

# Process and Activity-Based Costing

Managerial and Cost Accounting

Larry M. Walther; Christopher J. Skousen



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Larry M. Walther

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# Process and Activity-Based Costing

## Managerial and Cost Accounting

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ISBN 978-87-7681-588-2

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# Process Costing and Activity-Based Costing

Your goals for this “process costing and activity-based costing” chapter are to learn about:

- The purpose and functioning of a process cost accounting system.
- The concept of equivalent units of production.
- Assigning total cost to completed units and units in process.
- Activity-based costing systems.



# 1. Process Costing

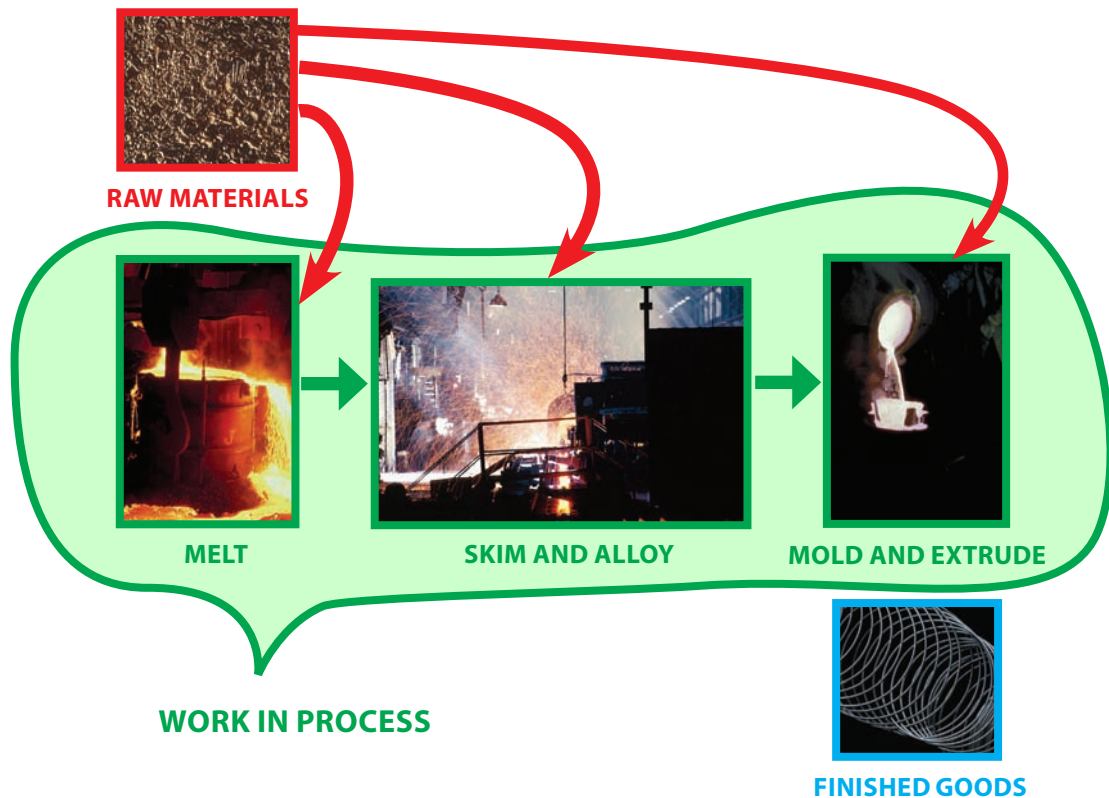
Oftentimes the production of manufactured products is easily divisible into specific jobs, and the job costing method illustrated in the previous chapter is appropriate. However, the job costing method does not work well when the production cycle involves a continuous flow of raw materials through various processing departments, and the finished output is characterized as homogenous units, each displaying the same basic characteristics. Examples of such “processes” are numerous. Wood pulp is “processed” into giant rolls of paper, refineries “process” crude oil to gasoline, iron ore is “processed” into steel, sand is “processed” into glass, and on and on. The physical nature of these “processes” makes it hard to identify and associate specific units of direct labor and direct material with the final output. For example, do you suppose anyone really knows which barrel of oil was used to produce the last tank of gasoline you purchased for your vehicle? Obviously, the crude oil was pumped from the ground, transported, put through a refinery, transported to a storage tank, etc. The molecules of oil were stirred, cracked, blended, and converted many times so that it is no longer possible to trace your tank of gasoline back to any specific barrel of oil. The gasoline was not produced as a specific job; it was the result of a “process.”

## 1.1 Process Costing

Now, if you were in charge of a refinery, how would you associate the cost of the barrels of crude oil with the gallons of finished gasoline? Logic would tell you to develop a mathematical approach that would divide the total cost of all oil and allocate it in some proportion to all the gallons of gasoline. This is the essence of “process costing.” Process costing is methodology used to allocate the total costs of production to homogenous units produced via a continuous process that usually involves multiple steps or departments.

If you are comfortable with the cost flow concepts from the prior chapter, you are already well on your way to understanding process costing. The reason is that the same cost flow concepts and accounts will be evident. That is, material, labor, and factory overhead will still occur and still be assigned to work in process. And, amounts assigned to work in process will in turn make their way to finished goods. The debits/credits and financial statement outcomes are going to look the same.

The big difference between job costing and process costing arises in the work in process “units.” Remember, under job costing we captured costs for each job (recall the discussion about job cost sheets and subsidiary amounts for each job). Under process costing, we will instead capture the costs for each process or department. Let’s think about a steel production factory. The basic processes for producing steel are to (1) melt iron ore (along with perhaps processed coal/coke and limestone), then (2) skim the material while adding alloys to adjust for tensile strength and flexibility, and finally (3) oxygen blast and extrude the material into its finished form (I-Beams, sheet steel, coils, etc.). Below is a representative graphic:



### 1.2 Comparing Job and Process Costing

The first thing you should note in the above graphic are familiar inventory categories relating to raw materials, work in process, and finished goods. However, rather than observing work in process as being made up of many individual/discrete jobs, you now begin to see that it consists of individual/discrete processes - melt, skim/alloy, mold/extrude. You will also note that material can be introduced into each process - ore in the melt stage, alloys in the skim/alloy stage, etc. (this is equally true for labor and overhead). This necessitates the employment of a separate Work in Process account for each major manufacturing activity. Examine the graphic on the top of the next page that compares job and process costing, noting in particular the difference in how costs are shifted out of work in process. Process costing entails handing off accumulated costs from one department to the next.

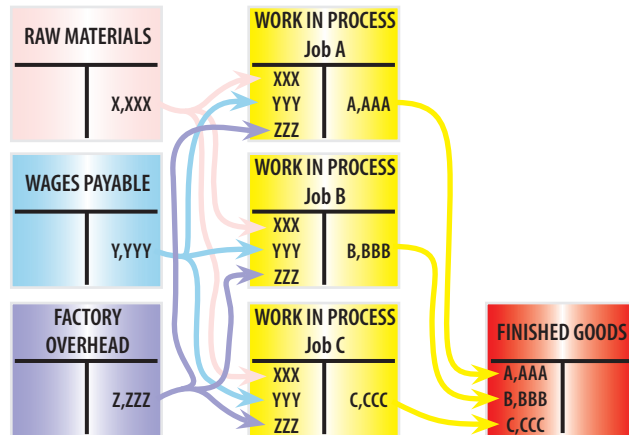
### 1.3 Introduction to the Cost of Production Report

With a job costing system, the costs of each job were tabulated on some form of job cost sheet. A similar tabulation of costs is needed for process costing, but with emphasis on costs by department. The cost report that is prepared for each department is termed a cost of production report. The graphic on next page illustrates this important comparative distinction.

