.14	1.92	0.90	2.99	-
Equivalent percentage		8.0%	10.0%	12.2%	4.0%	1.5%	21.2%	9.9%	33.2%	0.0%
Legend: High association = ● Medium association = ▲ Low association = ■										

- F) Complete the financial section of the HC-OEM box score for the current state (22,500 connectors at \$61.60) using the cost information provided in Table 6 and the above narrative. Compute the cost gap in total and on a per unit basis if HC-OEM reduces the price to \$59.00 and the sales volume remains at 22,500 per month.

	Current State	Target	Cost Gap	Notes
Units	22,500	22,500		
Price	61.60	59.00		
Revenue	<u>1,386,000</u>	<u>1,327,500</u>		
Material cost	522,675			496,350 + 26,325
Conversion cost	<u>464,066</u>			182,520 + 261,791 + 15,583 + 4,172
Total cost	986,741	862,875	123,866	Target total cost calculated to yield 35% VS-ROS
Value stream profit	<u>399,259</u>	<u>464,625</u>		
VS-ROS	<u>28.81%</u>	<u>35.00%</u>		
Average cost per unit	43.86	38.35	5.51	

- G. Use the information from table 6 and the table you created in requirement E to perform a cost value analysis on the processes. Which processes are high value, low cost, and which are low value high cost? Use your analysis to suggest general improvement strategies for two processes.

High cost processes are Machining (38.3%), Threading (29.9%), and Maintenance (11.8%). Customer Service (6.3%) could be classified either way. High Value processes are Engineering (33.2%), Customer Service (21.2%), and Statistical Process Control (12.2%). Threading (10%, Maintenance (9.9%) and Machining (8%) are borderline and could be classified either way.

Engineering, Statistical Process Control, and Customer Service are clearly low cost high value processes. The generic strategy is to enhance these processes to pre-empt competition. With the cost reduction focus in the HC-OEM value stream, they want to avoid making cuts here and use these processes, particularly Engineering and Statistical Process Control, to drive waste elimination in other processes.

The HC-OEM Value Stream at XYZ does not have any processes that are unambiguously high cost and low value. Machining, Threading, and Maintenance are high cost and could be considered low value if you force the cut point in the high low designation. Machining has the highest ratio of cost percentage to value percentage (other than Management with 0 value), but Machining and Threading are instrumental in providing basic features. Being high cost, however, these processes are prime targets for cost reduction via elimination of waste.

H. Complete the financial section of the HC-OEM box score for the future state assuming the following results from the planned kaizens:

- Unit sales have increased 10 percent due to the lower price and improved quality.
- Material costs in machining have been reduced from \$22.06 per connector to \$21.56 by reducing waste.
- Material costs in Inspect & Pack have been reduced from \$1.17 to \$.75 per connector.
- Sufficient excess capacity was created in Machining, Threading, Inspect & Pack, and Shipping to handle the increased volume without added resources. Labor costs were reduced by \$3,510 each in Threading, Inspect & Pack, and Shipping by redeploying people to other value streams.
- Overall machine costs were reduced by \$4,480 in Machining and \$2,240 in Threading despite the increase in volume.

If the 35% return on sales target is not satisfied, compute the future state cost gap in total and on a per unit basis. Where would you look for additional improvements to close the cost gap?

	Current State	Future State	Target	Cost Gap	Future state calculation Notes
Units	22,500	24,500	24,500		
Price	61.60	59.00	59.00		
Revenue	<u>1,386,000</u>	<u>1,445,500</u>	<u>1,445,500</u>		
Material cost	522,675	546,595			24,500 × (21.56 + .75)
Conversion cost	464,066	446,816			Current state less (3 × 3,510), 4,480 & 2,240
Total cost	<u>986,741</u>	<u>993,411</u>	<u>939,575</u>	53,836	
Value stream profit	399,259	452,089	505,925		
VS-ROS	<u>28.81%</u>	<u>31.28%</u>	<u>35.00%</u>		
Average cost per unit	43.86	40.55	38.35	2.20	

The HC-OEM value stream has not reached its target profit, but it should be noted that a 35% return on the current state sales volume would be \$485,100, so 20,825 of the cost gap represents added return requiring no additional investment. That said, the HC-OEM value stream needs to continue to aggressively eliminate waste and create capacity for further sales growth without adding additional resources.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 17: Expanding Value Streams Outside Our Four Walls

1. Which of the following is not a principle of lean thinking?
C) Waste – non value-adding work should be eliminated immediately.
2. Which of the following is the best definition of the term value stream?
D) The set of all activities required to design, produce, and deliver a finished product or service to an end use customer.
3. For companies that sell to other companies (business-to-business) the prime point of contact is usually ...
A) the sales department in contact with the customers' purchasing department.
4. How should a lean company manage information flow between its suppliers and customers?
B) They should integrate information systems with their customers and suppliers or create networks of relationships throughout their organization.
5. Which of the following is an advantage that can be obtained through collaboration with suppliers and customers?
A) Duplication of efforts such as order and payment processing by customer and supplier can be reduced or eliminated.
6. Eight percent of the overall value of Therma-Clear's high R Value windows is attributed to the assembly process, ranking it fifth highest of 12 business processes at Therma-Clear. Assembly uses ten percent of the overall conversion costs, the fourth highest percentage of 12 business processes at Therma-Clear. What is the value-cost ratio for the Assembly process?
A) 80%
7. Eight percent of the overall value of Therma-Clear's high R Value windows is attributed to the assembly process, ranking it fifth highest of 12 business processes at Therma-Clear. Assembly uses ten percent of the overall conversion costs, the fourth highest percentage of 12 business processes at Therma-Clear. How would Therma-Clear's assembly classified?
B) High cost, low value.
8. _____ processes can be considered a core competence if the proportion of value created exceeds the cost, but otherwise the process could be considered for outsourcing.
D) Low, cost, low value
9. _____ processes should be eliminated if possible, or considered for outsourcing.
B) High cost, low value
10. Beneficial collaborations between a supplier and a customer ...
D) can be initiated by either the customer or the supplier.

Discussion questions and problems

1. You are at a busy airport walking to the gate for your connecting flight. You know meals will not be served on your next flight. You see a McDonalds with only a couple of customers in line at the register and decide to stop and get a large order of French fries to tide you over. Taking a broad perspective, describe the French Fries value stream.

Oil companies produce petro chemicals, shipping them to chemical companies that produce pesticides and fertilizer. The fertilizer and pesticides are shipped to potato farmers. The farmers ship potatoes to processing plants that produce French fries. The French Fries to a distribution center, and then to the McDonalds outlet where they are deep-fried and sold to the consumer.

2. Enormous Motors Corporation (EMC) has embarked on a lean transformation in hopes of competing more effectively with Toyota and other automobile companies. They used to carry 60 days inventory of most parts and they received weekly or monthly shipments from suppliers. Now they demand daily shipments from suppliers like Flint Fuel Systems. EMC's inventory turns have improved dramatically, and their dock-to-dock times have improved. Flint Fuel Systems, like most EMC suppliers, is a conventionally managed company. To satisfy EMC, their biggest customer by far, they try to keep 90 days inventory of all the components they produce for EMC avoid stock-outs. Has EMC's lean transformation eliminated waste in the value stream?

EMC's lean transformation has probably not eliminated waste in the overall value stream. The delays, excess inventory and other waste have been pushed upstream to their suppliers.

