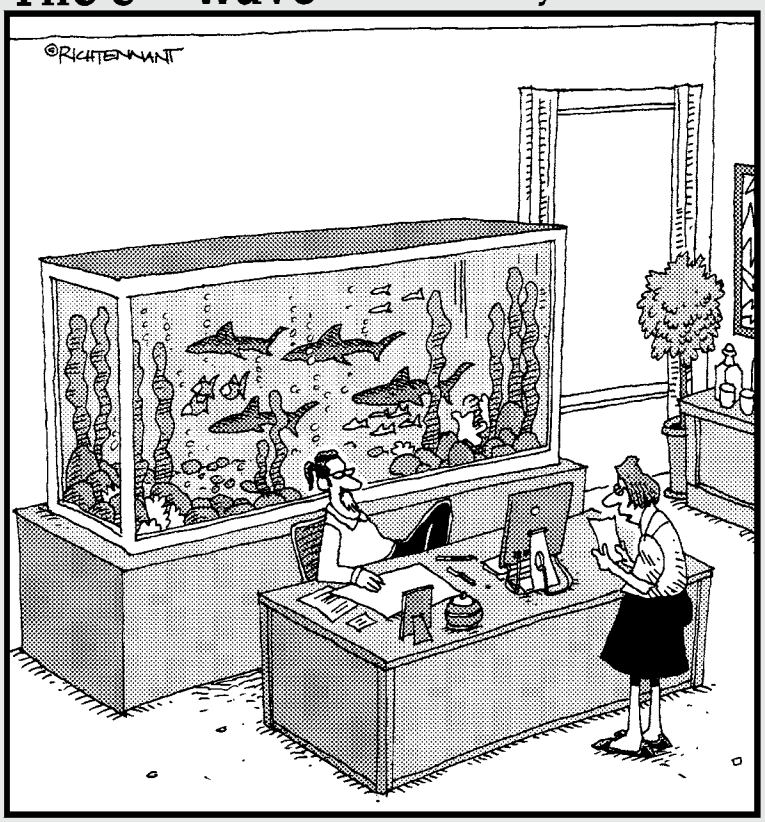
Part V
Considering Quality Issues

The 5th Wave By Rich Tennant



"Do you want the variable cost figures with or without the shark tank overhead?"

In this part . . .

Customers want products that work. If you don't sell a quality product, customers may not buy from you again! Quality has an effect on the cost of your product. Part V revolves around quality, and the costs associated with quality. Chapter 17 deals with spoilage, rework, and scrap. The chapter is all about minimizing waste in your production. Ordering costs are covered in Chapter 18, and you see an overview of quality in Chapter 19. Selling a quality product keeps customers coming back.

Chapter 17

What a Waste! Getting the Most from Spoilage, Scrap, and Reworked Products

In This Chapter

- Understanding the differences among spoilage, rework, and scrap
- Gauging the impact of spoilage
- Changing process costing totals due to spoilage
- Analyzing job costing for spoilage costs
- Reworking products and selling scrap

Spoilage is a term that describes units you produce that don't meet your production standards. There may be defects (errors) in production, or in the case of food, at some point in time the product will no longer be wholesome. Either way, you won't be able to sell substandard units to customers.

No production process is perfect. Every manufacturer ends production with stuff that's left over and not used. Accountants refer to leftover material with a low sales value as *scrap*.

Sometimes, you can repair a defective product so it meets your production standards. At that point, you can sell it to a customer. Those units are considered *reworked*.

No production process "works" all the time, so there's usually some scrap, spoilage, and rework. That costs you something, and you need to account for those costs. Allocating these costs generate an accurate total product cost. You use the total product cost to price your product and generate a profit.

Accounting for Waste

In a perfect world, there would be no waste in manufacturing and retailing. (In a perfect world, there'd be no earthquakes or hurricanes, and French fries wouldn't make you fat.) In the real world, however, some material is flawed, some products are made wrong, and items bought for retail sale get broken. This section shows you how to account for the waste in manufacturing, retailing, and craft services.