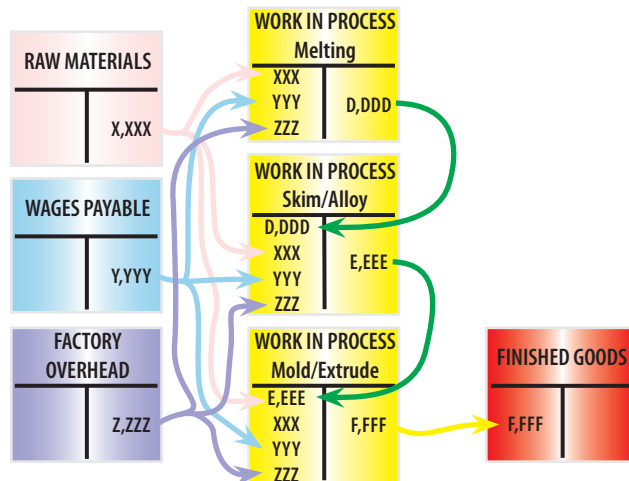
The cost of production report provides comprehensive information on the material, labor, and overhead incurred within each department during a period. It is the primary source document for determining how those costs are allocated to actual production. Soon, we will look more closely at the specific content of a production cost report. But, first, it is necessary to introduce a new concept called “equivalent units” of production.



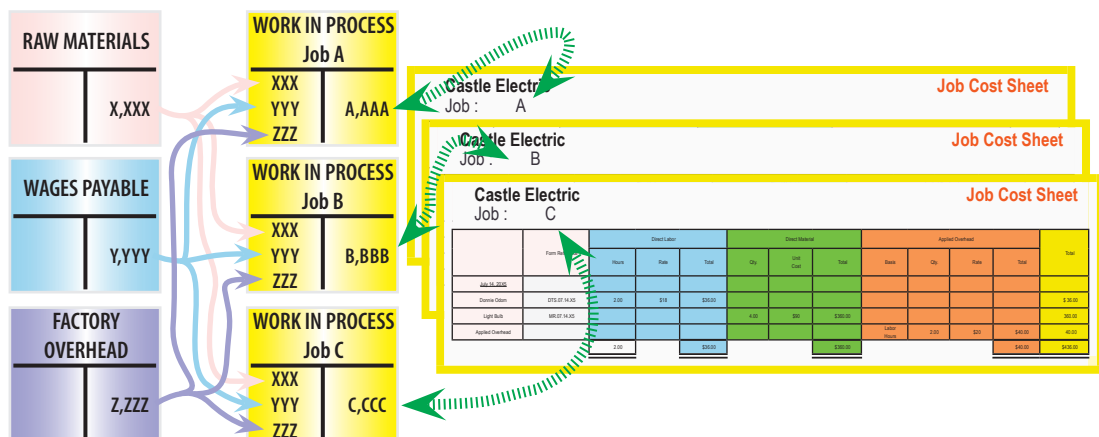
### 1.4 Job Costing Flows



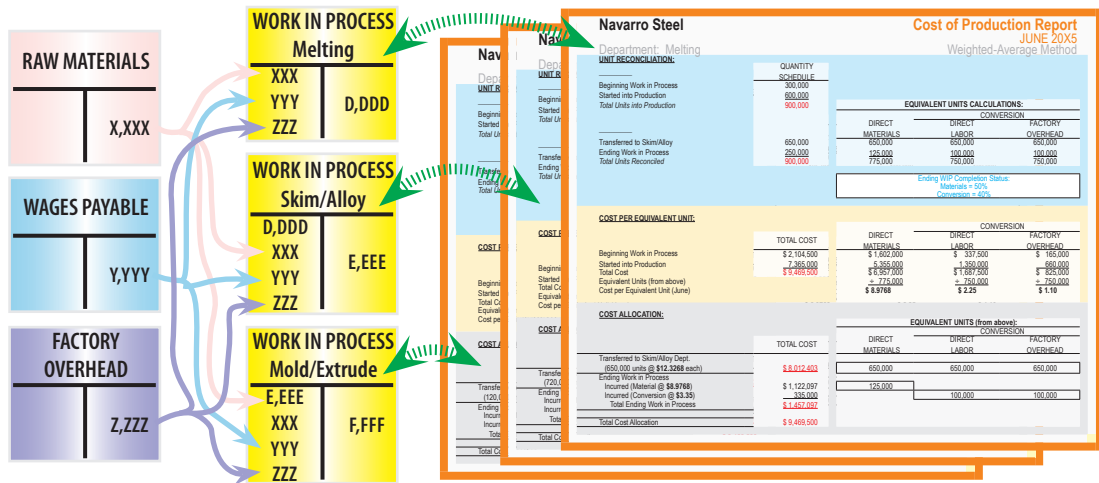
### 1.5 Process Costing Flows



### 1.6 Job Costing Flows on Job Cost Sheets



### 1.7 Process Costing Flows on Cost of Production Reports



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## 2. Equivalent Units

One feature of process costing scenarios is that inventory is usually produced in a continuous process. Production does not start and stop just because a calendar page is being flipped. It is very likely that goods will be in various stages of production within each department at the end of each accounting period. For example, at the end of each month, Navarro Steel may have vats of iron ore that are in the process of being melted, other pools of material may have been skimmed but not yet laced with the requisite alloys, and partially cooled material may be awaiting the extrusion process. How are the costs incurred to be allocated between work in process versus finished goods?

To deal with the aforementioned question, accountants have devised the concept of an equivalent unit. An equivalent unit is a physical unit expressed in terms of a finished unit. As a simple example, ten units in process that are 30% complete equates to three equivalent units of output. None of the ten units is complete; merely the equivalent amount of work necessary to complete three units is said to be performed. As you might suspect, this determination of equivalent units is a bit abstract.

### 2.1 Factors of Production

For starters, it is necessary to consider equivalent units relative to each of the factors of production. In other words, 80% of necessary direct material may be in process, but only 60% of the direct labor and factory overhead (i.e., conversion cost) has been incurred. Therefore, proper costing methodology for 100 units in process would require us to state that 80 equivalent units have been produced based on material, while 60 equivalent units based on conversion have been produced.

To assess the equivalent units of production requires careful reasoning about the amount of direct material injected into production for each department, relative to the total amount of direct material that will ultimately be needed to complete the process within that department. This type of assessment must be repeated for direct labor and overhead (i.e., conversion costs). If overhead is applied based on labor, the process is simplified because the “percent complete” would be the same for labor and overhead. However, if overhead is applied on some other basis (like machine hours) then a separate determination of equivalency would be needed for labor and for overhead (note: the illustrations within this chapter will assume overhead is applied based on labor, and the equivalent units for labor and overhead are therefore shown to be the same -- but be aware that such is not always the case).

### 2.2 An Illustration of Equivalent Units Calculations

To better understand equivalent units, let's focus on an example for Navarro Steel. To begin, one needs to identify the total units that are to be considered, no matter their stage of completion at the beginning and end of the month.

The first stage in Navarro’s production process is the Melting Department. Navarro started the month of June with 300,000 tons of iron ore in process in the Melting Department. During June, an additional 600,000 tons were introduced into the melting vats. This means 900,000 total units must be “reconciled.” The quantity schedule below provides this reconciliation. It shows that 650,000 units were transferred on to the Skim/Alloy Department, leaving 250,000 tons still in process. You should not proceed to try to calculate equivalent units until you have done this reconciliation.