3. Hinckley Hinges makes decorative hardware that it sells to hardware and home improvement stores. Hinckley's customers wanted the products to be easy to unpack and display on store shelves. Listening to their customers, Hinckley ships their hardware in blister packs that protect the hardware and can be easily slid onto display hangers. This has reduced stocking time and inventory damage experienced by its customers. Homeowners buying Hinckley hardware have great difficulty opening the blister packs. They sometimes scratch or mar the hardware or cut the installation instruction sheet opening the blister pack. The blister pack material is a plastic that is not accepted for recycling by most communities. Has Hinckley's packaging added value?

From the overall value stream perspective, Hinckley Hinges probably has not added value. It's possible the savings for the Hardware stores exceed the costs imposed on the end users of the hardware and the community (dealing with non-recyclable plastic, but the reverse may be true.

4. Has Hinckley's packaging eliminated waste in the value stream?

Hinckley's packaging has probably not eliminated waste in the value stream. It's not clear how much waste has been saved from reducing the hardware damaged in transit. The product damaged when end use customers struggle with the packaging may also end up in the waste stream, or it may just be less pleasing in use. The amount of packaging in the waste stream probably has not decreased and it may have increased. Regardless of volume, the packaging is difficult waste material to deal with.

5. Which is the more effective way to efficiently deliver value to the end-use customer, collaborative relationships with customers and suppliers or arms length relationships governed by market forces?

We cannot say that one course is always superior to the other. The dominant school of thought in business in recent years is that market forces will always push self-interested individuals to optimal results. John Nash (the mathematician whose life was dramatized in the movie “A Beautiful Mind”) proved that cooperation could produce results superior to those achievable by parties competing and acting independently in their self-interest. Cooperation may be more difficult to achieve, but if companies operating along the same value stream adopt a lean perspective cooperation can yield superior results. Note that we are referring to companies operating in different parts of the value stream in supplier customer relationships. We are not referring to collusion among suppliers operating at the same stage of the value stream.

6. Consider the Customer Service process in Table 17.1 and Figure 17.5. What would you recommend ECI do: (1) continue to provide customer service, but improve it, (2) have a customer or supplier perform most or all of the customer service activity, (3) outsource customer service (to a company other than their customers and suppliers)? Does your answer change if it costs more to outsource than it currently costs ECI to perform customer service in house?

A case can be made for any of these alternatives. Customer service is classified as a low value, low cost process with a value-cost ratio below one. The generic strategy suggests would make Customer Service a candidate for outsourcing (either to a supplier or customer in the value stream, or to a third party customer service specialist). However, if the outsourcing cost is greater, ECI has a comparative advantage providing the service in house despite the ranking.

The arguments for keeping customer service in house are that it provides closer interaction with customers regarding their problems (a valuable source of information for continuous improvement) and the process can be improved, possibly to the point where it becomes a core competence and a service that could be provided for other partners in the value stream. The counter arguments are that information and external customer service provider can provide information on customer complaints and problems, and that ECI is currently a long way from making Customer Service a core competence.

It's important to remember that the conversion cost percentages and equivalent value percentages are subjective estimates. They should be used to organize thinking and suggest possibilities, not as the primary basis for decisions.

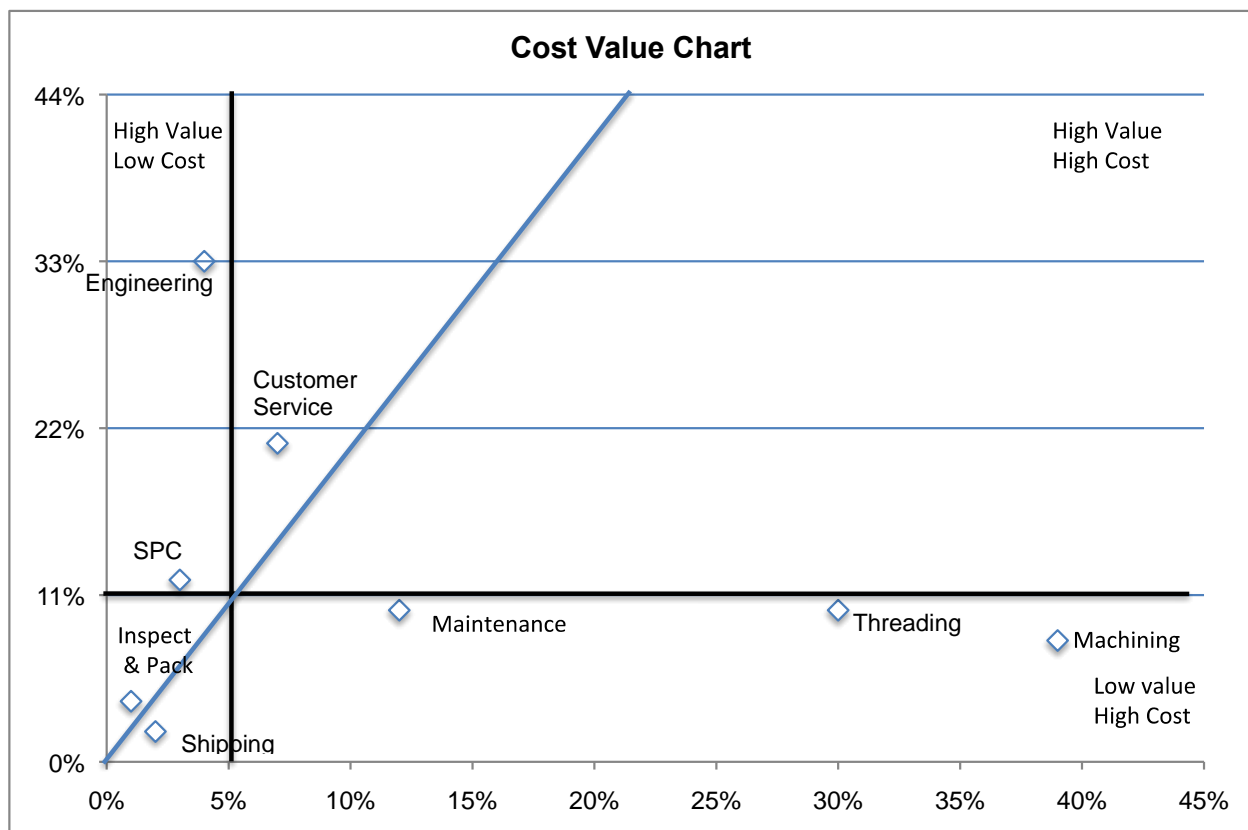
7. Why do you think Superior Meter Company was able to successfully collaborate with Automobile Interiors Company? What factor or factors were key to the success?

Some possibilities: Superior had a pressing need to use the surplus capacity it had created. Automobile Interiors was open to explore the possibility of change for the better. Automobile Interiors did not feel threatened by Superior Meter. Jointly they were able to propose a change that solved problems (eliminating frequent rework and scrap) as well as saving costs. They agreed to an equitable sharing of the savings.

8. The following table lists the percentage of conversion costs and the percentage of total value associated with each process in a future state for the HC-OEM Value Stream of XYZ Industries (see the Chapter 16 problem 17 for more details). The HC-OEM Value Stream produces hydraulic connectors for original equipment manufacturers of pump and filtration systems.