Determining the inspection point

The *inspection point* is the stage in production when you inspect the units produced to determine if they meet your standards. If so, they are units you can sell to a customer. If not, you consider whether the units can be reworked and sold later. The inspection point is also the time when you determine if any spoilage is avoidable or unavoidable.

Consider the timing of the inspection. Ideally, units should be inspected at each stage of the production process. Cost accountants assume that the spoilage occurs at the completion of a particular production stage, and that that's when the goods are inspected. So, for example, if your company bakes 200,000 cookies per day, the inspection point would be when the cookies exit the oven. Then it's obvious that any spoilage happened in the baking department.

Understanding spoilage and scrap

The *matching principle* (a term made popular throughout this book and a fundamental accounting principle) matches the costs incurred to produce a product with the revenue generated from selling it. The problem with the cost of spoilage and scrap is that you can't directly *trace* it to a product you've sold. You have to *allocate* it.

Spoilage and scrap are *not* the costs making a single finished unit. Just the same, the units you sell must absorb some of this costs. So although spoilage and scrap don't relate directly to finished units, they do relate *indirectly*.

If it's any consolation, you may be able to sell scrap as something else — a different product with a lower sales value. For example, beef processors (also known as slaughterhouses) sell any usable scrap, edible or not, to a rendering plant. That decision allows you to increase the revenue you earn from your production process.

Even though the additional revenue is great to have, the revenue produced by scrap isn't revenue from the primary product. They aren't (and you aren't) running production to generate scrap revenue.

A *factory second* is an item that's spoiled, in that it failed quality inspection and doesn't meet your standards. But with a factory second, there's nothing intrinsically wrong with the product. The finish on an electric guitar might have a blemish (a "blem"), but the guitar plays fine. A garment might have a "holiday" in the fabric, or a seam isn't perfectly sewn. Still, it's a wearable garment. And bread sold at a big bakery's retail outlet (a "bakery thrift shop") may be day-old bread, but it's still good. The point is, you may be able to make money by selling so-called spoiled items.

Differentiating normal or abnormal spoilage

Not all spoilage is created equal. As you look at your production results, you need to distinguish between *normal spoilage* and *abnormal spoilage.*

Normal spoilage occurs even in the best of production environments. No matter how efficiently you work, you still incur normal spoilage. That's because there are limitations to any production process. For example, if you're baking 200,000 cookies per day in a continuous baking oven, consistency is vital. The trouble is that even with the best of ovens, there's spoilage you can count on. It could be as simple as cookies breaking when they leave the belt, and that situation might be costly to fix. If the vast majority of cookies are coming out fine, the breakage is considered to be normal spoilage.

The *matching principle* connects your production costs to production revenue. You include the cost of normal spoilage as part of cost of goods manufactured. That makes sense, because some normal spoilage is inevitable. It's a normal part of the production process.

Because normal spoilage always shows up, you spread the cost over the *good units* you sell. Good units are those that meet your standards — items that are sellable to a customer.

Abnormal spoilage is spoilage beyond what you normally expect in production. Accountants also define the term as spoilage that wouldn't happen if you operated efficiently. If you have spoilage you can avoid, you have abnormal spoilage.

As a business owner, you're probably starting to think about your staff and machinery. Consider just how well your operation is running. If machines aren't kept in good working order, they won't operate correctly, and the goods they produce may be defective. These are costs that can be avoided.

Assume again that you're baking 200,000 cookies per day in a continuous baking oven. You can overbake or underbake if the heat distribution is wrong, or if the wheels and pins in the chain aren't well lubricated. Some cookies won't meet the standard. The defective units generate abnormal costs. Some machine problems are unavoidable, but the lack of proper maintenance *is avoidable.*

Keep your thinking cap on!

