Activity-Based Costing, Lean Operations, and the Costs of Quality

Chapter 4

Reviews of Chp3 and Goal of Chp4

- Trace direct material and direct labor, and allocate MOH
- Refine costing systems
- Other methods to improve competitive ability:

1) Lean operations
2) Total quality management and the cost of quality

Objective 1

Develop and use departmental overhead rates to allocate indirect costs

Why and How do Companies Refine Their Cost Allocation Systems?

- Why refine?
  - Mismatching resources
  - Cost distortion

(Some product are overcosted while other products are undercosted by the cost allocation system)

- Who can refine?
  - Manufacturing operations
  - Service companies and governmental agencies

Example of Cost distortion

Rent, Internet, and utilities	$570
Cable TV	50
Covered parking fee	40
Groceries	240
Total monthly costs	$900

	A	B	C	D	E
1	**Allocation of Expenses**	**David**	**Matt**	**Marc**	**Total**
2	*More-refined cost allocation system:*				
3	Rent, internet, and utilities	$190	$190	$190	$570
4	Cable TV	25	0	25	50
5	Covered parking	0	40	0	40
6	Groceries	0	80	160	240
7	Total cost allocated	$215	$310	$375	$900
8					
9	*Original cost allocation system:*				
10	Equal allocation of expenses	$300	$300	$300	$900
11					
12	**Difference**	($85)	$ 10	$ 75	$ 0
13					

Plantwide Overhead Rate—Example in Textbook

- Using one predetermined manufacturing overhead rate for all operations

$$\text{Predetermined MOH rate} = \frac{\text{Total estimated manufacturing overhead costs}}{\text{Total estimated amount of the allocation base}}$$

$$\text{Predetermined MOH rate} = \frac{\$1{,}000{,}000}{62{,}500 \text{ DL hours}} = \$16 \text{ per DL hour}$$

Plantwide Overhead Rate

- Using one predetermined manufacturing overhead rate to allocate MOH to units

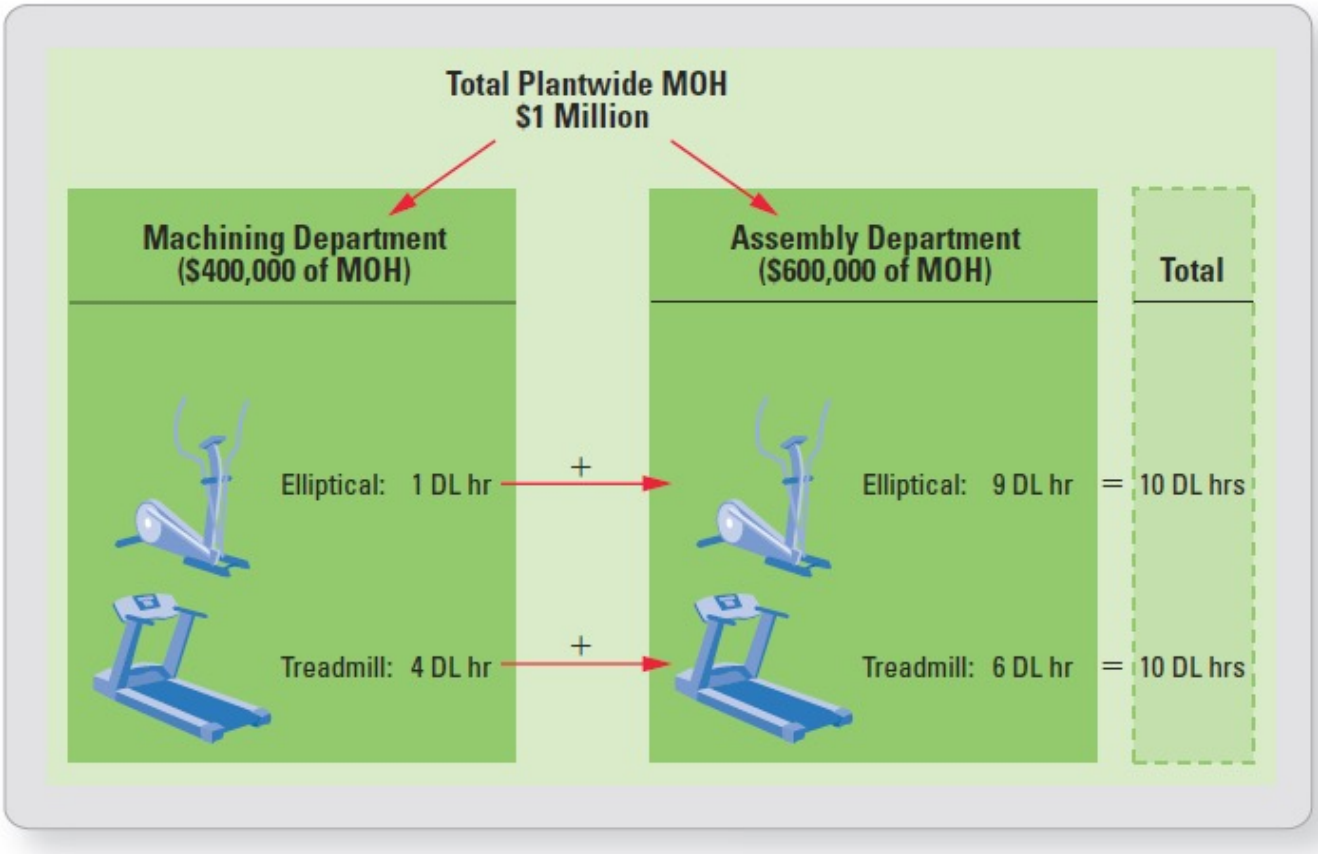
	A	B	C	D	E	F	G	H
1	Job	Plantwide Overhead Rate			Actual Use of Allocation Base			MOH Allocated to Job
2	Job 101: One elliptical	$ 16	per DL hour	×	10	DL hours	=	$ 160
3	Job 102: One treadmill	$ 16	per DL hour	×	10	DL hours	=	$ 160
4								