<b>UNIT RECONCILIATION:</b>	
	<u>QUANTITY SCHEDULE</u>
Beginning Work in Process	300,000
Started into Production	<u>600,000</u>
<i>Total Units into Production</i>	<u>900,000</u>
Transferred to Skim/Alloy	650,000
Ending Work in Process	<u>250,000</u>
<i>Total Units Reconciled</i>	<u>900,000</u>

In reconciling total units into production with the total units transferred out/still in process, it is not uncommon to come up short; many processes may involve scrap, waste, or spoilage (e.g., evaporation, spilling, etc.). Such units would be “identified” as the missing amount needed to balance the quantity schedule column. Advanced managerial accounting courses usually demonstrate the mechanics of handling the cost of spoilage within a process cost system. However, for now you should simply know that the cost of “normal” spoilage is allocated to the inventory of good units, while the cost of excessive waste is charged off as a loss on the income statement. The remaining details are left for subsequent courses.

Once the total units have been reconciled, the equivalent units are computed. The correct manipulation of the data will depend on the inventory method in use. In this illustration, Navarro is assumed to use the weighted-average costing method (first-in, first-out is illustrated later). This simplifies the process because the beginning inventory and current period production can be combined or “averaged” together; thus, the 650,000 units that were completed are counted as 650,000 equivalent units of output (a 1:1 correspondence for material, labor, and factory overhead) - - no matter their origin from beginning inventory or otherwise. However, the units in ending work in process require more thoughtful consideration. Let’s assume that the 250,000 tons in ending work in process are 50% complete with respect to material (i.e., 125,000 equivalent units) and 40% complete with respect to conversion (i.e., 100,000 equivalent units of direct labor and factory overhead). The right-hand side of the following schedule shows how the total units are translated into equivalent units:

UNIT RECONCILIATION:		QUANTITY SCHEDULE		EQUIVALENT UNITS CALCULATIONS:		
Beginning Work in Process		300,000				
Started into Production		600,000				
Total Units into Production		<u>900,000</u>				
				CONVERSION		
				DIRECT MATERIALS	DIRECT LABOR	FACTORY OVERHEAD
Transferred to Skim/Alloy		650,000		650,000	650,000	650,000
Ending Work in Process		250,000		<u>125,000</u>	<u>100,000</u>	<u>100,000</u>
Total Units Reconciled		<u>900,000</u>		775,000	750,000	750,000
				Ending WIP Completion Status:		
				Materials = 50%		
				Conversion = 40%		

### 2.3 Cost per Equivalent Unit

The equivalent units, as determined in the blue schedule above, are carried forward into the tan schedule below (see the small arrow on the right-hand edge). This “cost per equivalent unit” schedule shows how the combined costs from beginning work in process (assumed at \$2,104,500 for Navarro, broken down between materials, labor, and overhead as shown) and current period production (assumed at \$7,365,000, again broken down as shown) are divided by the equivalent units. The result is the weighted-average cost per equivalent unit for each factor of production: direct material, direct labor, and factory overhead. The individual cost factors can be combined to identify conversion cost per equivalent unit, and overall cost per equivalent unit. It can be very important to extend the decimals beyond the “cent” level (avoid rounding) because the per unit cost may ultimately be multiplied times millions of units!

COST PER EQUIVALENT UNIT:		CONVERSION		
	TOTAL COST	DIRECT MATERIALS	DIRECT LABOR	FACTORY OVERHEAD
Beginning Work in Process	\$ 2,104,500	\$ 1,602,000	\$ 337,500	\$ 165,000
Started into Production	<u>7,365,000</u>	<u>5,355,000</u>	<u>1,350,000</u>	<u>660,000</u>
Total Cost	<u>\$ 9,469,500</u>	\$ 6,957,000	\$ 1,687,500	\$ 825,000
Equivalent Units (from above)		÷ 775,000	÷ 750,000	÷ 750,000
Cost per Equivalent Unit (June)		<b>\$ 8.9768</b>	<b>\$ 2.25</b>	<b>\$ 1.10</b>
		<div style="border: 1px solid black; padding: 2px; display: inline-block;">\$ 3.35</div>		
		<div style="border: 1px solid black; padding: 2px; display: inline-block;">\$ 12.3268</div>		

### 3. Cost Allocation to Completed Units and Units in Process

Thus far, we know that Navarro’s Melting Department incurred total cost of \$9,469,500 in producing output that entailed 775,000 equivalent units of material and 750,000 units of conversion. We also know the average cost per equivalent unit. Of course, the end objective is to allocate the total costs between work in process at the end of the month and units that were completed and transferred out during the month. This causes us to revisit the equivalent units calculations, this time applying the per unit cost to the proportion of equivalent units completed and those still in process:

<b>COST ALLOCATION:</b>		<b>EQUIVALENT UNITS (from above):</b>		
	TOTAL COST	DIRECT MATERIALS	CONVERSION	
			DIRECT LABOR	FACTORY OVERHEAD
Transferred to Skim/Alloy Dept. (650,000 units @ \$12.3268 each)	<b>\$ 8,012,403</b>	650,000	650,000	650,000
Ending Work in Process				
Incurred (Material @ \$8.9768)	\$ 1,122,097	125,000		
Incurred (Conversion @ \$3.35)	<u>335,000</u>		100,000	100,000
Total Ending Work in Process	<b>\$ 1,457,097</b>			
<b>✓ Total Cost Allocation</b>	<b>\$ 9,469,500</b>			

If you carefully examine the above, you will see that the cost assigned to completed units totals \$8,012,403. This amount is the per unit cost of \$12.3268 multiplied times the 650,000 units that were completed and transferred on. The ending work in process is \$1,457,097, determined as 125,000 equivalent units of material at \$8.9768 each, plus 100,000 equivalent units of conversion at \$3.35 each. A check mark is placed beside the total cost allocation (\$9,469,500 = \$8,012,403 + \$1,457,097) as a reminder that this schedule must allocate the entire cost incurred within the Melting Department. If the total cost allocation does not equal the total cost incurred, an error has been made.

#### 3.1 Cost of Production Report

The preceding schedules are combined into a single report called a cost of production report. The report summarizes the activity within Navarro’s Melting Department for the month of June, as shown on the facing page.

A similar report would be prepared for each Department. These reports are used for many management purposes, such as inventory control, efficiency studies, incentive pay plans, and the like. They also provide the basis for the entries that are needed to update the ledger accounts for the inventory cost allocations.