You may be able to turn costs you "can't recover" into a profit center. For a classic case of cost recovery, consider world-famous Jelly Belly jelly beans, a favorite of President Ronald Reagan. Jelly Bellys have their share of normal spoilage, because the company makes 14,800,000,000 jelly beans per year. So what do you do with out-of-spec Jelly Bellys? You sell them as Belly Flops. The official website says, "Belly Flops are no less flavorful, or lovable, than regular Jelly Belly jelly beans; they just come in wild shapes and sizes. You may find one that's round, one that's square, or you may even find a bunch stuck together."

If you bake cookies in batches, you cut the dough as precisely as you can, but the dough surrounding the cookies be left over. (Come to think of it, this book is all about leftover dough. That's a little cost accounting humor for you.) Anyway, the excess dough is neither avoidable nor unavoidable spoilage; it's scrap. "Donut holes" were scrap until someone figured out that they could be a product.

If an employee isn't properly trained, he or she may make mistakes, and those errors may produce a defective product. For example, an employee who isn't trained properly to monitor baking oven temperature may cause overbaking or underbaking. That would produce defective units and avoidable (hence, abnormal) costs.

Accountants post the cost of abnormal spoilage to a "loss for abnormal spoilage" account. The loss isn't related to cost of goods manufactured. Instead, abnormal spoilage is a separate cost that you can't recover.

Expiration date: A special kind of spoilage

When a product reaches its expiration date, it no longer meets your standards. The product can't be sold to a customer. Say you own a grocery store; consider milk that goes bad. When that milk expires and can't be sold, you incur a cost. Even worse, you don't generate any revenue from that stale milk.

Grocery stores have to be precise about when they order products that are perishable — and how much they order. They need to be aware of expiration dates and plan to remove expired product from their shelves.

Spoilage and process costing

Process costing assumes that all units produced are identical — that's the assumption you make throughout this book. Step on over to Chapter 16 for more on process costing.

When spoilage creates costs in a process-costing environment, you apply the methods in this section to account for them.

Breaking out abnormal spoilage

Accountants post the cost of abnormal spoilage to a "loss for abnormal spoilage" account. The loss isn't related to cost of goods manufactured. Instead, abnormal spoilage is a separate cost that you can't recover.

As a result, abnormal spoilage isn't included as a product cost. So break it out first. Your accountant will put the cost in a loss account separate from costs of manufacturing. When you determine that a cost represents abnormal spoilage, you recognize a loss — and you're all done with that part.

Shifting to normal spoilage

Costing normal spoilage takes a little math. You add spoilage costs to cost of goods manufactured. Now consider how costs are assigned using process costing.

As units move from one production department to another, the costs move along with them. Process costing uses equivalent units to account for units that are partially complete. The percentage of completion for material cost might be different from conversion costs, and vice versa. (Recall that for a lot of products, most material costs are incurred at an early stage of production.) Equivalent units even things out. The goal is for each *equivalent unit* to have the same amount of costs attached to it.

Some of your equivalent units will be spoiled. Maybe you're running production of 10,000 magazines. As you inspect the magazines for defects, you notice that 10 magazines have pages that were printed incorrectly. Those magazines aren't sellable to customers. Because you expect some spoilage (due to the limits of your machine's capability), the ten magazines are considered normal spoilage. Normal spoilage adds costs to your goods.

So you have a choice when accounting for normal spoilage. You can include the spoiled units in your calculation of physical units and equivalent units, or you can exclude them.

Presenting normal spoilage methods

Get ready to see two costing methods for normal spoilage. You calculate equivalent units *including* spoiled units first. Then you look at the results when you *exclude* spoiled units from equivalent units.

Say you manufacture men's leather belts. Consider this information for the example:

- Material costs enter production at the beginning of the process. There is no beginning inventory for this month (January).
- Because material costs are incurred at the beginning of the process, assume that the units are 100 percent complete for material costs. So material equivalent units equal physical units. Other costs (like conversion costs) may not be complete. This analysis considers only material costs.
- You produce 6,000 units during January. Of these, 5,800 are good units that can be sold to customers. The other 200 units are spoiled. The spoilage is about 3 percent of total production (200 spoiled units ÷ 6,000 units produced × 100). Based on your experience and knowledge of the process, a 3 percent level of spoilage isn't unusual. You consider the defective units to be normal spoilage.
- Spoiled units are treated as completed goods that are transferred out.
- Ending work in process is 2,000 units. Good units completed and transferred out are 3,800 units (5,800 good units – 2,000 ending work in process).
- The total material costs to be allocated are $150,000.