Departmental Overhead Rates

- When to use:
  - Departments incur different amounts and types of MOH
  - Different jobs or products use the department resources to a different extent

Departmental Overhead Rates

- Separate predetermined manufacturing overhead rates for each department



Departmental Overhead Rates Example—Exhibit 4-7

	A	B	C	D	E	F	G	H
1	Department	Step 1: Total Departmental Overhead Cost Pool		Step 2: Total Amount of Departmental Allocation Base			Step 3: Departmental Overhead Rate	
2	Machining	$ 400,000	÷	12,500	DL hours	=	$ 32	per DL hour
3	Assembly	$ 600,000	÷	50,000	DL hours	=	$ 12	per DL hour
4								

Departmental Overhead Rates Example—Exhibit 4-8—Ellipticals

	A	B	C	D	E	F	G	H
1	Department	Departmental Overhead Rate (from Exhibit 4-7)			Actual Use of Departmental Allocation Base (from Exhibit 4-4)			MOH Allocated to Job 101: One Elliptical
2	Machining	$ 32	per DL hour	×	1	DL hours	=	$ 32
3	Assembly	$ 12	per DL hour	×	9	DL hours	=	$ 108
4	Total							$ 140
5								

Departmental Overhead Rates Example—Exhibit 4-9—Treadmills

	A	B	C	D	E	F	G	H
1	Department	Departmental Overhead Rate (from Exhibit 4-7)			Actual Use of Departmental Allocation Base (from Exhibit 4-4)			MOH Allocated to Job 102: One Treadmill
2	Machining	$ 32	per DL hour	×	4	DL hours	=	$ 128
3	Assembly	$ 12	per DL hour	×	6	DL hours	=	$ 72
4	Total							$ 200
5								

Departmental Overhead Rates Example—Exhibit 4-11

	Plantwide Overhead Rate MOH Allocation (from Exhibit 4-2)	Departmental Overhead Rates MOH Allocation (from Exhibits 4-8 and 4-9)	Amount of Cost Distortion
Job 101: One Elliptical	$160	$140	$20 *overcosted*
Job 102: One Treadmill	$160	$200	$40 *undercosted*

Now turn to S4-3

Kettle Snacks makes potato chips, corn chips, and cheese puffs using three different production lines within the same manufacturing plant. Currently, Kettle uses a single plant-wide overhead rate to allocate its $3,315,000 of annual manufacturing overhead. Of this amount, $2,014,000 is associated with the potato chip line, $672,000 is associated with the corn chip line, and $629,000 is associated with the cheese puff line. Kettle's plant is currently running a total of 17,000 machine hours: 10,600 in the potato chip line, 3,000 in the corn chip line, and 3,400 in the cheese puff line. Kettle considers machine hours to be the cost driver of manufacturing overhead costs.

1. What is Kettle's plantwide overhead rate?
2. Calculate the departmental overhead rates for Kettle's three production lines. Round all answers to the nearest cent.
3. Which products have been overcosted by the plantwide rate? Which products have been undercosted by the plantwide rate?

S4-3—Compute Departmental Overhead Rates

1. What is Kettle's plantwide overhead rate?

$$\frac{\text{Total estimated manufacturing overhead costs}}{\text{Total estimated amount of the allocation base}}$$

$$\frac{\$3{,}315{,}000 \text{ manufacturing overhead}}{17{,}000 \text{ machine hours}}$$

= $195 per machine hour

S4-3 (cont.)

2. Calculate the departmental overhead rates for Kettle's three production lines. Round all answers to the nearest cent.

Department	Overhead Cost	Machine Hours	Overhead Rate
Potato chips	$2,014,000	10,600 MH	**$190.00**
Corn chips	$672,000	3,000 MH	**$224.00**
Cheese puffs	$ 629,000	3,400 MH	**$185.00**

S4-3 (cont.)

3. Which products had been overcosted by the plantwide rate? Which products had been undercosted by the plantwide rate?

   Plantwide rate = $195.00 per machine hour

   Departmental Rate:

Potato Chips	= $190.00	**Overcosted**
Corn Chips	= 224.00	**Undercosted**
Cheese Puffs	= 185.00	**Overcosted**