<b>Navarro Steel</b>		<b>Cost of Production Report</b> JUNE 20X5			
Department: Melting		Weighted-Average Method			
<b>UNIT RECONCILIATION:</b>					
	QUANTITY SCHEDULE				
Beginning Work in Process	300,000				
Started into Production	600,000				
<i>Total Units into Production</i>	<u>900,000</u>				
		<b>EQUIVALENT UNITS CALCULATIONS:</b>			
		CONVERSION			
	DIRECT	DIRECT	FACTORY		
	MATERIALS	LABOR	OVERHEAD		
Transferred to Skim/Alloy	650,000	650,000	650,000		
Ending Work in Process	<u>250,000</u>	<u>100,000</u>	<u>100,000</u>		
<i>Total Units Reconciled</i>	<u>900,000</u>	775,000	750,000		
Ending WIP Completion Status:					
Materials = 50%					
Conversion = 40%					
<b>COST PER EQUIVALENT UNIT:</b>					
	TOTAL COST	DIRECT	CONVERSION		
		MATERIALS	DIRECT	FACTORY	
			LABOR	OVERHEAD	
Beginning Work in Process	\$ 2,104,500	\$ 1,602,000	\$ 337,500	\$ 165,000	
Started into Production	<u>7,365,000</u>	<u>5,355,000</u>	<u>1,350,000</u>	<u>660,000</u>	
Total Cost	<u>\$ 9,469,500</u>	\$ 6,957,000	\$ 1,687,500	\$ 825,000	
Equivalent Units (from above)		÷ 775,000	÷ 750,000	÷ 750,000	
Cost per Equivalent Unit (June)		<b>\$ 8.9768</b>	<b>\$ 2.25</b>	<b>\$ 1.10</b>	
		<b>\$ 3.35</b>			
		<b>\$ 12.3268</b>			
<b>COST ALLOCATION:</b>					
	TOTAL COST	<b>EQUIVALENT UNITS (from above):</b>			
		CONVERSION			
		DIRECT	DIRECT	FACTORY	
		MATERIALS	LABOR	OVERHEAD	
Transferred to Skim/Alloy Dept. (650,000 units @ \$12.3268 each)	<u>\$ 8,012,403</u>	650,000	650,000	650,000	
Ending Work in Process		125,000			
Incurred (Material @ \$8.9768)	\$ 1,122,097		100,000	100,000	
Incurred (Conversion @ \$3.35)	<u>335,000</u>				
Total Ending Work in Process	<u>\$ 1,457,097</u>				
Total Cost Allocation	<u>\$ 9,469,500</u>				

### 3.2 Journal Entries

These journal entries are needed to record the June activity within the Melting Department:

6-30-X5	<b>Work in Process Inventory - Melting</b>	7,365,000	
	<b>Raw Materials Inventory</b>		5,355,000
	<b>Salaries Payable</b>		1,350,000
	<b>Factory Overhead</b>		660,000
	<i>To record material, labor, and overhead for the month of June for the Melting Department (see cost of production report)</i>		
6-30-X5	<b>Work in Process Inventory - Skim/Alloy</b>	8,012,403	
	<b>Work in Process Inv. - Melting</b>		8,012,403
	<i>To transfer completed units from Melting Department to Skim/Alloy Department</i>		

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The journal entries, along with the beginning work in process of \$2,104,500, result in an ending work in process of \$1,457,097. The following T-account portrays the cost flow through the Work in Process account of the Melting Department:

WORK IN PROCESS MELTING DEPARTMENT		
Beginning Balance	2,104,500	8,012,403 Transfer to Skim/Alloy
June Costs	7,365,000	
Total Debits	9,469,500	8,012,403 Total Credits
Ending Balance	1,457,097	

### 3.3 Subsequent Departments

It is very important for you to notice that the journal entry to transfer \$8,012,403 out of the Melting Department (credit) is offset with an increase in the Work in Process of the Skim/Alloy Department (debit). The Skim/Alloy Department’s T-account for June might look something like this (amounts are assumed):

WORK IN PROCESS SKIM/ALLOY DEPARTMENT		
Beginning Balance	3,500,000	14,505,400 Transfer to Mold/Extrude
Transfer From Melting	8,012,403	
June Costs	5,000,000	
Total Debits	16,512,403	14,505,400 Total Credits
Ending Balance	2,007,003	

The corresponding journal entries for the Skim Alloy Department for June are as follows (don’t forget, a debit to Work in Process of the Skim/Alloy unit was also recorded in the earlier entry):

6-30-X5	Work in Process Inventory - Skim/Alloy	5,000,000	
	Raw Materials Inventory		2,000,000
	Salaries Payable		1,500,000
	Factory Overhead		1,500,000
	<i>To record material, labor, and overhead for the month of June for the Skim/Alloy Department (amounts are assumed/note that overhead can be applied on a different basis in each department!)</i>		
6-30-X5	Work in Process Inv. - Mold/Extrude	14,505,400	
	Work in Process Inventory - Skim/Alloy		14,505,400
	<i>To transfer completed units from Skim/Alloy Department to Mold/Extrude Department</i>		

And, the Mold/Extrude Department has this T-account and related entries:

WORK IN PROCESS MOLD/EXTRUDE DEPARTMENT		
Beginning Balance	2,000,000	20,000,000 <span style="float: right;">Transfer to Finished Goods</span>
<span style="background-color: #f8d7da;">Transfer From Skim/Alloy</span>	<span style="background-color: #f8d7da;">14,505,400</span>	
June Costs	7,000,000	
Total Debits	<u>23,505,400</u>	Total Credits
Ending Balance	3,505,400	

6-30-X5	<b>Work in Process Inv. - Mold/Extrude</b>	7,000,000	
	<b>Raw Materials Inventory</b>		3,000,000
	<b>Salaries Payable</b>		3,000,000
	<b>Factory Overhead</b>		1,000,000
	<i>To record material, labor, and overhead for the month of June for the Mold/Extrude Department (amounts are assumed/note that overhead can be applied on a different basis in each department!)</i>		
6-30-X5	<b>Finished Goods Inventory</b>	20,000,000	
	<b>Work in Process Inv. - Mold/Extrude</b>		20,000,000
	<i>To transfer completed units from Mold/Extrude Department to finished goods inventory</i>		

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Notice that the costs transferred from the Mold/Extrude unit go to the finished goods inventory, since this is the final process.

### 3.4 The Big Picture

You have probably heard it said “not to lose site of the forest for the trees.” This means that the details sometimes obscure the big picture. Here, the “big picture” is to remember that we are trying to assign money spent to items produced (and still in production). By examining the schedule below of work in process, you will see that Navarro assigned \$19,365,000 to work in process and transferred \$20,000,000 to finished goods during June. As a result, total work in process inventory should have declined by \$635,000 ( $\$19,365,000$  minus  $\$20,000,000$ ); a fact that can be verified by comparing the beginning and ending work in process balances ( $\$7,604,500 - \$6,969,500 = \$635,000$ ). Navarro’s balance sheet at June 30, 20X5, would include \$6,969,500 as the work in process inventory category.

### 3.5 FIFO Process Costing

Thus far, the discussion and illustration of process costing has been based upon the weighted-average method. When you consider that the objective is to allocate cost to inventory, it should come as no surprise that other “inventory methods” can be used. One such alternative is the first-in, first-out (FIFO) method.

## 4. Activity-Based Costing

In the previous chapter you learned about job costing, and this chapter presented process costing. You may be wondering why there could possibly be a need for yet another approach to determining how much a product costs to produce. Nevertheless, in recent times a number of companies have expressed frustration with the traditional methods. This has led to an increased utilization of a uniquely different approach called activity-based costing (ABC). A simplified explanation of ABC is that it attempts to divide production into its core activities, define the costs for those activities, and then allocate those costs to products based on how much of a particular activity is needed to produce a product. Before digging into the details, it is best to first consider the pros and cons of ABC.

### 4.1 Pros of ABC

Traditional costing methods divide costs into product costs and period costs. The period costs include selling, general, and administrative items and are charged against income in the period incurred. Product costs are the familiar direct materials, direct labor, and factory overhead. You know how these costs are traced/allocated to production under both job and process costing techniques. However, some managers reject this methodology as conceptually flawed. For example, it can be argued that the cost of a finished product should include not only the cost of direct materials, but also a portion of the administrative cost necessary to buy the raw materials (e.g., many companies have a separate administrative unit in charge of all purchasing activity, like writing specifications, obtaining bids, issuing purchase orders, and so forth). Conversely, the cost of a plant security guard is part of factory overhead, but some managers fail to see a correlation between that activity and a finished product; after all, the guard will be needed no matter how many units are produced.