Business Process	Percentage of Conversion Cost	Percentage of Total Value
Machining	39%	8%
Threading	30%	10%
SPC	3%	12%
Inspect & Pack	1%	4%
Shipping	2%	2%
Customer Service	7%	21%
Maintenance	12%	10%
Engineering	4%	33%

Map the processes on a cost value matrix as in figure 17.5. Which processes represent strengths to build on? Which processes should be explored for customer supplier collaboration?



Engineering, SPC and Customer Service are strengths to build on.

The basic framework for the Cost – Value matrix suggests Inspect & Pack, and as borderline cases possibly Maintenance, Threading, and Machining as possibilities for customer/supplier

collaboration. Inspect and Pack would lend itself to possible collaboration with customers. HC-OEM value stream could possibly collaborate with suppliers on Machining and Threading to acquire more advanced material requiring fewer value stream resources in Machining and Threading. Collaboration on maintenance is a more difficult case to make.

PRACTICAL LEAN ACCOUNTING

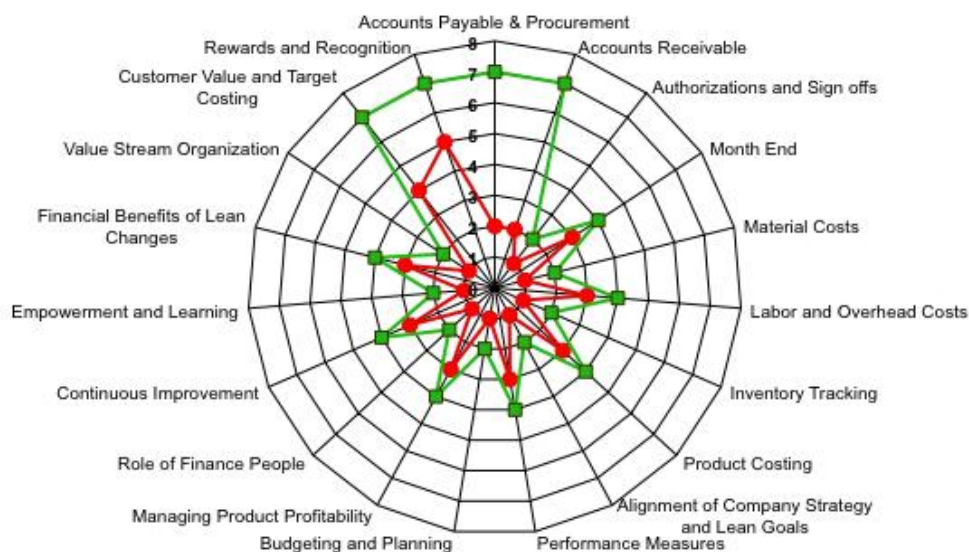
SUGGESTED SOLUTIONS

Chapter 18: The Lean Accounting Diagnostic

1. Which of the following is **not** an accounting change that can be implemented during the Piloting Lean Cells stage.
C) Link value stream cost analysis to sales and operations planning.
2. Which of the following is **not** an accounting change that is typically implemented during the Managing by Value Stream stage.
A) Extend value stream analysis outside the company to suppliers, customers, and partners.
3. The use of target costing is associated with the _____ phase.
D) Lean Enterprise
4. The lean accounting diagnostic tool is used to ...
B) Assess the current state of lean accounting at a company, and provide a basis for developing an action plan to reach the desired future state.
5. The lean accounting diagnostic has nineteen assessments grouped in five diagnostic areas. A move from multiple entries for labor and materials for tracking and costing work-in-process to visual controls would show progress in the _____ diagnostic area.
B) operational accounting

Use the following chart to respond to questions 6 and 7

Lean Accounting Diagnostic



6. The interior area on the chart outlined by the points marked by circles represents ...
A) the current state of lean accounting at the company
7. The scores on some assessments (for example, customer value and target costing, and rewards and recognition are much higher than on others. For the current state, the higher scores mean that ...
B) the company currently has a higher level of lean accounting maturity in these areas.

Discussion questions and problems

1. What is the purpose of the lean accounting diagnostic?

The lean accounting diagnostic is a tool used to assess the current state of lean accounting in an organization and to provide guidance and a framework for developing an action plan to reach a desired future state of accounting maturity.

2. How does the lean accounting maturity path relate to the lean accounting diagnostic?

The lean accounting maturity path identifies and describes three basic stages of maturity as a lean enterprise. It also identifies and describes accounting changes that can occur at each stage of maturity because operational changes make new accounting procedures possible, and changes that should take place to avoid stalling the lean transformation and to encourage further improvement.

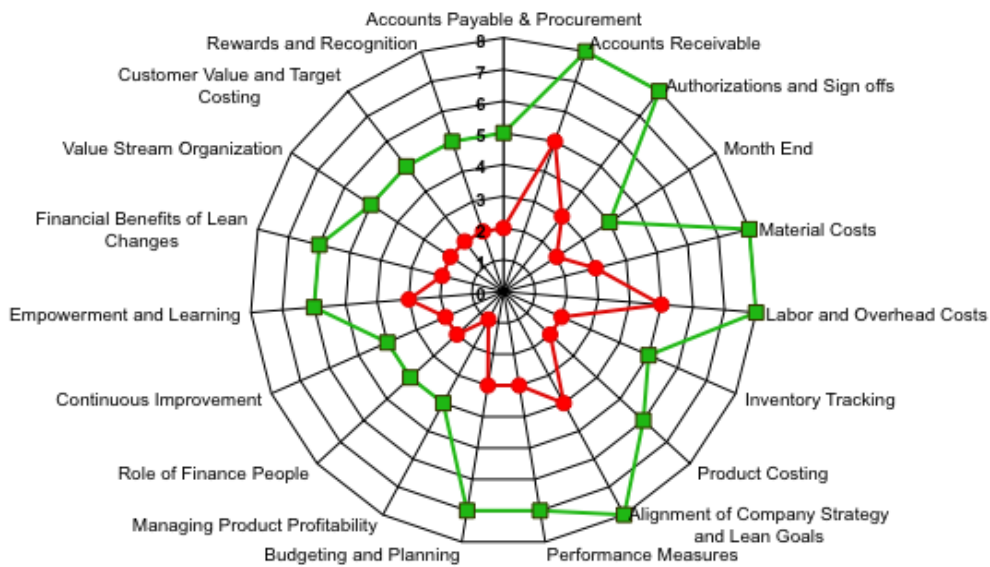
The lean accounting diagnostic adds a pre-lean “traditional” stage for lean accounting and provides two descriptions (beginning and advanced) for each stage or level on 19 dimensions of accounting in five diagnostic areas. These descriptions help the accountants and managers better assess the current state of accounting, which can then be compared to the current state of maturity of the lean enterprise. The diagnostic also helps accountants and managers identify a desired future state for lean accounting and better visualize what that future state will look like and what needs to be done to get there.

In short the lean accounting diagnostic provides a rich detailed description of each stage of accounting maturity to help accountants and managers better assess their current state and identify and specify a desired future state.

3. Name the five lean accounting diagnostic areas and describe in general terms the shift from traditional accounting to mature lean accounting in each diagnostic area.
 - Financial Accounting—shifting from transaction-oriented processes with considerable auditing control, to processes with few transactions and process control.
 - Operational Accounting—shifting from tracking labor and materials through the production process to reliance on visual controls, low and level inventories, and short lead times.
 - Management Accounting—shifting from a historical/results-based orientation, to a process focus using causal-based operating measures, shifting from departmental to value stream organization and reporting structure, and from cost-based to value-based orientation.
 - Support for the Lean Transformation—shifting the financial professionals and financial reports from a results orientation to integral supporters of the lean effort – guiding improvement initiatives, disclosing existing waste and the benefits of lean, and providing real-time, actionable information.