Illustration of Plantwide Allocation System

EXHIBIT 4-3 Plantwide Allocation System

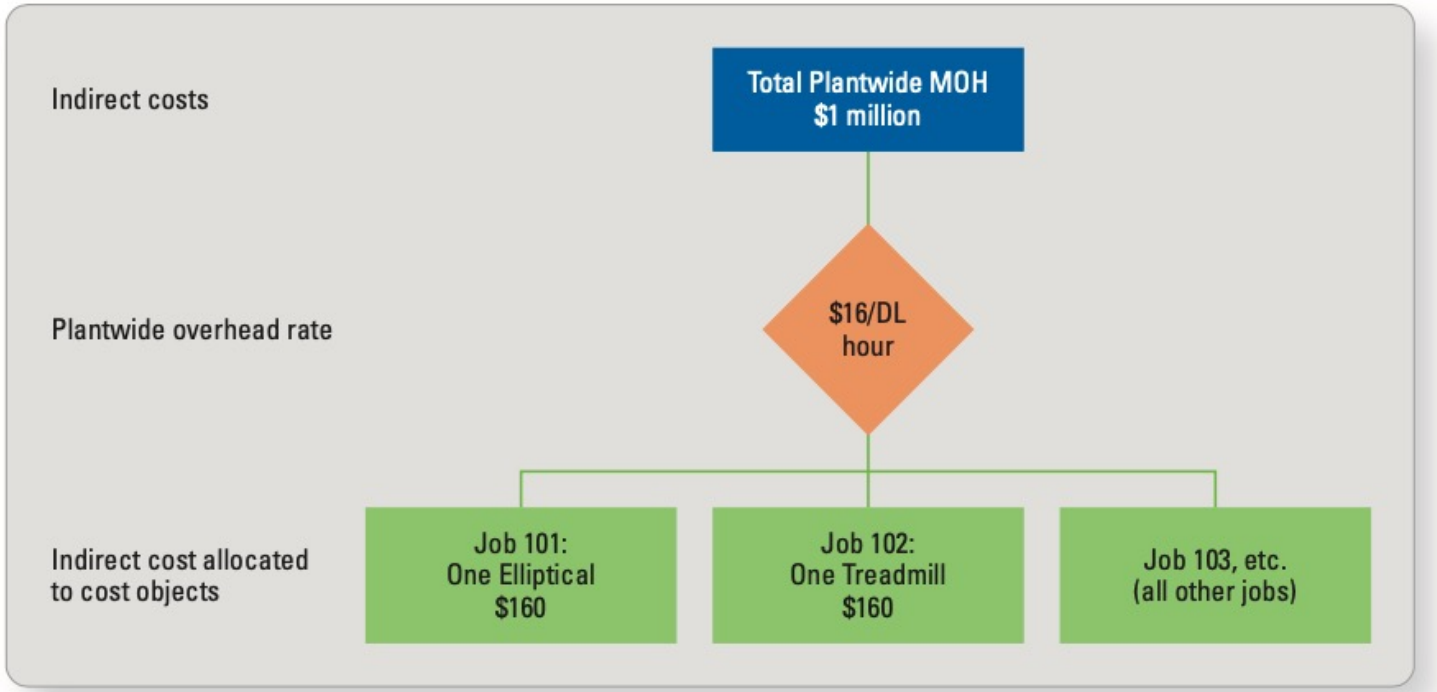
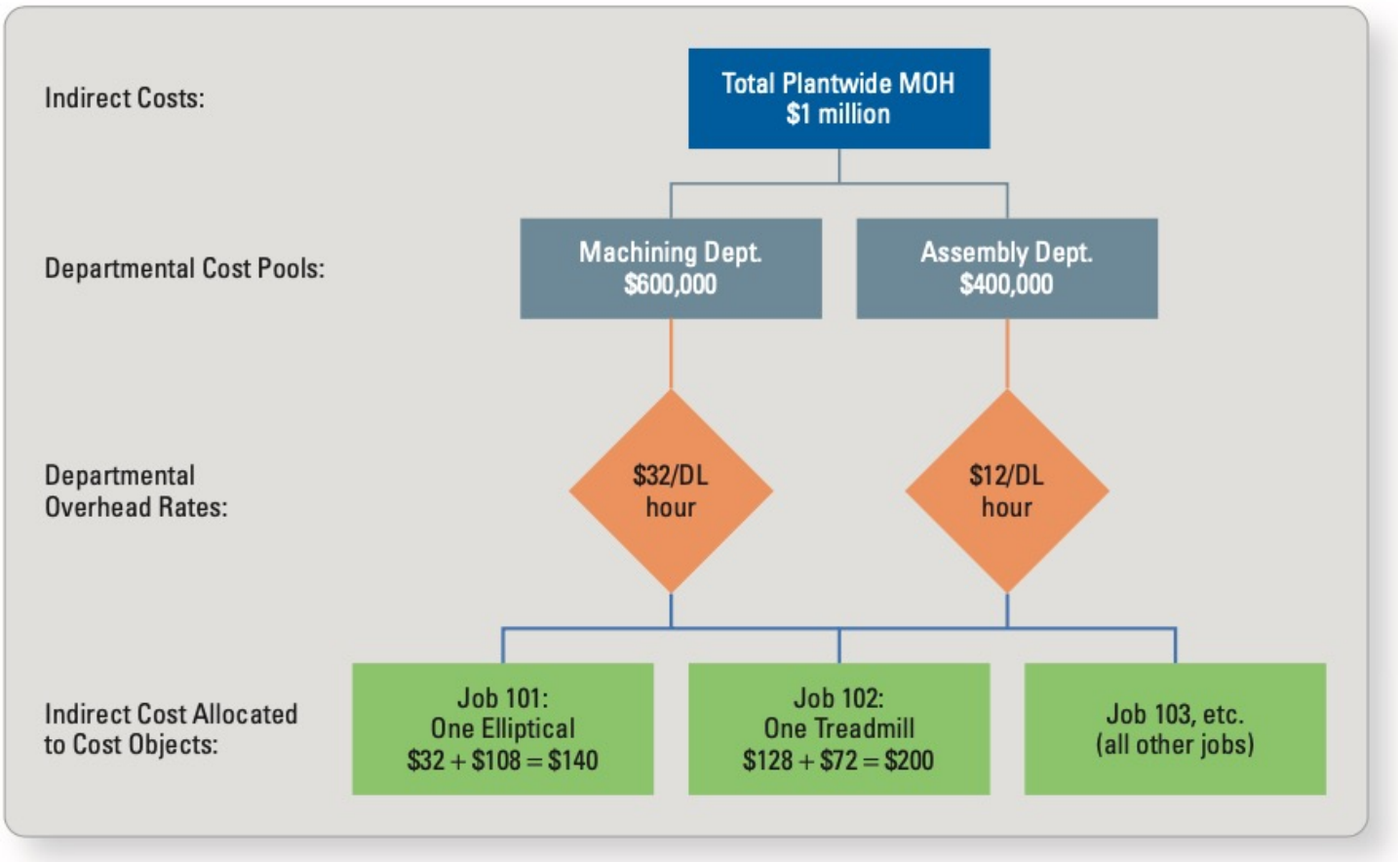