Activity-based costing attempts to overcome the perceived deficiencies in traditional costing methods by more closely aligning activities with products. This requires abandoning the traditional division between product and period costs, instead seeking to find a more direct linkage between activities, costs, and products. This means that products will be charged with the costs of manufacturing and nonmanufacturing activities. It also means that some manufacturing costs will not be attached to products. This is quite a departure from traditional thought.

Another benefit of ABC is that a product is only charged with the cost of capacity utilized. Idle capacity is isolated and not charged to a product or service. Under traditional approaches, some idle capacity may be incorporated into the overhead allocation rates, thereby potentially distorting the cost of specific output. This may limit the ability of managers to truly understand and identify the best business decisions about product pricing and targeted production levels. This problem was touched on in the previous chapter's discussion of capacity utilization.



### 4.2 Cons of ABC

One limitation of ABC is that external reporting must be based on traditional absorption costing methods. Absorption costing requires the traditional division between product costs and period costs, with inventory absorbing all of the manufacturing costs and none of the period costs. As a result, ABC may produce results that differ from those required under generally accepted accounting principles (GAAP). Therefore, ABC is usually viewed as supplemental in nature. It is used for internal management decision making, but it may not be suitable for public reporting (note: when the aggregate financial statement results do not differ materially between ABC and other methods, ABC can be used for both internal and external purposes).

The fact that ABC is not GAAP usually means that a company that wishes to benefit from ABC must develop two costing systems -- one for external reporting and one for internal management. Some companies feel they have enough to do without working through two costing methods! Another disadvantage of ABC is that it is usually more involved than other approaches. Rather than applying all factories overhead on some simple basis such as labor hours, it requires the development of numerous cost pools that must be individually allocated. In other words, ABC is a more intensive technique, and the costs to implement it may not be worth the trouble.

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### 4.3 The Reality of ABC

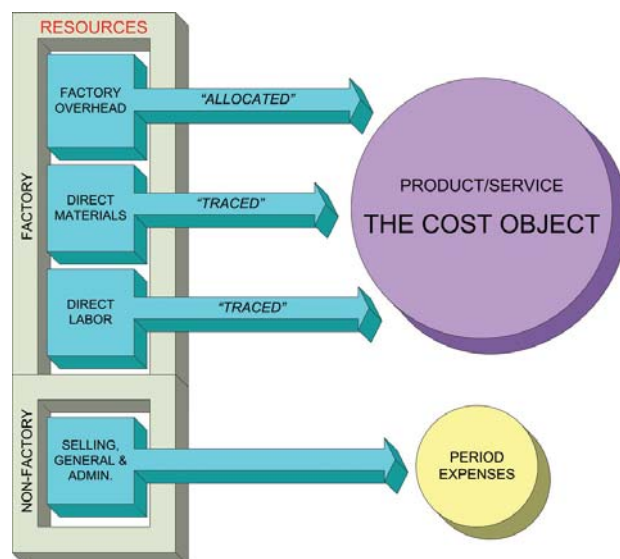
Despite the limitations of ABC, many companies utilize the method. A quick internet search will reveal millions of references to the approach, including various management consultant groups praising its merits. As you might suspect, many important business decisions about the fate of a product are based on assessment of profitability, and profitability boils down to comparing sales price to cost. Because the sales price is pretty well set, the “decision” about how to determine a product’s cost is obviously quite significant in assessing the bottom-line profitability for an individual product or service.

Now, for a single-product company with fairly stable inventory levels, this is much to do about nothing. Traditional and ABC methods will get to about the same end point. But, for multi-product/service firms, the arbitrary allocation of costs can pretty much “make or break” the perceived profitability of each product or service. As companies have grown larger and more diverse in output, there has been an accompanying concern about how costing occurs. Arguably, product diversification has been a major contributing factor into the management accountant’s pursuit of alternative costing devices like ABC.

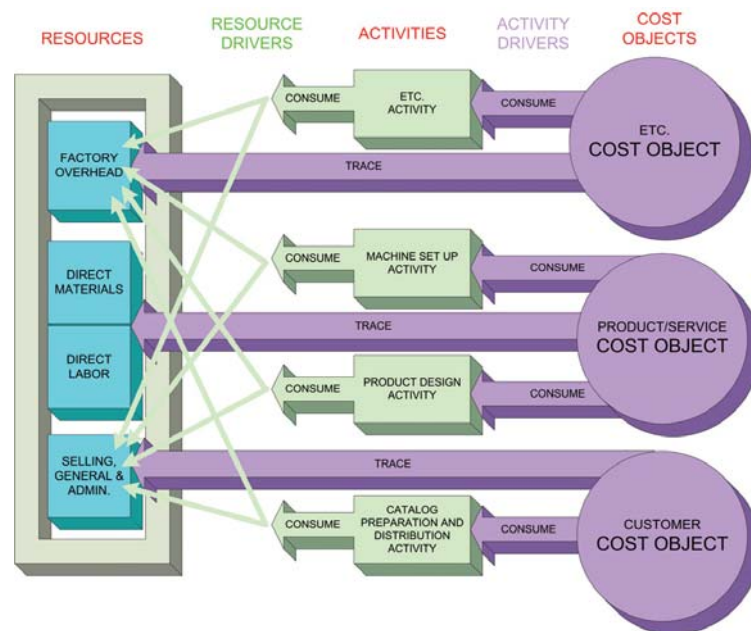
Another driver of ABC-type approaches has been the advent of computer technology. Before modern information systems, it was very expensive to manipulate data. Most firms were perfectly content to live with simple approaches that allocated factory overhead on a single basis. The ease with which data can be managed under a sophisticated information system greatly reduces the cost and error rate associated with ABC. It is not surprising that the method’s popularity is inversely related to data processing costs.

### 4.4 A Closer Look at ABC Concepts

If you think about traditional costing methods, the “cost object” is usually an end product or service. Very simply, prime costs are traced to output while factory overhead is allocated to output. Nonfactory costs do not get assigned to a product:



Compare this traditional logic to ABC, and you will see a reversal of the thought process. With ABC, the “cost objects” are broadened to include not only products/services, but other objects like customers, markets, and so on. These “cost objects” are seen as consuming “activities.” The “activity driver” is the event that causes consumption of an activity. For instance, each customer may receive a catalog, whether they order or not during a period. Preparation and distribution of the catalog is the “activity” that is being driven by the number of customers. Continuing, activities necessarily consume resources. Thus, preparation of a catalog will require labor, printing, office space, etc. Thus, activities drive the need for resources and are said to be “resource drivers.” The following graphic reveals the conceptual notion of ABC, which is quite different and much more involved than the traditional costing approaches. In reviewing the graphic, notice that costs that are directly traced to a cost object need not be “routed” through an activity:



One last item before moving on. The preceding graphic is simplistic. A business might have dozens of cost objects, hundreds of activities, and numerous resource pools to evaluate. A diagram of the interconnectivity can look like a printed circuit board design with multiple cost objects feeding off of many shared activities that in turn pull on various resources. At some point, the cost to implement and monitor ABC can exceed the benefit. Never forget the primary purpose is to allow management to get a better feel for product costs; some degree of arbitrariness will inevitably be accepted to avoid excessive complication.

### 4.5 The Steps to Implement ABC

Even a cursory review of the concepts of ABC will help you appreciate that several steps must be taken for a successful implementation:

1. **STUDY PROCESSES AND COSTS** -- It is said that ABC is process oriented. Therefore, the first step in implementing ABC is a detailed study of all business processes and costs. This extensive study will usually involve employees from throughout the organization.