Table 17-1 is the calculation of equivalent units with spoiled units included in the calculation. It calculates cost for *material only.*

Table 17-1 Equivalent Units — Spoiled Units Included

	Units	*Cost/Unit*	*Cost*
Costs incurred to date (A)			$150,000
Equivalent units (B)	6,000		
Cost per equivalent unit (A)/(B)		$25.00	
Assignment of costs			
Units completed, transferred out	3,800	$25.00	$95,000
Add spoiled units	200	$25.00	$5,000
Goods transferred out	**4,000**		**$100,000**
Work in process, ending	2,000	$25.00	$50,000
Costs accounted for	**6,000**		**$150,000**

Work your way from the top of the table toward the bottom. Cost per equivalent unit is the total cost to date ($150,000) divided by the 6,000 equivalent units cited in the text. Jump over to Chapter 16 for more detail on calculating equivalent units.

Any goods you work on during the period (whether in work in process or started during the period) end up in one of two places. They are goods completed and transferred out to finished goods inventory, or they are considered work in process. Keep in mind, however, the actual spoiled units aren't transferred to finished goods. Spoiled units aren't sellable. Finished goods are units that can be sold to a customer.

In Table 17-1, there are 4,000 units transferred out, 3,800 of which are good units (units you can sell to a customer). You treat the 200 spoiled units as completed, too. They're bad units, and you can't sell them to a customer — but you are finished working on them.

This costing method for normal spoilage equivalent units assumes spoiled units are completed. It makes sense, if you assume there's an inspection at the point of completion, and some units are spoiled.

Defective units could be reworked and sold as good units. That's not always the case, but it's possible. To be clear, the Table 17-1 and the following Table 17-2 don't take reworks into account. Check out the "Reworking a product to recoup some profit" section later for more on reworked products.

In Table 17-1, the work in process units (2,000 units), plus the completed and transferred-out units (4,000 units), total the 6,000 equivalent units at the top of the table. You've accounted for all of the units. Finally, the cost accounted for ($150,000) at the bottom of Table 17-1 agrees with the costs incurred to date at the top of the table.

So you just calculated equivalent units and accounted for normal spoilage. Table 17-1 assumes that spoiled units were *included* in the equivalent unit calculation. Now give it a try with spoiled units *excluded* from equivalent units.

Table 17-2 excludes the spoiled units. All the other variables are the same.

Table 17-2 Equivalent Units — Spoiled Units Excluded

	Units	*Cost/Unit*	*Cost*
Costs incurred to date (A)			$150,000
Equivalent units (B)	5,800		
Cost per equivalent unit (rounded) (A)/(B)		$25.86	
Assignment of costs			
Good units completed	3,800	$25.86	$98,276
Add spoiled units	0		$0
Goods transferred out	3,800		**$98,276**
Work in process, ending	2,000	$25.86	$51,724
Costs accounted for	**5,800**		**$150,000**

Here's how Table 17-2 differs from the first calculation of equivalent units:

- There are 5,800 equivalent units. You get that number by taking 6,000 total units produced and subtracting 200 spoiled units.
- Your total material costs remain at $150,000. You're spreading the same cost over *fewer equivalent units.* Your cost per equivalent unit is $25.86 ($150,000 total cost ÷ 5,800 units). The cost per equivalent unit is $0.86 higher than the cost per equivalent unit in Table 17-1.
- The good units completed are the same as Table 17-1 (3,800 units). However, no spoiled units are added to the total goods transferred out. So those same 3,800 units are transferred out (instead of 4,000 in the previous example).
- Work in process (2,000 units) is the same as in Table 17-1. The total units accounted for are 5,800 (not 6,000, as in Table 17-1).
- The costs accounted for is the same $150,000. That agrees with the cost incurred to date at the top of the table. You assign the same cost to 200 fewer units than you did in Table 17-1, because the cost per equivalent unit is higher.