Illustration of Departmental Cost Allocation System

EXHIBIT 4-10 Departmental Cost Allocation System

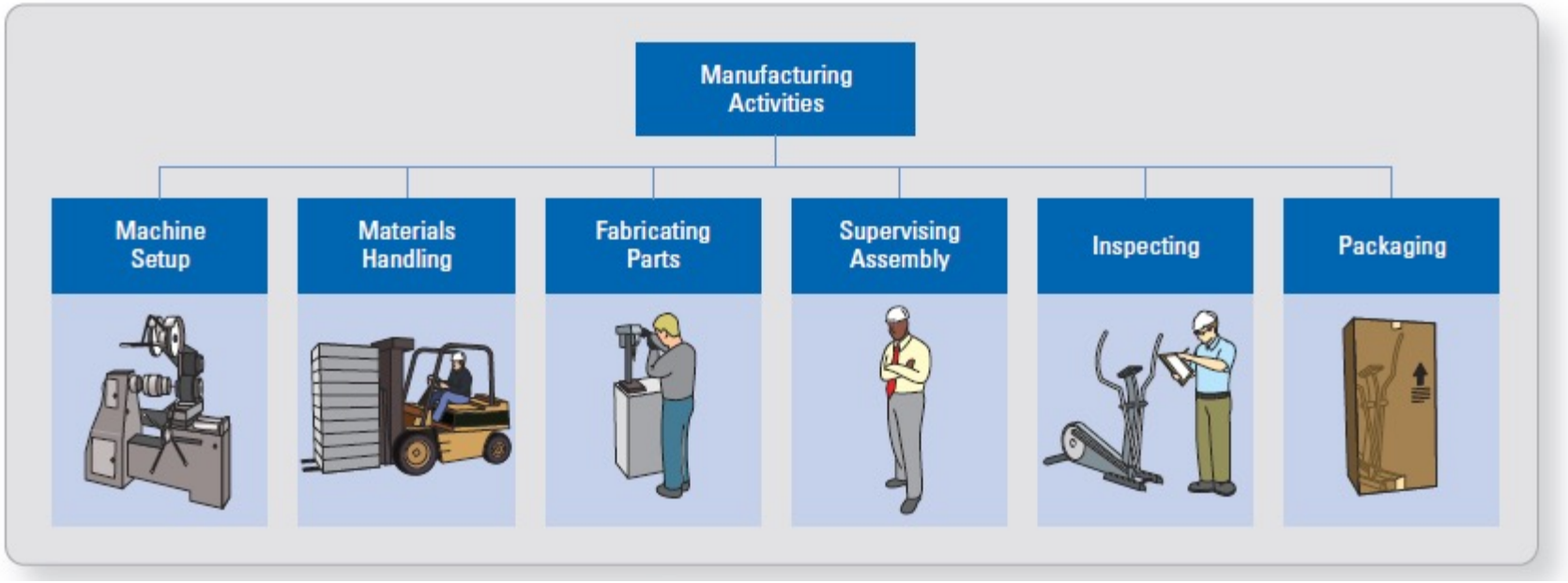


Objective 2

Develop and use activity-based costing (ABC) to allocate indirect costs

Activity-Based Costing

- Allocates indirect costs to production
- Focuses on activities and costs of activities
- Separate allocation rate for each activity



Activity-Based Costing Steps

Step 1: Identify and estimate indirect costs

Activity	MOH Costs Related to the Activity	Total Activity Cost Pool
Machine Setup	Indirect labor used to set up machines	$ 80,000
Materials Handling	Forklifts, gas, operators' wages	200,000
Fabricating Parts	Machine lease payments, electricity, repairs	300,000
Supervising Assembly	Production engineers' labor	150,000
Inspecting	Testing equipment, inspection labor	170,000
Packaging	Packaging equipment	100,000
	TOTAL MOH	$1,000,000

Activity-Based Costing Steps

Step 2: Select an allocation base for each activity

Activity	Activity Allocation Base	Total Estimated Amount of Allocation Base
Machine Setup	Number of setups	8,000 setups
Materials Handling	Number of parts moved	400,000 parts
Fabricating Parts	Machine hours	12,500 machine hours
Supervising Assembly	Direct labor hours	50,000 DL hours
Inspecting	Number of inspections	34,000 inspections
Packaging	Cubic feet packaged	400,000 cubic feet

Activity-Based Costing Steps

Step 3: Compute cost allocation rate for each activity

	A	B	C	D	E	F	G	H
1	**Activity**	**Step 1: Total Activity Cost Pool (from Exhibit 4-13)**		**Step 2: Total Amount of Activity Allocation Base (from Exhibit 4-14)**			**Step 3: Activity Cost Allocation Rate**	
2	Machine Setup	$ 80,000	÷	8,000	setups	=	$ 10.00	per setup
3	Materials Handling	200,000	÷	400,000	parts	=	$ 0.50	per part
4	Fabricating Parts	300,000	÷	12,500	machine hours	=	$ 24.00	per machine hour
5	Supervising Assembly	150,000	÷	50,000	DL hours	=	$ 3.00	per DL hour
6	Inspecting	170,000	÷	34,000	inspections	=	$ 5.00	per inspection
7	Packaging	100,000	÷	400,000	cubic feet	=	$ 0.25	per cubic foot
8	Total MOH	$ 1,000,000						
9								

Activity-Based Costing Steps

Step 4: Allocate some manufacturing overhead for each activity to the individual jobs that use the activities.