Employee involvement is crucial to get the system dialed in correctly, and so that there will be acceptance of the measures produced by the system. Employees at all levels need to believe the results of the accounting system before they will truly rely on the results.

2. IDENTIFY ACTIVITIES -- Once a business is understood, care should be used in selecting the business activities that will be central to the cost allocations. Too many activities and the system will become unmanageable; too few and the information will not be meaningful. It is helpful to think of activities at different levels:
  - Unit-level activities are those activities that have a one-to-one correspondence with a unit of output. For example, a telescope manufacturer may have to perform some final calibration activity to each finished product (whether it be an entry level scope or an advanced device). Thus, calibration may be seen as an activity.
  - Batch-level activities are those activities that must be performed, but can relate to one or more units of output. In some cases, shipping can be seen as an excellent example of a batch process. Assume that Nile is an online bookstore. Some customers order only one book while others may order a dozen books at a time. In each case the customer's books must be packaged and shipped. Roughly the same activity is required independent of how many books are put in a box.

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- Product-level activities are carried out at the product level, no matter the volume of production. Product design, product marketing, and so forth are typically cited as activities that have a one-to-one correspondence with the number of end products.
- Customer-level activities can take many forms. These include technical support help lines, catalogs, sales calls, and so on. You would generally expect this category to grow as the customer base expands.

Other activity levels might be appropriate. Some businesses will identify market level activities. For example, most global companies' contract with an independent customs broker within each market served. Thus, the cost of customs brokerage services can be seen as a function of markets served. There is also entity sustaining activities. A public company in the USA must incur substantial costs to comply with the Sarbanes-Oxley legislation; this may cause the company to identify Sarbanes-Oxley compliance as a separate activity.

The identification of activities is unique to each company. The above "levels" provide a frame of reference that is helpful in considering the important activities of an organization. Consultants who specialize in ABC can also be very helpful in coaching a company as it searches for its important activities that will become central to an ABC system. As a general rule, these consultants advise to (1) develop a list of every conceivable activity, (2) segregate the activities according to level, and (3) look for logical ways to combine similar activities within each level (but not across levels as this will undermine the basis on which activity cost will eventually be allocated to cost objects).

3. IDENTIFY TRACEABLE COSTS -- Whenever a cost is solely related to a specific cost object, that cost should be traced directly to the end object. The most obvious example of this is the direct material and direct labor that goes into an end product. But, there are other examples. The preparation of a product catalog can consume many hours of indirect labor and other internal resources that would be attributable to a related activity cost pool, but it may also involve an outside printer/ postage and that cost can be traced right to the "customer" cost object.
4. ASSIGN REMAINING COSTS TO ACTIVITIES -- After sorting out the costs that can be traced to cost objects, the remaining costs are assigned to activities. Sometimes this is easy and logical, and it is sometimes challenging. As examples, there may be a separate industrial engineering group that does nothing but machine set up prior to a production run. The cost of this group is easily assigned to the machine set-up activity, which in turn will be reallocated to a variety of end products. However, it may be that the industrial engineers are messy and the janitorial group must always do a major cleanup after each machine set up. Perhaps 10% of the janitorial staff's time should be assigned to machine set up and the other 90% to general maintenance. You can see how quickly ABC can get complex!

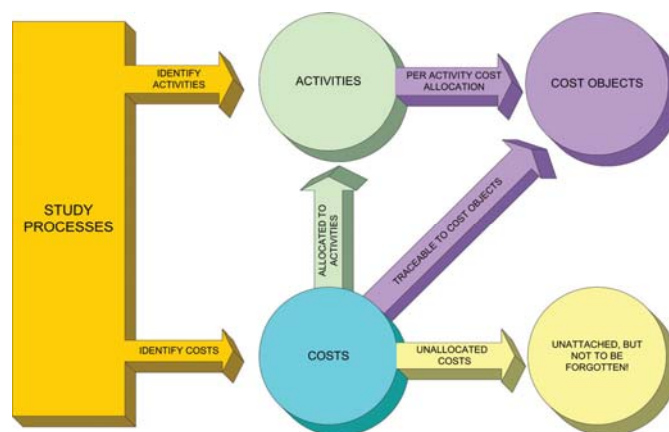


There is also the problem of trying to put a “square peg in a round hole.” Some resources are consumed and no one can agree as to the activity that consumed the resource. Someone perhaps decided that the entry gate to the factory should be nicely landscaped with seasonal flowers. What activity will absorb this cost, and more importantly, to what cost object shall this cost ultimately be attributed? If a product manager gets a bonus based on profitability for her unit, you can be sure she does not want her products to absorb any of the floral costs -- no matter how much she enjoys looking at the flowers! And, the marketing manager for a region half way around the globe surely does not want his market to bear the cost -- he and his customers have probably never seen the factory. Suffice it to say that the cost allocation decisions can be contentious, and some costs may never find a logical home. Therefore, ABC may leave some costs as unallocated.

Unallocated does not mean to “ignore”. While it may be perfectly logical to leave some costs as unallocated for purposes of identifying the cost of a specific product or other cost object, it would be foolhardy to forget about those costs in overall management of the organization. After all, they must be recovered. To survive, prices need to be high enough to recover the allocated and unallocated costs!

5. DETERMINE PER-ACTIVITY ALLOCATION RATES -- Once the costs for each activity have been determined in the aggregate, it is then necessary to unitize the cost pool. For example, if the catalog preparation activity cost pool contained \$500,000 and 200,000 catalogs were produced, then the allocated catalog cost would be \$2.50 each.
  
6. APPLY COSTS TO OBJECTS -- The final step is to utilize the activity-based rates in determining the amount of activity cost to allocate to each cost object. Continuing with the catalog illustration, we know that the allocated cost from the catalog preparation pool was \$2.50 each. Of course, this is not the total cost, this is just the allocated amount. The total cost would also include the directly traceable amounts (printing, postage, etc.). This catalog cost, along with other customer-related costs would be compiled in some form of summary report. Managers would then have a measure of how much it costs to support one additional customer. Similarly, measures would be produced for each additional cost object.

The necessary steps to develop an ABC system are summarized as follows:





### 4.6 A Simple Analogy

The objective of ABC is to derive improved measures of cost. A simple analogy might be helpful in showing how ABC can achieve this outcome.

Suppose you have two one-gallon pitchers filled with tea, one sweetened and one unsweetened. You desire to fill a pint glass with 75% sweetened and 25% unsweetened tea. You have an empty pint glass and it has no markings indicating fluid level. Is it possible for you to pour from the pitchers to the glass and achieve your special blend (no mixing within the pitchers is allowed)? About the best solution you can reach is based on guesswork.

Now, assume you also have an empty cup (remember, two cups make a pint). You now have the added tool necessary to solve your problem and get the desired blend. For instance, you could (a) pour a cup of sweetened tea and transfer it to the glass, then (b) pour a cup of unsweetened and transfer it to the glass, then (c) shake the glass to achieve a 50/50 mix, then (d) pour a cup of the 50/50 mix from the glass back into the cup, then (e) top off the half-full glass of 50/50 mix with sweetened tea, and (f) shake the glass to achieve the 75/25 mix.

With the tea example, we see that the introduction of an intermediate container (cup) enables the correct allocation of the resource (tea) to the end object (glass). The analogy to ABC is that by introducing activity cost pools (the intermediate cup) we are better able to allocate the costs (resources) to end objects (products, customers, etc.). Without the activity cost pool, it becomes difficult/impossible to make a connection between each resource consumed and each end object.