Choosing a method to cost normal spoilage

Think about which method you want to use to account for normal spoilage. Consider an issue that recurs throughout this book: You go through the effort of cost accounting to identify areas where you can make improvement. Ideally, you prefer a system where a problem generates a red flag — it gets your attention so you can fix it.

Those spoiled units need to get your attention. Because most companies inspect goods periodically during production, you eventually identify the spoiled units. If you identify spoiled units sooner instead of later, however, you can evaluate your production method and make changes faster.

Normal spoilage is considered unavoidable. Normal spoilage occurs because even the best machines can break down and even the best employees can make some mistakes.

Improvement includes changing production to reduce *any* spoilage, including normal spoilage. Because you need to evaluate production constantly, you need an accounting system that identifies spoilage cost every month, quarter, or year.

The better method, according to the matching principle, to use for normal costing is to *include* spoiled units in the equivalent unit calculation. Look at the inspection process once again:

- The inspection process occurs when units are 100 percent complete. (That's not always the case. Many companies inspect goods more frequently than just at the end of production.)
- If you include spoiled units in the equivalent unit calculation, spoiled units are considered completed (and transferred out).
- Excluding the costs of spoiled units for the equivalent unit calculation "pushes" costs into ending work in process (WIP). In Table 17-2, the cost of ending WIP is $51,724. That's higher than the previous ending WIP cost of $50,000 (in Table 17-1). When the costs are pushed into WIP, they are not yet expensed. Because WIP is an inventory account, moving costs into WIP delays the recognition of cost of goods sold.

Table 17-2 assigns the same $150,000 in cost as Table 17-1, only to fewer units.

Including spoiled units in the equivalent unit calculation is the better choice. It allows you to identify spoiled units sooner. The spoiled units act as a much-desired red flag, too. Hopefully, you analyze the spoiled units and find ways to improve your production process.

Reworking a product to recoup some profit

The good news is that you can sometimes rework a defective product to make it right. The bad news is that you incur a cost to rework it. For example, if the lining in a felt hat needs to be resewn, you incur labor and material costs to make it right.

Here's where rework differs from spoilage and scrap: Rework revenue is generated from producing the primary product (felt hats). You didn't *intend* to generate rework costs. Your intention is that all hats are made to meet your standards.

Obviously, if you do have defects, the rework cost reduces your profit on each reworked felt hat you sell, but that's better than not having the hat to sell.

Applying Process Costing Methods to Spoilage

This section uses the two great process costing methods — *weighted average* and *first-in first out* (FIFO) — to account for spoilage. You find those concepts in Chapter 16. Swing, dance, or bounce over to that chapter, if you need to.

Weighing in on the weighted average costing method

You use the *weighted average costing method* to calculate costs in a process-costing environment. Now incorporate weighted average analysis into calculating spoilage costs.

To get super-psyched for the weighted average method, keep these points in mind:

- To keep it simple, you analyze only the material units and material costs for a product.
- Assume that material costs go into production at the beginning of the period. Material is 100 percent complete in any ending work in process.
- The weighted average method calculates units and costs on work done to date. The cost includes work performed in the *preceding* period (beginning WIP) and in the *current* period.

Here are the steps you take to implement process costing:

1. **Account for the physical units you produce.**
2. **Compute equivalent units, based on percentage of completion.**
3. **Total your costs and then calculate cost per equivalent unit.**
4. **Multiply your equivalent units by cost per equivalent unit.**

In this section, you're going through the same process. You're simply adding in the impact of spoilage.