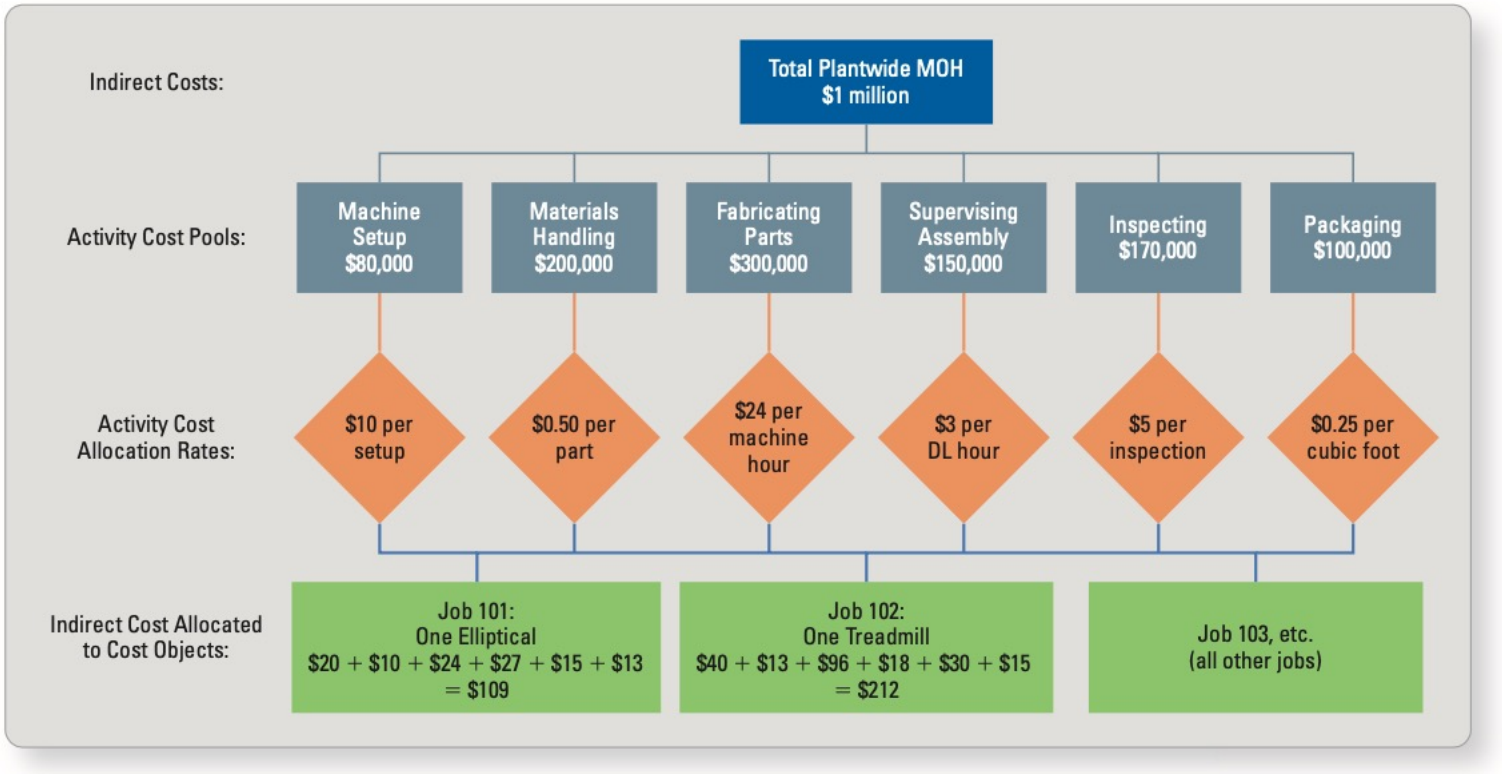
	A	B	C	D	E	F	G	H
1	Activity	Activity Cost Allocation Rate (from Exhibit 4-15)			Actual Use of Activity Allocation Base (information collected on job cost record)			MOH Allocated to Job 101: One Elliptical
2	Machine Setup	$10.00	per setup	×	2	setups	=	$ 20
3	Materials Handling	$ 0.50	per part	×	20	parts	=	10
4	Fabricating Parts	$24.00	per machine hour	×	1	machine hours	=	24
5	Supervising Assembly	$ 3.00	per DL hour	×	9	DL hours	=	27
6	Inspecting	$ 5.00	per inspection	×	3	inspections	=	15
7	Packaging	$ 0.25	per cubic foot	×	52	cubic feet	=	13
8	Total							$ 109
9								

Examples of Cost Drivers

Activities:	Cost drivers:
Material purchasing	# of purchase orders
Material handling	# of parts
Production scheduling	# of batches
Quality inspections	# of inspections
Photocopying	# of pages copied
Warranty service	# of service calls

Illustration of the Firm's ABC System

EXHIBIT 4-18 Illustration of the Company's ABC System



Now turn to S4-6

Salari Industries, a small, family-run manufacturer, has adopted an ABC system. The following manufacturing activities, indirect manufacturing costs, and usage of cost drivers have been estimated for the year:

Activity	Estimated Total Manufacturing Overhead Costs	Estimated Total Usage of Cost Driver
Machine setup.....	$159,500	2,900 setups
Machining.....	$720,000	4,800 machine hours
Quality control.....	$264,000	4,400 tests run

During May, John and Allison Salari machined and assembled Job 557. John worked a total of 12 hours on the job, while Allison worked 4 hours on the job. John is paid a $25 per hour wage rate, while Allison is paid $28 per hour because of her additional experience level. Direct materials requisitioned for Job 557 totaled $1,250. The following additional information was collected on Job 557: the job required 2 machine setups, 4 machine hours, and 3 quality control tests.

1. Compute the activity cost allocation rates for the year.
2. Complete the following job cost record for Job 557:

S4-6

Activity	Estimated Total Manufacturing Overhead Costs (A)	Estimated Total Usage of Cost Driver (B)	Activity Cost Allocation Rate (A ÷ B)
Machine setup	$ 159,500	2,900 set-ups	$ 55 per setup
Machining	$ 720,000	4,800 machine hours	$ 150 per machine hour
Quality control	$ 264,000	4,400 tests run	$ 60 per QC test

S4-6 Example (cont.)