- Lean Business Management—shifting from a functional organization to a value stream organization, and an approach to decision making that measures the contribution to customer value as the primary criteria.

Lean Accounting Diagnostic



4. The above diagnostic was completed by a division of a Fortune 1000 corporation. Required:
- On which area or areas and on which specific assessments does the division currently have the highest level of maturity?

The highest specific assessments are on accounts receivable and labor and overhead costs where the assessment indicates their maturity is equivalent to the beginning of the managing by value streams stage.

They are most advanced on the financial and operational accounting areas, averaging level 3, equivalent to the beginning of the pilot stage.

- On which area or areas and on which specific assessments does the division currently have the lowest level of maturity?

They are least advanced on business management. They have made some improvements in traditional practices but they remain very much a functional organization with traditional measures supporting decision making.

Their lowest score specific assessment is on managing product profitability in the management accounting area. There they retain a traditional approach, but otherwise they

have made more progress in the management accounting area than in the business management area.

- C. On which area or areas and on which specific assessments does the division want to make the greatest progress in the immediate future?

The company has laid out an ambitious agenda. They want to move up almost 4 levels on average in each specific assessment dimension in Operational and Management Accounting. The two biggest leaps planned are in authorizations and sign-offs and in material costs, hoping to move up five levels to a fully mature lean enterprise level on the specific dimensions.

Development plans are slowest in the areas of support for the lean transformation and business management. Perhaps the division feels they have less autonomy from corporate in these areas and that the transition at corporate will be proceeding more slowly.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 19: Performance Measurement Linkage Chart

1. Critical success factors are ...
C) drivers, factors that will enable strategic goals to be achieved.
2. Performance measures are needed for ...
B) critical success factors and strategic goals for the overall company, the value streams, and production cells.
3. What determines the frequency with which measures should be gathered and reported?
D) The speed of change, how rapid the response must be, and the time required for change to appear in performance for the system or activity being measured. Measurement frequency can vary from almost instantly to weekly or even monthly.
4. What determines the type of control that should be used on the processes being measured?
D) The nature of the process (manual or automated), the speed of change, how rapid the response must be, and the time required for change to appear in performance for the system or activity being measured.
5. To be effective, lean performance measures should be focused on ...
B) understanding root causes and performance improvement to meet future goals.
6. The process of developing performance measures should begin with ...
A) the company's strategy.

Discussion questions and problems

1. What are critical success factors?

Critical success factors are the drivers of performance – the activities, decisions, and conditions that will be needed to achieve outcomes established in the goals.

2. What should lean organizations measure, results, processes or both?

Lean organizations should measure results and processes. Process measures are used to reveal problems so that root causes can be discovered and corrective action can be taken. Results measuring goals important to the organization should also be measured to see if goals are achieved and to check whether or not the expected relationships between drivers and results are realized. This is the “check” in the PDCA cycle.

3. What determines how often measurements must be made and reported?

Measurement frequency is determined by the speed of change, how rapid the response must be, and the time required for change to appear in performance for the system or activity being measured. The measurement and reporting frequency must be short enough to allow timely response and adjustment, but long enough to distinguish systemic variation from random variation. Measurement frequency can vary from almost instantly to weekly or even monthly.

4. What is the focus of lean performance measurement and how does that focus differ from traditional financial reporting?

Traditional management emphasizes results. Financial targets are established, and the means and process by which the targets are achieved is left to the managers. If target performance is not achieved, causes for the failure are sought. Lean companies identify the causes of desired performance (the drivers, the critical success factors) beforehand and design the measurement and control processes that maintain these drivers within prescribed limits. Lean companies identify goals and link those goals to the critical factors required to achieve them. They do this at each level of the organization. (Traditional companies using the balanced scorecard are moving away from the emphasis on financial results and are identifying, measuring and controlling drivers of those results).

5. What is the purpose of the performance measurement linkage chart? Briefly describe how the chart is used to achieve its purpose.

The performance measurement linkage charts show the connections between strategies, goals and measures at the plant, value stream, and cell/process levels. The linkage between goals and critical success factors allows senior management to embed its policies into every level of the organization. The chart helps value stream managers and employees understand how their value stream contributes to the overall success of the organization. The performance measurement linkage charts help get everyone pulling in the same direction, and motivate the performance of the entire organization toward the attainment of the aims of the company.

6. AAA Access Control Inc. Performance Measurement

AAA Access Control Inc. produces and sells a wide variety of security and access control devices. The corporate goals are: (1) to be the industry leader in product and process innovation, (2) to be recognized for having products able to completely satisfy customer needs, (3) to be highly profitable while offering great value to customers through cost efficiency. They also have sales growth and profitability goals, and they want to reduce inventory to increase cash flow.

The Card Division designs and produces cards containing magnetic strips, chips or RFID devices for swipe or proximity access control. The division plans to contribute to AAA Access Control's goals by (1) offering rapid customization to customers (2) providing perfect quality and on-time delivery with short lead times, and (3) continually improving cost performance and eliminating waste through lean management.

The Card Division's goals for the coming year are:

- 20% sales growth.
- Inventory turns greater than 15.
- Five day lead-time from approved design to shipment.
- Two day lead-time from customer request to design approval for custom cards.
- 99.9% external quality, 99% internal quality.
- 95% on-time delivery.
- Profitability – target ROS.
- One implemented improvement per employee per month.

The Custom Card Value stream receives orders from customers and designs a card to meet their specifications. Once the design is approved, the cards go into production. One of the production cells in the Custom Card Value Stream is a Lamination Cell, where the layers are laminated to a sheet of basic card stock to make the completed card.

Required:

- A. Identify critical success factors for the Custom Card Value Stream. What must it do to be successful in contributing to the Card Division's goals?

See the second column on the performance measurement linkage chart for some suggestions.

- B. Create a performance measurement linkage chart For the Card Division, the Custom Card Value Stream and the Lamination Cell. Use the Card Division's goals and the starter set of value stream and cell measures.

See the performance measurement linkage chart below.