Accounting for physical units

Say you manufacture an electric kitchen wall oven. Your total production cost is $1,500 per oven. A portion of that cost is for materials (plastic, steel, and aluminum). You use the weighted average method to account for costs, including the cost of spoilage. As you start the analysis for May, consider these factors:

- You *include* normal spoilage units as completed units. That means that normal spoilage units will be part of the equivalent unit calculation.
- Normal spoilage is expected to be 5 percent of production. That percentage is based on past production results and your product knowledge.
- The cost of *abnormal* spoilage won't be attached to the product. Instead, those costs are posted to a "loss for abnormal spoilage" account. Abnormal spoilage isn't part of the cost of goods manufactured.

Just as in Chapter 16, start by accounting for the physical units. Check out Table 17-3.

Table 17-3 Weighted Average — Physical Flow of Units (May)

Material Cost Analysis	*Units*	*Equivalent Units*
Work in process, beginning inventory (5/1)	100	
Units started during May	600	
Units to account for	**700**	
Completed and transferred out during May	400	400
Normal spoilage (5 percent of good units)	20	20
Abnormal spoilage (2.5 percent of good units)	10	10
Work in process, ending inventory (5/31)	270	270
Units accounted for	**700**	**700**

For these high-end ovens, material is introduced at the beginning of production. For your analysis, assume that material costs are 100 percent complete. As a result, the equivalent units are equal to the physical units. The 700 units for which you need to account equal the 700 units accounted for.

Attaching costs to equivalent units

Here are the material costs for making ovens for the period:

Total costs = cost of beginning inventory + costs added during the period

Total costs = $80,000 + $400,000

Total costs = $480,000

To calculate equivalent units, divide total costs for the period by the total equivalent units. Here's the calculation:

$480,000 total costs ÷ 700 equivalent units = $685.71 cost per equivalent unit

Table 17-4 assigns the $480,000 total cost to units produced. The table multiplies equivalent units by the cost per equivalent unit ($685.71).

Table 17-4 Weighted Average — Equivalent Units (May)

	Equivalent Units	*Cost Per Unit*	*Total Cost*
Completed, transferred	400	$685.71	$274,286
Normal spoilage	20	$685.71	$13,714
Cost of good units	**420**	**$685.71**	**$288,000**
Abnormal spoilage	10	$685.71	$6,857
Work in process, ending	270	$685.71	$185,143
Totals	**700**		**$480,000**

Note in Table 17-4 that the cost of good units includes both units transferred out and the normal spoilage. The total units (700) agree with the total in Table 17-3. The total costs assigned ($480,000) agree with the total cost calculation in Table 17-4.

Normal spoilage cost ($13,714) is attached to cost of goods manufactured. Abnormal spoilage cost ($6,857) is recognized as a loss — not attached to the cost of goods.

You've assigned total material costs to the units you worked. To complete costs for the full product, you perform the same analysis on conversion costs. You finish up by adding material costs to conversion costs. That total is your full product cost for the ovens.

Doing the FIFO Hokey Pokey: Put your first in first, take your first out first

The FIFO method for process costing treats beginning work in process differently from the weighted average method for process costing.

The FIFO method divides completed and transferred units into two groups. One group is the beginning WIP units that are completed during the period (they often have a lower cost). All other completed units are considered *started and completed* during the period (they reflect current cost). Ending WIP is treated in the same way as the weighted average cost calculation; nothing special happens to it.

The equivalent units process for the FIFO method is different from the weighted average method. Consider the beginning WIP units. Equivalent units for beginning WIP include the percentage to be completed in the *current period* only (May, in this case). So here's the formula for beginning WIP's equivalent units:

> Beginning WIP's equivalent units = Beginning WIP physical units × percentage to be completed during the period

The equivalent unit calculation drives the costs assigned. Beginning WIP costs incurred during May are included in the FIFO cost calculation. Therefore, you are including the work done in May and matching it with the costs incurred in May.

Beginning WIP costs *before May* are excluded from the FIFO cost calculation. Because the costs are excluded from the cost calculation in May, so is the work you completed in the preceding period.

The scenario is basically the same as in the section "Accounting for physical units." This time, however, you use the FIFO method for process costing.