Job Cost Record JOB #557	Manufacturing Costs
Direct Materials	$1,250
Direct Labor: John: 12 × $25 = $300 Allison: 4 × $28 = $112	412
Manufacturing Overhead: 2 setups × $55 / setup = $110 4 machine hours × $150 / machine hour = $600 3 tests × $60 / test = $180	890
TOTAL JOB COST	$2,552

Comparing the Three Allocation Systems

EXHIBIT 4-19 Comparing the Three Cost Allocation Systems

	Plantwide Overhead Rate (Exhibit 4-2)	Departmental Overhead Rates (Exhibit 4-8 & 4-9)	Activity-Based Costing (Exhibit 4-16 & 4-17)
Job 101: One Elliptical	$160	$140	$109
Job 102: One Treadmill	$160	$200	$212

ABC costs are generally thought to be the most accurate because ABC takes into account (1) the *specific resources* each product uses (for example, inspecting resources) and (2) the *extent* to which they use these resources (for example, three inspections of the elliptical, but six inspections of the treadmill).

If we consider all of the jobs and products the company produced during the year, we will see that the total amount by which some products have been overcosted will equal the total amount by which other products have been undercosted.

Discussion 1

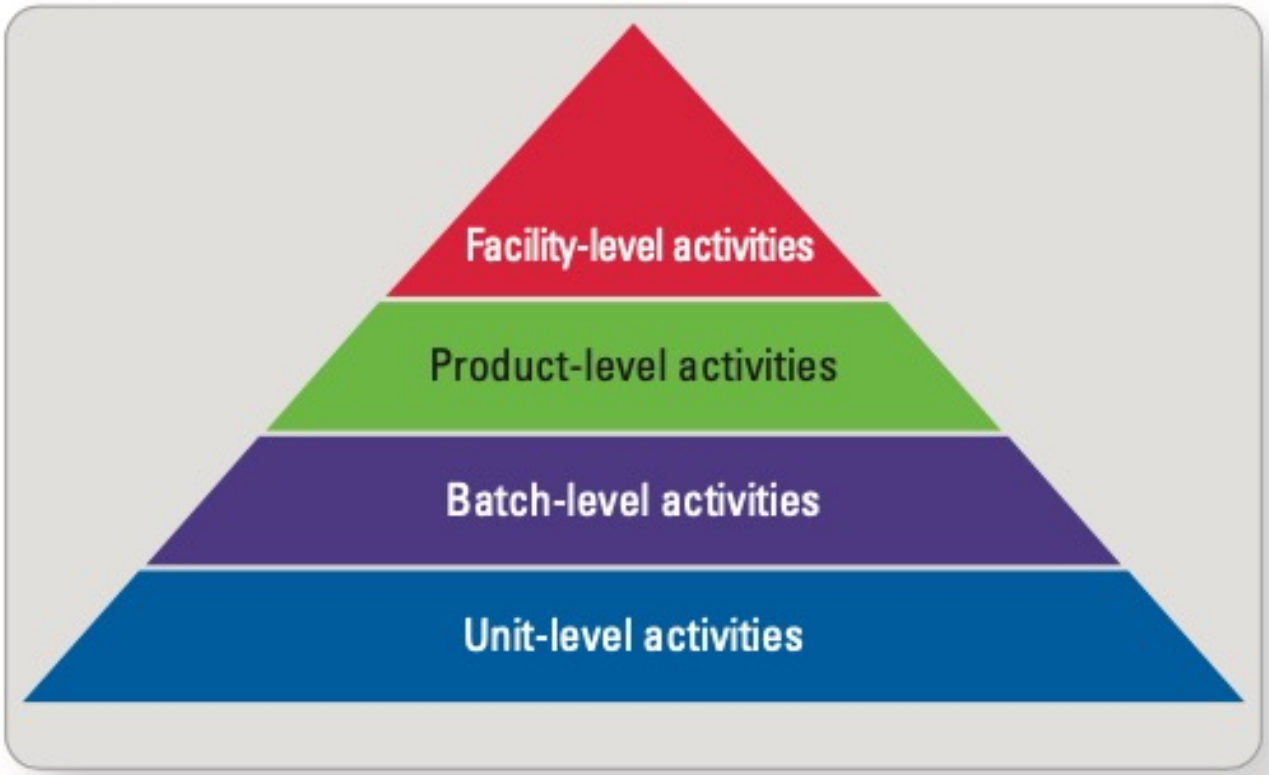
- If a company refines its costing system using departmental overhead rates or ABC, will manufacturing overhead still be overallocated or underallocated by the end of the year?

Discussion 2

- Do the journal entries used to record job costing differ if a manufacturer uses a refined cost allocation system (departmental overhead rates or ABC) rather than a single, plantwide overhead rate?

The Cost Hierarchy

EXHIBIT 4-20 The Cost Hierarchy



Objective 3

Understand the benefits and limitations of ABC/ABM systems

Why?

- We see how companies can increase the accuracy of their product costing systems by using departmental overhead rates or ABC.

- How managers use this improved cost information to run their companies more effectively and efficiently?

Activity-Based Management (ABM)

- ABM refers to using activity-based cost information to make decisions that increase profits while satisfying customers' needs.
- Using ABC information to make decisions
  - Pricing and product mix
  - Cost cutting
  - Planning and control

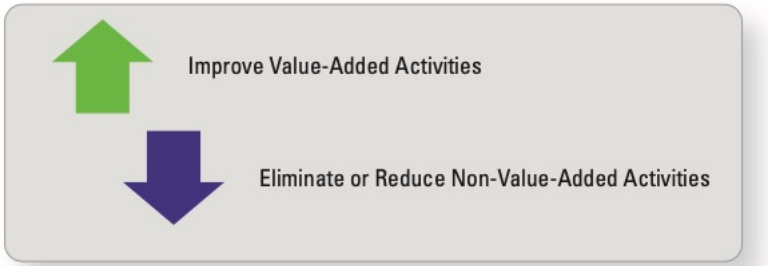
Pricing and Product Mix Decisions

- Change the prices for products after identifying the different total cost
- Decide to market the higher profitability product
- Shift the product mix away from less-profitable products

Cutting Costs

- Analyze costs in value chain
  - Value-added activities
  - Non-value-added activities
- Value-added vs. non-value-added
- Value-Engineering

EXHIBIT 4-22 The Goal of Value-Engineering



How to determine

- One way determining whether an activity adds value is to ask if it could be eliminated or reduced by improving another part of the process.
- For later: tools that many companies have adopted to identify and eliminate these costly non-value-added activities.