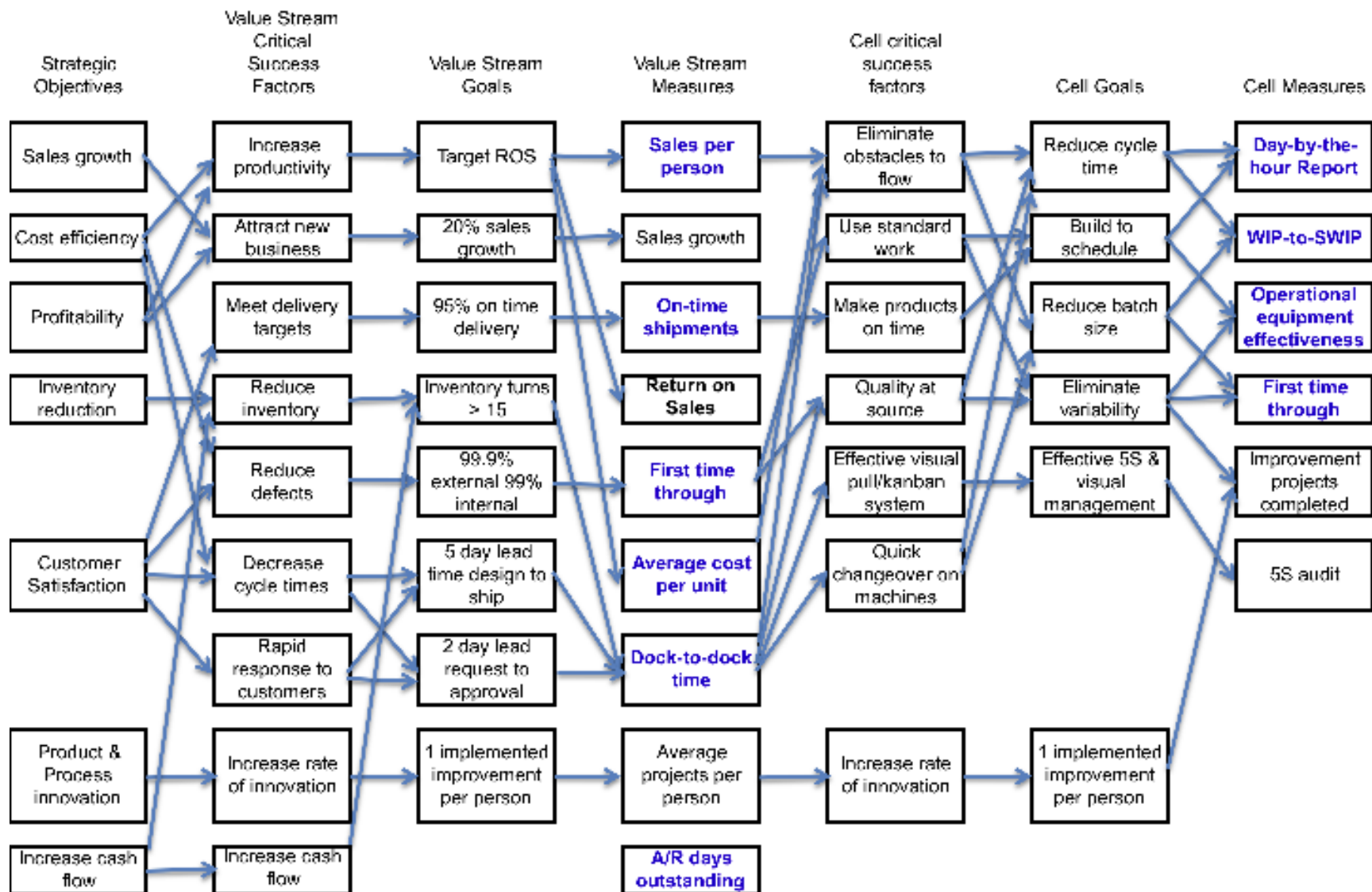
- C. Are all Card Division goals supported by Value Stream measures? If not, suggest one or more additions to the starter set that would support the Card Division's goals.

The Card Division has sales growth and return on sales targets that are not included in the Starter set, although Sales and Return on Sales would be included in the financial results section of the value stream box score. The inventory turns goal is linked to the dock-to-dock starter set measure, and inventory value is typically reported in the financial section of the box score. However, it is not uncommon to report inventory days, or inventory turns at the value stream level and this company does in fact use inventory turns. The inventory turns measure is not included on the model linkage chart below, but it could easily be added.

The only starter set value stream measure that is not in use in this example is Accounts Receivable Days Outstanding. The corporate goal related to improving cash flow is to reduce the money tied up in inventory, and this goal and emphasis flows down to the value stream level.

The linkage chart in the suggested solution extends the implemented improvements measure to the cell level. This was not suggested in the cell performance measurements chapter, but an implemented improvements measure is shown at the cell level on the performance linkage chart in Figure 19.6, the reference for this problem. Tracking participation in improvements at the value stream level is usually sufficient.

There may be some disagreement on specific links. Other links could be proposed, and a few of those made could arguably considered too indirect to bother listing. What is important is that company managers and employees agree on the important links.



PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 20: Transaction Elimination Maturity Path Table

1. When can transactions be eliminated?
B) When processes are stable and under control, and recording transactions is no longer necessary to ensure reasonably accurate information.
2. What is a transaction elimination maturity path table?
D) A table used to assess the current and planned future states of lean production and lean accounting maturity and to plan the orderly elimination or replacement of transaction driven processes.
3. Which of the following best describes how the transaction elimination maturity path table should be used?
A) Managers assess the current state and planned future state of lean production, and prepare a table planning for the orderly elimination of transactions no longer needed at each stage of maturity.
4. What is the relationship between the transaction elimination maturity path table and a detailed action plan to eliminate transactions?
B) The transaction elimination maturity path table provides guidance for development of a detailed action plan by a lean accounting team.
5. How can process maps facilitate transaction elimination?
D) A, B, and C are all ways that process maps can facilitate transaction elimination.

Discussion questions and problems

1. If transactions are wasteful, why are they so prevalent in control systems?

Transaction records make it possible to track and control resources and prepare reasonably accurate financial reports when the processes using and creating the resources are unreliable and out of control. It is the equivalent of assuring high quality through inspection at the end of production.

2. If transactions are necessary for control, how can they be eliminated as lean production and lean accounting matures? Give one example of transaction elimination that does not lead to a loss of control.

Lean production works on process improvement to create stable, reliable processes. Mistake proofing, process reliability and visual control replace transaction control. Operational measures are used to identify and correct problems as they occur rather than waiting for unexpected outcomes to be revealed in the financial results.

3. What is the transaction elimination maturity path table, and how is it used?

The transaction elimination maturity path table describing accounting changes that can occur to eliminate transactions and reduce waste at each stage of lean production maturity. The table

begins with a description of what should be seen across ten areas at each stage of lean production maturity. Generic lean production maturity assessment tools can be used as a starting point and can be modified to the specific company. Many companies already have such assessments to guide their lean production implementation plans. The current state of lean production of lean production maturity is assessed, and a determination is made about what transactions can be eliminated at this stage. Transaction elimination possible at all maturity levels are also developed to determine what transaction elimination will be possible in planned future states of lean production maturity. An action plan for transaction elimination can then be developed based on the planned advances in lean production. The plan helps ensure that transaction elimination takes place in an orderly and timely fashion.

4. What is the relationship between the lean accounting maturity path, the lean accounting diagnostic, and the transaction elimination maturity path table?

The lean transformation in production or accounting cannot be achieved in a single bound. Lean transformation is a journey of continuous improvement. Accounting reports supporting production activity and reporting the results of production activity must be developed in a manner consistent with the state of maturity of production processes. If accounting tries to advance too rapidly they may lose control in financial reports. If accounting lags production by too much, they may become an obstacle to further improvement in production and operations.

Accounting processes can also be viewed as production processes, and lean improvements will be incremental. Current improvements build on past improvements and make possible future improvements that previously could not have been considered.

The lean accounting maturity path describes three phases of lean maturity (lean pilots in place, managing by value streams and the lean enterprise) and describes the corresponding accounting processes, procedures and changes that are possible at each stage. This provides general guidance for assessing the current state and considering future accounting changes.

The lean accounting diagnostic provides a more detailed description of accounting tools processes and procedures on nineteen different dimensions grouped in five areas. A traditional or “just getting started” precedes the lean pilots in place level. The diagnostic focuses on accounting, not production. It supports a more detailed assessment of the current state and provides more detail to support planning future state improvements.