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### 4.7 A Case Study in ABC

Enough general discussion on ABC, it is now time to consider a comprehensive illustration.

David Eng enjoys portable digital music players and golf. However, he was frustrated because the cord for his digital music player interfered with his golf swing. This modern problem prompted him to form the Golf and Music Enthusiast Company (GAME).

GAME developed two specialized products. The first product is GLASSESong, a pair of sunglasses with a built in music player and very short cord to the earbud speakers. The other is CAPlayer, a golf cap with a built in music player having a very short unobtrusive cord from the cap to the speakers.

GAME has been employing traditional costing methods, and applies factory overhead on the basis of labor costs. The products sell as fast as they can be produced so there is virtually no inventory. CAPlayer has sold 900,000 units and GLASSESong has sold 1,100,000 units. Each unit sells for \$60. David Eng’s new frustration is with the CAPlayer. It is reportedly much more expensive to produce than GLASSESong. Following is an analysis of GAME’s cost of production by product:

	CAPlayer	GLASSESong
Direct material	\$ 30,000,000	\$ 44,000,000
Direct labor	7,000,000	2,000,000
Applied factory overhead (300% of direct labor)	<u>21,000,000</u>	<u>6,000,000</u>
Product cost	<u>\$ 58,000,000</u>	<u>\$ 52,000,000</u>
CAPlayer cost per unit (\$58,000,000/900,000)	\$64.44	
GLASSESong cost per unit (\$52,000,000/1,100,000)		\$47.27

Sales totaled \$120,000,000 ((900,000 + 1,100,000) X \$60), and selling, general and administrative costs totaled \$6,000,000. The result is that GAME generated a \$4,000,000 profit, computed as follows:

Revenues		\$120,000,000
CAPlayer Cost	\$ 58,000,000	
GLASSESong Cost	52,000,000	
SG&A	<u>6,000,000</u>	<u>116,000,000</u>
Profit		<u>\$ 4,000,000</u>

Despite the overall profit, the per unit cost data suggests that the CAPlayer is losing money because the \$60 per unit sales price is below the \$64.44 per unit cost. David Eng has employed a cost consultant to review GAME’s costing techniques and identify why the CAPlayer is so expensive. The consultant has returned a management report suggesting that the CAPlayer is actually much more profitable than GLASSESong. The consultant employed ABC in reaching this conclusion. Below is a review of the methods employed by the consultant:

### 4.8 Study Process and Costs

The consultant’s study of the business revealed the following additional information:

- The accompanying cost analysis details the \$116,000,000 in total costs.
- The technology and core components are basically the same for each device.
- The extra material cost in a GLASSESong relates mostly to the polarized lenses.
- The extra labor in a CAPlayer is directly related to the manual labor for sewing.
- Both devices are generally produced in batches on the same automated assembly line, at the same pace, and through the same steps.
- The automated machinery is leased from Rebel Robotics which bases its rental charges on a “units processed” basis.
- There is one production line, and it must be “set up” for each production batch.
- CAPlayers are produced in batches of 9,000 and GLASSESongs are produced in batches of 1,000 units (therefore, CAPlayer required 100 set ups (900,000 units/9,000 units per set up) and GLASSESong required 1,100 set ups (1,100,000 units/1,000 units per set up)).
- Both products were designed by an internal development team.
- CAPlayers are sold in two markets -- the Americas and Europe (market research indicated the product would not be popular in Asia).
- GLASSESongs are sold in three markets -- Asia, Europe, and the Americas.
- Blast Advertising was hired to provide a comprehensive marketing campaign called “Get Your GAME On.” This campaign was conducted in each of the three major markets, at a cost of \$1,000,000 per campaign. The campaign in Asia promoted only GLASSESong; both products were promoted in Europe and the Americas.
- A tech support department has been established to help customers download music to their devices. The CAPlayers are sold only through the world’s 1,000 most exclusive golf courses. The golf pros at these courses usually call once to learn the product and require no further assistance. The GLASSESong units are sold over the internet, and individual purchasers average one call per unit sold.

<b>Cost Analysis</b>	
Direct materials	\$ 74,000,000
Direct labor	9,000,000
Indirect labor	2,000,000
Indirect material	1,000,000
Factory maintenance	1,500,000
Robotics lease	20,000,000
Insurance	700,000
Other	<u>1,800,000</u>
<b>Total Product Cost</b>	<b><u>\$110,000,000</u></b>
<b>SG&amp;A</b>	
Management salaries	800,000
Selling expenses	500,000
Design and engineering	900,000
GAME on campaign	3,000,000
Business office rent	200,000
Accounting	<u>600,000</u>
<b>Total Period Cost</b>	<b><u>6,000,000</u></b>
<b>TOTAL COSTS</b>	<b><u>\$116,000,000</u></b>

### 4.9 Identify Activities

After carefully studying GAME Company, the consultant identified five unique activities. Costs for each of these activities was a significant consumer of resources. The robotics function related to the operation of the highly automated assembly line. A large part of the cost of robotics was tied directly to the number of units produced. Production set up was a batch level activity. The company was required to set up the assembly process for each batch of caps and glasses. Tech support was driven by the number of customers. Each purchaser of the glasses was identified as a “customer” and each golf course was identified as a “customer.” The activity driver for product design is the number of products. The advertising activity is driven by the number of markets served.

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ACTIVITY	LEVEL	METRIC
Robotics	Unit Level	Number of units produced (900,000 + 1,100,000 = 2,000,000)
Production Set Up	Batch Level	Number of set ups (100 + 1,100 = 1,200)
Tech Support	Customer Level	Number of tech support calls (1,000 + 1,100,000 = 1,101,000)
Product Design	Product Level	Number of products designed (1 + 1 = 2)
Advertising Campaign	Market Level	Number of markets (1 + 1 + 1 = 3)

#### 4.10 Determine Traceable Costs and Allocation Rates

Of the total costs, direct material and direct labor were traceable directly to the product cost object. The other costs were either deemed attributable to one of the five activities, or otherwise not allocated. The following spreadsheet was prepared based on careful analysis, interviews, and meetings. It shows what percentage of each cost category was attributable to each of the five activities – the percentages in each row must equal 100%.

Notice that none of the direct material and direct labor is attributable to an activity cost pool because it is traced to the end product. Other costs may be wholly attributable to one activity (e.g., the robotics lease cost is all attributable to the robotics activity). Finally, large portions of some costs could not be attributed to any of the identified activities and are simply placed in the Unallocated category.

Each percentage should have a logical basis (e.g., earbud speakers are very inexpensive and carried as indirect material; some of these earpieces were made into key chains to be given out free as part of the advertising campaign, thereby consuming 5% of the indirect materials pool).