Planning and Control Decisions

- Uses the costs of activities to create budgets
- Compare with actual activities to see if goals are being met

Using ABC Outside of Manufacturing

- Merchandising and service: Find the most profitable product or service

- Manufacturers: Allocate operating activities

Using ABC in Service and Merchandising Companies

- Accounting firm:

Secretarial support, software costs, and travel costs between its tax, audit, and consulting clients.

- Walmart:

Operating activities like Housewares, Clothing, and Electronics Departments.

Cost Benefit Test

- Do the *benefits* of adopting ABC/ABM *exceed* the costs?

- Benefits are higher for companies in competitive markets:
  - Accurate product cost information is essential
  - ABM can pinpoint cost savings opportunities

- Benefits are higher when risk of cost distortion high:
  - Many different products, many different types/amounts of resources
  - High indirect costs
  - High- and low-volume products

Costs of Adopting ABC

- Generally lower with:
  - Accounting and information system expertise to develop the system
  - Information technology

- Are companies glad they adopted ABC?
  - 89% of the companies say that it was worth the cost
  - Not a cure-all, but helps managers understand costs better

Signs the Old System May Be Distorting Costs

- Cost system may need repair when
  - Managers don't understand costs and profits
  - Bids are lost when expected to win
  - Win bids expected to lose
  - Competitors price similar products much higher or much lower
- The cost system may be outdated if there is a diversified product line

Objective 4

Describe lean operations

Traditional Production Systems

- Keep large inventories on hand
- Problems:
  - Storage cost
  - Hide quality
  - Bottlenecks and obsolete products
- Solution: **Lean productions system**

Lean Thinking

- Philosophy and a business strategy
- Primary goal: Eliminate waste and cost
- Focus of JIT
  - Purchase raw materials *just in time* for production
  - Finish goods *just in time* for delivery

Pros to Lean Production Systems

- Defects: producing defective products or services cost time and money
- Overproduction: making more than product than needed or making product sooner than it needed
- Waiting: employees must often wait for parts, materials, information, or machine repairs before they can proceed with their tasks

Pros to Lean Production Systems

- Not utilizing people to their full potential: wisdom of crowds
- Transportation: excess movement of parts, inventory, and paperwork

e.g. caused by poor plant layout, large centralized storage cribs

- Inventory: too many inventories
- Movement: waste of transportation
- Excess processing: e.g. IKEA

Drawbacks to Lean Production Systems

- Vulnerable when problems strike suppliers or distributors

- Examples
  - Delays in delivery
  - Personnel problems—union strikes
  - Shortage of parts due to recalled products
  - Weather related issues

Sustainability and Lean Thinking

- Both seek to reduce waste
- Lean focus on internal: economic profits
- Green focus on external
- Lean and Green

Firm should be cognizant of all waste that could harm the planet.

Objective 5

Describe and use the cost of quality framework

Total Quality Management

- Goal: Provide customers with superior products and services
- Continuous improvement
- More investment up front to generate savings in the back end of the value chain

Cost of Quality (COQ)

- Cost of quality reports categorize and list the costs incurred by the company related to quality.
- Four categories

Four Types of Quality Costs

1. **Prevention costs**—Avoid poor quality goods or services

Caused: variability of the production process/ complexity of the product design

- Employee training
- Improved materials
- Preventive maintenance

Four Types of Quality Costs

2. **Appraisal costs**—Detect poor quality goods or services

Appraisal costs are **a specific category of quality control costs**. Companies pay appraisal costs as part of the quality control process to ensure that their products and services meet customer expectations and regulatory requirements. These costs could include expenses for field tests and inspections.

- Inspection throughout production
- Inspection of final product
- Product testing

Four Types of Quality Costs (cont.)

3. **Internal failure costs**—Avoid poor quality goods or services *before* delivery to customers
   - Production loss caused by downtime
   - Rejected product units

4. **External failure costs**—Incurred *after* defective product is delivered
   - Lost profits from lost customers
   - Warranty costs
   - Service costs at customer sites
   - Sales returns due to quality problems

Summary of Four Types of Quality Costs

EXHIBIT 4-29 Four Types of Quality Costs

Prevention Costs	Appraisal Costs
Training personnel	Inspection of incoming materials
Evaluating potential suppliers	Inspection at various stages of production
Using better materials	Inspection of final products or services
Preventive maintenance	Product testing
Improved equipment	Cost of inspection equipment
Redesigning product or process	

Internal Failure Costs	External Failure Costs
Production loss caused by downtime	Lost profits from lost customers
Rework	Warranty costs
Abnormal quantities of scrap	Service costs at customer sites
Rejected product units	Sales returns and allowances due to quality problems
Disposal of rejected units	Product liability claims
Machine breakdowns	Cost of recalls

Four Types of Quality Costs (cont.)