The transaction elimination maturity path table returns to the link between lean production maturity and accounting maturity, specifically addressing transaction elimination. The link is important because if transactions are eliminated too early there can be a loss of control, and if they are eliminated too late, there is a huge amount of waste. It is important to the company and especially important to accountants, that control and the integrity of financial reporting be maintained. The example table presented in chapter 20 expands the maturity path categories to include “making a start” and “lean production” an intermediate stage between “lean pilots in place” and “value stream management.”

The transaction elimination maturity path table is a tool supporting more detailed planning of transaction elimination, plans that might be initiated using the financial accounting and operational accounting areas of the lean diagnostic.

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 21: Value Stream Cost Analysis

1. Value stream cost analysis ...
B) shows how resources in the value stream are being used.
2. Which of the following is ***not*** a typical use of value stream cost analysis?
C) To compute standard costs for financial reporting.
3. _____ are a source for much of the basic value stream data gathered during the “define the value stream” step of value stream cost analysis.
A) Current and future state value stream maps.
4. For the purposes of capacity analysis, total available time for workers in the value stream for a month is ...
C) (hours per shift – time per shift for breaks) × shifts per day × working days per month.
5. Total time used in productive activity for a machine in the value stream for a month is ...
A) total good units produced × machine process time per unit.
6. Total time used in non-productive activity for workers in the value stream for a month includes ...
D) all of the above.

Use the following information for questions 7, 8 and 9

Continental Flange operates a single eight-hour shift five days per week. Workers have a 30-minute paid lunch period and two 15-minute breaks each day. During the most recent week, 1,520 flanges were ground, with 60 requiring rework and 20 being scrapped, 1,500 flanges were moved from grinding to the next process. Each flange requires 30 seconds of labor time. Reworking flanges takes on average the same amount of time as the initial process. The single worker in the grinding process set up the grinder for different model flanges eight times, averaging 75 minutes per setup. The worker also spent two hours in meetings and administrative activities during the week, two and a half hours on preventive maintenance, and 90 minutes cleaning the work area.

7. Total time used in productive activity for the worker for the week was ...
B) 750 minutes. [$1,500 \times .5$ minutes]
8. Total time used in non-productive activity for the worker for the week was ...
D) 1,000 minutes. [$((60 + 20) \times .5) + (8 \times .75) + 120 + 150 + 90$]
9. Available but unused time for the worker for the week was ...
A) 350 minutes. [$(8 - 1 \text{ hour lunch \& paid break}) \times 60 \times 5 = 2,100$ minutes, less 750 minutes productive use and 1,000 minutes non-productive use.]

Use the following information for questions 10, 11 and 12

Continental Flange operates a single eight-hour shift five days per week. During the most recent week, 1,520 flanges were ground, with 60 requiring rework and 20 being scrapped, 1,500 flanges were moved from grinding to the next process. Each flange requires an average of 45 seconds of time on the grinding machine. Reworking flanges takes on average the same amount of time as the initial process. The grinding machine was set up for different model flanges eight times, averaging 75 minutes per setup. The grinding machine was down twice for repairs, once for 3 hours and once for one hour. The grinding machine was also idle for 100 minutes while cleaning and regularly scheduled maintenance took place.

10. Total time used in productive activity for the grinding machine for the week was ...
A) 1,125 minutes. [$1,500 \times .75$]
11. Total time used in non-productive activity for the grinding machine for the week was ...
D) 1,000 minutes. [$((60 + 20) \times .75) + (8 \times 75) + 240 + 100$]
12. Total available but unused time for the grinding machine for the week was ...
D) 275 minutes. [$(8 \times 5 \times 60) = 2,400$ total available – 1,125 productive – 1,000 nonproductive.

Discussion questions and problems

1. A critical part of VSCA, value stream cost analysis, is value stream capacity analysis. What is the link between capacity and cost, and why is it so important to analyze value stream capacity?

Productive capacity is comprised of resources made available during a period: human resources, machinery and equipment, and the power to run them, a facility to house them, and ant materials they transform, and various administrative and support resources. The capacity analysis identifies the human resources, machinery and equipment available, the key productive resources, and shows how those resources are being used, or if they are unused and available for additional work. The value stream cost analysis show the current or anticipated future cost of making the capacity available as well as showing how much of the total capacity made available is being used productively, used nonproductively, or is unused.

2. Describe four ways value stream cost analysis can be used to support planning, decision-making and performance evaluation.

Value stream cost analysis can support planning: by identifying when capacity is or will be available to support introduction of new products or sales growth, or by showing when capacity will have to be added. It can help continuous improvement teams set improvement priorities by showing where additional capacity is needed to improve flow and or meet anticipated future demands. It can also be used to help develop marketing plans to promote maximum flow given current value stream constraints.

Value stream cost analysis supports decision-making by showing when and how much additional capacity will be needed to support given decision alternatives. This is essential to identifying the feasibility and costs of alternatives being considered.

Value stream cost analysis supports performance evaluation by showing trends in capacity use over time, revealing the results of continuous improvement efforts, and showing whether or not anticipated or planned capacity creation has been realized.

3. The Hand Load / Wave Post process had 27% available capacity in the current state. Why do you think it had eleven workers, when the capacity analysis suggests it could get by with fewer workers?

Most likely, these employees have been engaged in other nonproductive activity not included in the analysis because the activities are not part of the work required in the current state. For example, the employees may have participated in kaizens, or in additional meetings, that are not part of their regular work because they had the time available. If they have sufficient cross training, they may have also pitched in where needed in other processes. It's possible ECI had not previously analyzed the capacity utilization in the value stream and was not aware of the extent of the excess capacity, and workers may have been taking longer than needed to perform the identified productive and nonproductive activities because they had the time to spare. Of course, some extra capacity is desirable to accommodate unanticipated surges in demand and to be able to quickly take advantage of new opportunities that arise.

4. In the future state even more unused available capacity is created in the Hand Load / Wave Post operation. How could ECI take advantage of this added capacity?

They can add additional products or sell more of existing products in the Controller Value Stream, provided there is sufficient capacity in the bottleneck process. They can re-deploy people not needed in Hand / Load Wave Post to operations in the Controller Value Stream that need additional capacity, or to other value streams at ECI. They can have the workers engage in more training or if they have sufficient training, temporarily replace other workers who need additional training to free them for training. They can use the surplus resources for added kaizens, target costing studies, or other improvement efforts.

5. BWP Bats is a boutique baseball bat maker located in Pennsylvania. They currently make over 200 models of baseball bats to the specifications of major league baseball players and minor league teams. A key part of the bat making process is the lathe operation, where a 37-inch long, 2¾ inch diameter cylinder of ash or maple called a billet is placed in a computerized lathe and shaped to the model specifications. BWP runs a shift from 7:00 AM – 3:30 PM (8.5 hours Monday through Friday). There were four 5-day weeks during February. There were 2,930 billets processed by the lathe during February, producing 2,880 good bats and 50 that had to be scrapped. It takes 108 seconds to shape a bat on the lathe. The lathe was set up for 140 different models during February. It takes four minutes to program and set up the lathe for each model. The lathe is down for cleaning and maintenance 30 minutes per day, and it was stopped twice during the month for unscheduled cutting tool replacement, with each stoppage taking 75 minutes.