	B	D	F	H	J	L	N
1							
2	ACTIVITY COST POOLS						
3	COST ANALYSIS	Robotics	Production Set Up	Tech Support	Product Design	Advertising Campaign	Unallocated
4							
5	Direct materials	0%	0%	0%	0%	0%	0%
6	Direct labor	0%	0%	0%	0%	0%	0%
7	Indirect labor	40%	20%	10%	15%	0%	15%
8	Indirect material	20%	35%	5%	20%	5%	15%
9	Factory maintenance	25%	30%	0%	5%	0%	40%
10	Robotics lease	100%	0%	0%	0%	0%	0%
11	Insurance	25%	20%	10%	0%	0%	45%
12	Other	50%	30%	10%	5%	5%	0%
13	Total Product Cost						
14							
15	<u>SG&amp;A</u>						
16	Management salaries	10%	10%	20%	20%	25%	15%
17	Selling expenses	0%	0%	15%	15%	60%	10%
18	Design and engineering	5%	5%	15%	75%	0%	0%
19	GAME on campaign	0%	0%	0%	0%	100%	0%
20	Business office rent	0%	0%	35%	25%	5%	35%
21	Accounting	5%	5%	10%	5%	10%	65%

### 4.11 Assign Costs to Activities

Next, the costs are multiplied by the percentages to make allocations to each cost pool. For example, 20% of indirect material is allocated to robotics (\$1,000,000 total indirect material X 20% = \$200,000), etc. This process is revealed in the spreadsheet on the next page.

### 4.12 Determine Per-Activity Allocation Rates

Once the total cost for each activity pool is determined, it is divided by the activity quantity metric. For example, robotics cost \$22,605,000 and 2,000,000 units were produced. Thus, this activity cost \$11.3025 per unit. This calculation is repeated for each activity cost pool, and is summarized in the lower portion of the schedule on the next page.



	B	C	D	E	F	G	H	I	J	K	L	M	N	O				
1	ACTIVITY COST POOLS																	
2	COST ANALYSIS																	
3				Robotics			Production Set Up			Tech Support			Product Design		Advertising Campaign		Unallocated	
4	Direct materials	\$ 74,000,000	0%	\$ -	0%	\$ -	0%	\$ -	0%	\$ -	0%	\$ -	0%	\$ -				
5	Direct labor	9,000,000	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-				
6	Indirect labor	2,000,000	40%	800,000	20%	400,000	10%	200,000	15%	300,000	0%	-	15%	300,000				
7	Indirect material	1,000,000	20%	200,000	35%	350,000	5%	50,000	20%	200,000	5%	50,000	15%	150,000				
8	Factory maintenance	1,500,000	25%	375,000	30%	450,000	0%	-	5%	75,000	0%	-	40%	600,000				
9	Robotics lease	20,000,000	100%	\$20,000,000	0%	-	0%	-	0%	-	0%	-	0%	-				
10	Insurance	700,000	25%	175,000	20%	140,000	10%	70,000	0%	-	0%	-	45%	315,000				
11	Other	1,800,000	50%	900,000	30%	540,000	10%	180,000	5%	90,000	5%	90,000	0%	-				
12	Total Product Cost	\$110,000,000																
13	SG&A																	
14	Management salaries	\$ 800,000	10%	80,000	10%	80,000	20%	160,000	20%	160,000	25%	200,000	15%	120,000				
15	Selling expenses	500,000	0%	-	0%	-	15%	75,000	15%	75,000	60%	300,000	10%	50,000				
16	Design and engineering	900,000	5%	45,000	5%	45,000	15%	135,000	75%	675,000	0%	-	0%	-				
17	GAME on campaign	3,000,000	0%	-	0%	-	0%	-	0%	-	100%	3,000,000	0%	-				
18	Business office rent	200,000	0%	-	0%	-	35%	70,000	25%	50,000	5%	10,000	35%	70,000				
19	Accounting	600,000	5%	30,000	5%	30,000	10%	60,000	5%	30,000	10%	60,000	65%	390,000				
20	TOTAL COSTS	\$116,000,000		\$22,605,000		\$ 2,035,000		\$ 1,000,000		\$ 1,655,000		\$ 3,710,000		\$ 1,995,000				
21				Units			Set Ups			Calls			Designs			Markets		
22	CAPlayer	900,000		900,000		100		1,101,000		1								
23	GLASSESong	1,100,000		1,100,000		1,100		1,000		1								
24	Customers (courses)							1,100,000										
25	Customers (individuals)																	
26	Markets																	
27	TOTAL ACTIVITY QUANTITY	2,000,000		2,000,000		1,200		1,101,000		2								
28	ACTIVITY COST PER MEASURE																	
29	ACTIVITY COST PER MEASURE (Total Cost/Total Quantity)			\$11.3025		\$1,695.83		\$0.9083		\$827,500		\$1,236,667						

### 4.13 Apply Costs to Cost Objects

Based upon this new information, the final step is to analyze the results. The consultant developed the following information. The top portion of this profitability analysis applies the per-activity cost information to show how the total cost of CAPlayer is actually much less than the total cost of GLASSESong. The lower portion compares costs and revenues to determine product profitability. Finally, note that the unallocated cost is included in the total column only; it is important, but not tied to either product.

<b>PRODUCT PROFITABILITY ANALYSIS</b>				
		CAPlayer	GLASSESong	TOTAL
Direct Material	Traceable			
Direct Labor	Traceable	\$30,000,000.00	\$44,000,000.00	\$74,000,000.00
Robotics	\$11.3025 per unit	7,000,000.00	2,000,000.00	9,000,000.00
Production Set Up	\$1,695.83 per set up	10,172,250.00	12,432,750.00	22,605,000.00
Tech Support	\$0.9083 per customer call	169,583.33	1,865,416.67	2,035,000.00
Product Design	\$827,500 per design	908.27	999,091.73	1,000,000.00
		<u>827,500.00</u>	<u>827,500.00</u>	<u>1,655,000.00</u>
Advertising Campaign	Asia	\$48,170,241.60	\$62,124,758.40	\$110,295,000.00
	Europe (shared)		1,236,666.67	1,236,666.67
	Americas (shared)	618,333.33	618,333.33	1,236,666.66
		<u>618,333.34</u>	<u>618,333.33</u>	<u>1,236,666.67</u>
Total Traceable and Allocated Costs		<u>\$49,406,908.27</u>	<u>\$64,598,091.73</u>	\$114,005,000.00
Unallocated Costs				1,995,000.00
Total Costs				<u>\$116,000,000.00</u>
Product Revenues		\$54,000,000.00	\$66,000,000.00	\$120,000,000.00
Total Traceable and Allocated Costs		<u>49,406,908.27</u>	<u>64,598,091.73</u>	114,005,000.00
Product Margin		<u>\$ 4,593,091.73</u>	<u>\$ 1,401,908.27</u>	\$ 5,995,000.00
Unallocated Costs				1,995,000.00
Entity Profit				<u>\$ 4,000,000.00</u>

### 4.14 What Just Happened?

By now your head is probably spinning with all the numbers. How is it possible that ABC's results were so different than the traditional costing method? In this case, traditional costing applied overhead based on direct labor costs. But, direct labor was just a small piece of the whole puzzle, and it did not fall evenly on both products. Further, the glasses required a lot more production set ups and tech support. In addition, glasses were very expensive to market in Asia because the advertising cost only benefited the one product in that market. These facts were not taken into account with the traditional costing method.

### 4.15 A Great Tool, But not a Panacea

The lesson for you as a manager or future manager is to move carefully in using cost information. It is important to fully consider many variables, some of which are not always apparent. Managerial accounting provides many tools to support your decision making task. ABC is one tool which has gained many fans, for the reasons illustrated in this chapter. It is about applying logic and reason. It provides a basis for costing and more. It enables systematic review of activities that will help you pinpoint opportunities for cost control and reallocation of capacity to higher yielding products. But, ABC is not perfect. In fact, ABC is no better than the process used to identify activities and allocation percentages. These elements are ultimately based on human judgment. Office politics can play a heavy hand in setting the components of any allocation model -- after all it is human nature for employees to want their products to appear to be performing well! Therefore, a good manager must provide strong leadership to be sure that the ABC model is constructed with financial integrity.

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