- **Conformance cost:** all expenses incurred to ensure that a product meets the minimum quality standard

Prevention Cost & Appraisal Costs

- **Non-conformance cost:** costs incurred because the product or service is defective

Internal Failure Cost & External Failure Cost

Non-Manufacturing Costs of Quality

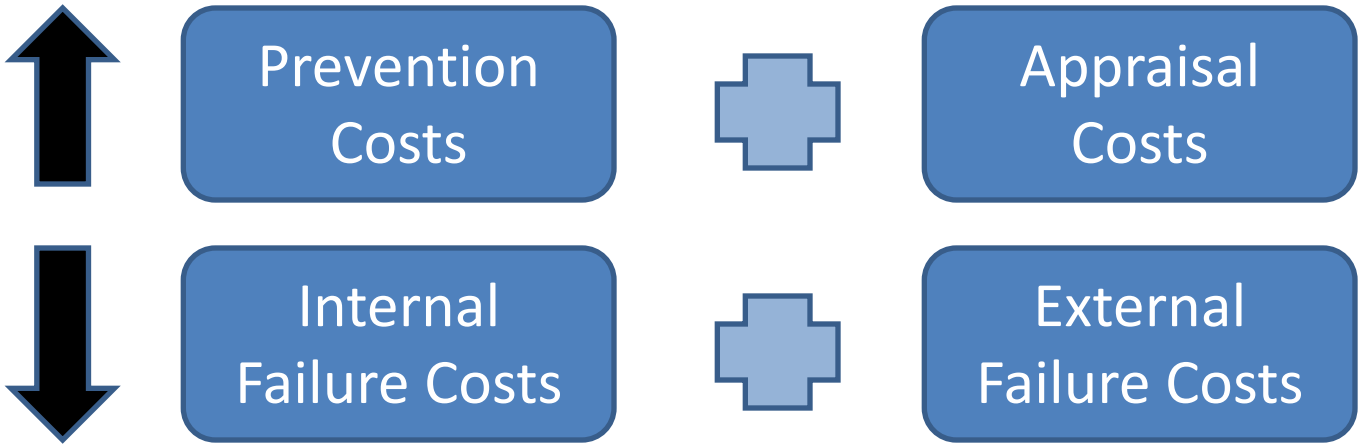
- Service firms and merchandising companies also incur costs of quality

- Prevention
  - Professional training to their staff
  - Develop standardized service checklists

- Appraisal costs
  - Review work continuously
  - Inspect before releasing

Cost of Quality Report

- Identifies, categorizes, and quantifies all of the costs it incurs relating to quality.
- Calculate the percentage of total costs of quality that are incurred in each cost category
- Use as a framework for decisions



Cost-Benefit Analysis (Exhibit 4-30)

	A	B	C	D
1	**Global Fitness Costs of Quality Report Year Ended December 31**	**Costs Incurred**	**Total Costs of Quality**	**Percentage of Total COQ**
2				
3	**Prevention Costs:**			
4	Employee training	$ 125,000		
5	Total prevention costs		$ 125,000	6.1%
6				
7	**Appraisal Costs:**			
8	Testing	$ 175,000		
9	Total appraisal costs		$ 175,000	8.5%
10				
11	**Internal Failure Costs:**			
12	Rework	$ 300,000		
13	Cost of rejected units	50,000		
14	Total internal failure costs		$ 350,000	17.0%
15				
16	**External Failure Costs:**			
17	Lost profits from lost sales due to poor reputation	$ 1,000,000		
18	Sales return processing	175,000		
19	Warranty costs	235,000		
20	Total external failure costs		$ 1,410,000	68.4%
21				
22	**Total costs of quality**		$ 2,060,000	100.0%
23				

Now turn to E4-27A

Clason Corp. manufactures radiation-shielding glass panels. Suppose Clason is considering spending the following amounts on a new TQM program:

Strength-testing one item from each batch of panels	$62,000
Training employees in TQM	$23,000
Training suppliers in TQM	$34,000
Identifying preferred suppliers that commit to on-time delivery of perfect quality materials	$51,000

Clason expects the new program to save costs through the following:

Avoid lost profits from lost sales due to disappointed customers	$85,000
Avoid rework and spoilage	$66,000
Avoid inspection of raw materials	$49,000
Avoid warranty costs	$25,000

Requirements

1. Classify each item as a prevention cost, an appraisal cost, an internal failure cost, or an external failure cost.
2. Should Clason implement the new quality program? Give your reason.

E4-27A

Prevention costs

- Training employees in TQM
- Training suppliers in TQM
- Identifying preferred suppliers who commit to on-time delivery of perfect quality materials

E4-27A (cont.)

Appraisal costs

- Strength testing one item from each batch of panels
- Avoid inspection of raw materials

Internal failure costs

- Avoid rework and spoilage

E4-27 (cont.)

External failure costs

- Avoid lost profits from lost sales due to disappointed customers
- Avoid warranty costs

E4-27A (cont.)

Costs of Adopting New Quality Program:

Prevention costs:	
Training employees in TQM	$ 23,000
Training suppliers in TQM	34,000
Identifying preferred suppliers	51,000
Appraisal costs:	
Strength testing	62,000
Savings on inspection of raw materials	(49,000)

E4-27A (cont.)

Quality report (continued from prior slide):

Internal failure costs:	
Savings on rework and spoilage	$ (66,000)
External failure costs:	
Savings on formerly lost profits	(85,000)
Savings on warranty costs	(25,000)
Net (Benefit)	($55,000)

Another example

EXHIBIT 4-31 Cost-Benefit Analysis of Global Fitness's Proposed Quality Program

	A	B	C	D
1	**Global Fitness Quality Initiative Cost Benefit Analysis**	**(Costs) and Cost Savings**	**Total (Costs) and Cost Savings**	
2				
3	**Prevention Costs:**			
4	Reengineer the production process	$ (750,000)		
5	Supplier screening and certification	(25,000)		
6	Preventive maintenance on equipment	(75,000)		
7	Total additional prevention costs		$ (850,000)	
8				
9	**Appraisal Costs:**			
10	Inspect raw materials	$ (100,000)		
11	Total additional appraisal costs		$ (100,000)	
12				
13	**Internal Failure Costs:**			
14	Reduction of rework costs	$ 250,000		
15	Total internal failure cost savings		$ 250,000	
16				
17	**External Failure Costs:**			
18	Reduction of lost profits from lost sales	$ 800,000		
19	Reduction of sales return	150,000		
20	Reduction of warranty costs	225,000		
21	Total external failure cost savings		$ 1,175,000	
22				
23	**Total savings (costs) from quality programs**		$ 475,000	
24				

End of Chapter 4