There was only one worker in the lathe operation during February. Workers get a ten minute break every morning and afternoon, and a 30 minute unpaid lunch break. The breaks and lunch time are not included in total available time. There are 120 seconds of manual labor per bat associated with the lathe process. Some of the manual labor on one bat can take place while another bat is being turned on the lathe. The lathe worker performs the setups, but was not involved with the unscheduled cutting tool replacements, which were performed by the repair staff. The lathe worker spent half an hour per day cleaning and

maintaining the lathe and another 24 minutes per day on average in meetings and performing administrative tasks.

- a. Based on the information above, report productive, non-productive, and unused available capacity for the machine (the lathe) in BWP Bat's lathe process for February.
- b. Based on the information above, report productive, non-productive, and unused available capacity for the employee in BWP Bat's lathe process for February.

BWP Bats - Labor	Lathe	BWP Bats - Machines	Lathe
People	1	Machines	1
Available minutes per shift	460	Available minutes per shift	510
Days per month	20	Days per month	20
Available time (seconds)	552,000	Available time (seconds)	612,000
Monthly units	2,880	Monthly units	2,880
Cycle time (seconds)	120	Cycle time (seconds)	108.00
Value-added production	345,600	Value-added production	311,040
Percentage value-added	63%	Percentage value-added	51%
Change-overs	140	Change-overs	140
Avg time per changeover	240	Avg time per changeover	240
Total change-over time	33,600	Total change-over time	33,600
Defective production units	50	Defective production units	50
Defective production	6,000	Defective production	5,400
Unscheduled downtime	-	Unscheduled downtime	9,000
Clean-up, 5S	36,000	Clean-up, 5S	36,000
Meetings	28,800	Meetings	-
Total non-value added time	104,400	Total non-value added time	84,000
Percentage non-value added	19%	Percentage non-value added	14%
Total available time	102,000	Total available time	216,960
Percentage available time	18%	Percentage available time	35%

The above answer assumes the lathe can run during the lunch break, paid employee breaks and meetings (either it can run unsupervised for 30 minutes or another employee could cover the 30-minute period if BWP Bats chose to do so). Alternately, one could assume the lathe is shut down when the single operator currently assigned to the operation is not available to monitor the lathe.

Under the alternate assumption, the time for meetings would be non-productive time for the lathe as well as for the operator, and either (1) the available scheduled time for the lathe would be reduced to 552,000 seconds, or (2) the scheduled time would be left at 612,000 seconds and the 60,000 seconds per month the operator spends on lunch breaks and paid breaks would be added to non-productive machine time.

6. Analyze the capacity for the current state for Caspian Corporation – Motors Value Stream (Requirement B of problem 11 in chapter 4, found on page 20 of the question file). See the table on page 109, and the discussion on page 111.
7. Analyze the capacity for the future state for Caspian Corporation – Motors Value Stream (Requirement B of problem 12 in chapter 4, found on page 23 of the question file). See the table on page 110, and the discussion on page 111.

Current State Labor	Parts Fab	Machining	Assembly	Shipping	Total
People	3.85	6.00	6.00	0.66	16.51
Hours per shift	7.50	7.50	7.50	7.50	7.50
Days per month	20	20	20	20	20
Total scheduled time (seconds)	2,079,000	3,240,000	3,240,000	356,400	8,915,400
Monthly units	8,880	8,704	2,176	2,176	
Cycle time (seconds)	120	150	600	90	
Value-added production	1,065,600	1,305,600	1,305,600	195,840	3,872,640
Percentage value-added	51.3%	40.3%	40.3%	54.9%	43.4%
Batch size	30	10	2	1	
Change-overs	296	870	1,088	2,176	
Avg time per changeover	2,400	1,800	300	-	
Total change-over time	710,400	1,566,720	326,400	-	
Inspection percentage	100%	100%	100%	0%	
Seconds per inspection	10	10	360	-	
Total inspection time	88,800	87,040	783,360	-	
Defective production percentage	2%	4%	9%	9%	
Defective production time	21,312	52,224	117,504	17,626	
Down time percentage	1%	5%	5%	5%	
Total down time	20,790	162,000	162,000	17,820	
Clean-up, 5S	50,400	108,000	72,000	11,880	
Meetings	27,720	43,200	43,200	4,752	
Other non value-added time	-	-	-	-	
Total non-value added time	919,422	2,019,184	1,504,464	52,078	4,495,148
Percentage non-value added	44.2%	62.3%	46.4%	14.6%	50.4%
Total available time	93,978	(84,784)	429,936	108,482	547,612
Percentage available time	4.5%	-2.6%	13.3%	30.4%	6.1%
Current State Machines	Parts Fab	Machining	Assembly	Shipping	Total
Machines	2.80	3.00	-	-	
Hours per shift x shifts per day	16.00	16.00			
Days per month	20.00	20.00			
Total scheduled time (seconds)	3,225,600	3,456,000	-	-	6,681,600
Monthly units	8,880	8,704			
Cycle time (seconds)	180	150			
Value-added production	1,598,400	1,305,600	-	-	2,904,000
Percentage value-added	49.6%	37.8%			43.5%
Batch size	30	10			
Change-overs	296	870			
Avg time per changeover	2,400	1,800			
Total change-over time	710,400	1,566,720			
Inspection percentage	N/A	N/A			
Seconds per inspection	N/A	N/A			
Total inspection time	-	-			
Defective production percentage	2%	4%			
Defective production time	31,968	52,224			
Down time percentage	1%	5%			
Total down time	32,256	172,800			
Clean-up, 5S	100,800	108,000			
Meetings	40,320	43,200			
Other non value-added time	-	-			
Total non-value added time	915,744	1,942,944	-	-	2,858,688
Percentage non-value added	28.4%	56.2%			42.8%
Total available time	711,456	207,456			918,912
Percentage available time	22.1%	6.0%			13.8%

Future State Labor	Parts Fab	Machining	Assembly	Shipping	Total
People	3.85	6.00	6.00	0.66	16.51
Hours per shift	7.50	7.50	7.50	7.50	7.50
Days per month	20	20	20	20	20
Total scheduled time (seconds)	2,079,000	3,240,000	3,240,000	356,400	8,915,400
Monthly units	8,792	8,704	2,176	2,176	
Cycle time (seconds)	120	150	600	90	
Value-added production	1,055,040	1,305,600	1,305,600	195,840	3,862,080
Percentage value-added	50.7%	40.3%	40.3%	54.9%	43.3%
Batch size	10	10	2	1	
Change-overs	879.2	870.4	1,088.0	2,176.0	
Avg time per changeover	600	900	150	-	
Total change-over time	527,520	783,360	163,200	-	
Inspection percentage	100%	100%	100%	0%	
Seconds per inspection	10	10	360	-	
Total inspection time	87,920	87,040	783,360	-	
Defective production percentage	1%	3%	5%	9%	
Defective production time	10,550	39,168	65,280	17,626	
Down time percentage	1%	2%	3%	5%	
Total down time	20,790	64,800	97,200	17,820	
Clean-up, 5S	50,400	108,000	72,000	11,880	
Meetings	27,720	43,200	43,200	4,752	
Other non value-added time	-	-	-	-	
Total non-value added time	724,900	1,125,568	1,224,240	52,078	3,126,786
Percentage non-value added	34.9%	34.7%	37.8%	14.6%	35.1%
Total available time	299,060	808,832	710,160	108,482	1,926,534
Percentage available time	14.4%	25.0%	21.9%	30.4%	21.6%
Future State Machines	Parts Fab	Machining	Assembly	Shipping	Total
Machines	2.80	3.00	-	-	
Hours per shift x shifts per day	16.00	16.00			
Days per month	20.00	20.00			
Total scheduled time (seconds)	3,225,600	3,456,000	-	-	6,681,600
Monthly units	8,792	8,704			
Cycle time (seconds)	180	150			
Value-added production	1,582,560	1,305,600	-	-	2,888,160
Percentage value-added	49.1%	37.8%			43.2%
Batch size	10	10			
Change-overs	879.2	870.4			
Avg time per changeover	300	480			
Total change-over time	263,760	417,792			
Inspection percentage	N/A	N/A			
Seconds per inspection	N/A	N/A			
Total inspection time	-	-			
Defective production percentage	1%	3%			
Defective production time	15,826	39,168			
Down time percentage	1%	2%			
Total down time	32,256	69,120			
Clean-up, 5S	100,800	108,000			
Meetings	40,320	43,200			
Other non value-added time	-	-			
Total non-value added time	452,962	677,280	-	-	1,130,242
Percentage non-value added	14.0%	19.6%			16.9%
Total available time	1,190,078	1,473,120			2,663,198
Percentage available time	36.9%	42.6%			39.9%

6. Analyze the capacity for the current state for Caspian Corporation – Motors Value Stream (Requirement B of problem 11 in chapter 4, found on page 20 of the question file). See the table on page 109.
7. Analyze the capacity for the future state for Caspian Corporation – Motors Value Stream (Requirement B of problem 12 in chapter 4, found on page 23 of the question file). See the table on page 110.

The times on the capacity analysis tables (other than hours per shift) are expressed in seconds. The scale used (seconds, minutes, or hours) is a matter of company preference. Most manufacturing companies have operations with short cycle times, so they think in terms of seconds of time and prefer to express the analysis in seconds.

The percentages carried to the value stream box score can be from the totals for all the processes in the value stream, or they can be from the bottleneck process (or processes, there may be different bottlenecks for labor and machine time). Eliminating waste in non-bottleneck processes may create capacity in those processes but it will not immediately improve flow or create added value stream capacity because value stream capacity is limited by the constraint. Consequently, using the totals for the value stream as the capacity measure will provide an overall assessment of continuous improvement in the value stream, but it is not as effective a measure for planning and decision making as the capacity of the bottleneck (constraining) processes. Most companies using box scores report the capacities of the bottleneck processes in the capacity sections of their box scores.

The cells shaded in gray on the future state capacity analysis contain input values that changed from the current state as a result of improvements in the value stream.

Note that the setup times in the future state differ for people and machines. The Motors Value Stream has created more machine capacity by identifying “external” setup activities that can be performed while the machine is still working on the preceding part. The external setup activities require labor time, but they do not require machine setup time.

8. Analyze the capacity for the current state for the Accounts Payable Process at Brand X Corporation (Part b of requirement A for problem 11 in chapter 6, found on page 30 of the question file).

Brand X Corporation A/P Current State Capacity Analysis				
Labor	Record	Match	Mail	Total
People	1	3	0.2	4.2
Available time (minutes)	8,400	25,200	1,680	35,280
Monthly units	4,000	4,000	4,000	4,000
Cycle time (minutes)	2.00	3.00	0.20	5.20
Processing time	8,000	12,000	800	20,800
Processing time percentage	95%	48%	48%	59%
Mismatch resolution	0%	12%	0%	12%
Cycle time (minutes)	-	20.00	-	
Error processing time	-	9,600	-	9,600
Meeting time	120	360	24	504
Other administrative	240	720	48	1,008
Total non-productive time	360	10,680	72	11,112
Percentage non-productive	4%	42%	4%	31%
Total available time	40	2,520	808	3,368
Percentage unused available time	0%	10%	48%	10%

9. Analyze the capacity for the current state for the Accounts Payable Process at Brand X Corporation (Part b of requirement A for problem 12 in chapter 6, found on page 33 of the question file).

Brand X Corporation A/P Future State Capacity Analysis			
Labor	Record & Match	Sort & Mail	Total
People	4	0.2	4.2
Available time (minutes)	33,600	1,680	35,280
Monthly units	2,400	2,400	2,400
Cycle time (minutes)	5.00	0.40	5.40
Processing time	12,000	960	12,960
Processing time percentage	36%	57%	37%
Mismatch resolution	13%	0%	13%
Cycle time (minutes)	22.50	-	
Error processing time	7,200	-	7,200
Meeting time	120	24	144
Other administrative	240	48	288
Total non-productive time	7,560	72	7,632
Percentage non-productive	23%	4%	22%
Total available time	14,040	648	14,688
Percentage available time	42%	39%	42%

PRACTICAL LEAN ACCOUNTING
SUGGESTED SOLUTIONS

Chapter 22: Value Stream Mapping

1. What is a value stream map?
D) A diagram showing the material and information flows in a value stream.
2. Which of the following statements describes a way the lean accounting uses value stream maps?
A) The current and future state value stream maps form the basis for calculating the financial benefits of lean improvements.
3. Accounting and Information processes such as billing and collection and accounts payable ...
C) are part of the value stream and can be added to the production processes shown on value stream maps.
4. The data boxes on the value stream maps ...
B) are the principal source of information for value stream cost and capacity analysis.
5. All of the following are items that might appear in a data box for a production process on a value stream map except ...
C) standard cost per unit for the process.

Discussion questions and problems

1. What is a value stream map? Why do managers and employees create value stream maps?

The purpose of a value stream map is to enable managers and employees to see the flow of materials, information, and sometimes cash, through the value stream. A value stream map is a graphic representation of the material and information flows through the value stream. It is often very difficult to see the entire value stream, and value stream maps help everyone involve picture and understand the entire process.

2. How are value stream maps used in lean accounting?

- Since value streams will be the basis for managing and reporting, it is essential as a pre-condition that value streams be recognized. Value stream maps help accountants recognize the value streams and determine the resources that can be directly assigned to each value stream.
- The information in data boxes on the value stream maps are a primary source of information for conducting value stream cost and capacity analysis and for preparing current and future state value stream box scores.
- Support processes can be incorporated into the value stream maps, helping to reveal waste and obstacles to flow in information processing and accounting processes.

3. Should support processes and the accompanying data boxes be included on the value stream map? Provide one argument supporting their inclusion and one supporting their exclusion.

Reasonable arguments can be made both for and against including support processes in the value stream map.

The argument against their inclusion is that the value stream map should focus on the value creating process, that can be extremely complex even in a well designed value stream. Adding the support processes may make it extremely difficult to see and understand the entire value creating process.

The argument for including the support processes is that their inclusion may reveal waste and obstacles to flow that may otherwise remain hidden. For example, order entry or processing customer change orders may be a source of significant delay, increasing lead times and late deliveries. The support processes are non-value-adding and represent great opportunities for eliminating waste. Including the support processes on the value stream maps can reveal possible improvements that would otherwise remain hidden.

4. Consider the SMT production cell for ECI shown in figures 22.1 and 22.2. Recommend additional information that could be included in the data box to support value stream cost and capacity analysis.

The SMT process box shows the number of people and machines. The data box includes the production cycle time, the changeover time, down time, the production demand and the number of shifts. No distinction is made between machine and employee changeover time. In the absence of the distinction, it can be assumed the four workers and the machine are occupied for the changeover time.

Average batch size and defect or scrap rates would be welcome additions. Other possible additions are Inspection percentage and inspection time, rework rate, and rework time.