Table 17-5 shows the physical flow of units, using the FIFO method. It's similar to the format used for weighted average in Table 17-3. The one big difference is that goods "completed and transferred out during May" are split into two groups. Some completed goods were originally beginning WIP and have different costs from the goods started and completed during the period (May). Of course, Table 17-5 includes the number of spoiled units during the period.

Table 17-5 FIFO — Physical Flow of Units (May)

Material Cost Analysis	*Units*	*Equivalent Units*
Work in process, beginning inventory (5/1)	100	
Units started during May	600	
Units to account for	**700**	
Completed and transferred out during May		
From beginning work in process	100	0
Started and completed during May	300	300
Total units completed, transferred out	**400**	
Normal spoilage (5 percent of units)	20	20
Abnormal spoilage (2.5 percent of units)	10	10
Work in process, ending inventory (5/31)	270	270
Units accounted for	**700**	**600**

The 700 units accounted for equal the 700 units you need to account for. Be reminded that for these high-end ovens, material is introduced at the beginning of production, and material costs are 100 percent complete in beginning work in process. As a result, the equivalent units are equal to the physical units. (Remember that the product has not been completed because there are likely some conversion costs that are not yet finished.)

The FIFO method generates different equivalent units for beginning WIP:

- Beginning WIP units are assumed to be 100 percent complete for material costs. Because all material was added in the preceding period, no material (0 percent) needs to be completed in the current period.
- The material costs for WIP were incurred in the *preceding period.*
- The 100 physical units for beginning WIP are multiplied by 0 percent completion (in the current period) to yield zero equivalent units for May. So you're costing 600 total equivalent units versus 700 in the weighted average analysis used in Table 17-3.
- Note that units started in May (600) does not equal units started and completed during May (300). That means that 300 units (600 – 300) were started during the period but don't yet count as completed.
- Ending WIP is 270 units. That's different from the number of units started during the period and *not finished* (300). The difference is 30 units with normal and abnormal spoilage. Yes, they're considered finished, but they're no good. So they're not in ending inventory.

To calculate equivalent units, divide current costs for the period ($400,000) by the equivalent units (600). Here's that calculation:

Cost per equivalent unit = $400,000 ÷ 600

Cost per equivalent unit = $666.67

Table 17-6 multiplies the FIFO equivalent unit counts by cost per equivalent unit.

Table 17-6 FIFO — Equivalent Units (May)

	Equivalent Units	*Cost Per Unit*	*Total Cost*
Completed, transferred			
From beginning WIP	0	$666.67	$0
Started and completed	300	$666.67	$200,000
Normal spoilage	20	$666.67	$13,333
Cost of good units	**320**	$666.67	**$213,333**

	Equivalent Units	*Cost Per Unit*	*Total Cost*
Abnormal spoilage	10	$666.67	$6,667
Work in process, ending	270	$666.67	$180,000
Totals	**600**		**$400,000**

Job Costing for Spoilage, Reworked Products, and Scrap

Job costing assigns costs based on a specific job or customer. You use job costing when each customer sale incurs a different level of costs. Stroll on over to Chapter 4 for more about job costing.

People who work in "the trades" (plumbers, carpenters, and roofers, for example) use job costing. Say you own a plumbing company and work with homeowners and small commercial buildings. You're reviewing your plumbing supply costs for the week, and you notice that some brackets you used on pipes were defective.

You have several decisions to make about the defective part. You need to decide whether the spoilage is normal or abnormal. You also need to decide whether the cost should be assigned to a specific job or to *all* jobs.

The first section covers how to handle spoilage costs in a job costing environment. Later, I address job costing reworked products and scrap as well.

Making adjustments for normal and abnormal spoilage

Normal spoilage is expected under the best of circumstances. The cost is included in cost of manufacturing, and it's part of job costing. On the other hand, abnormal spoilage produces more defects than you would expect from normal production. Those costs are posted to a loss account. Abnormal costs aren't part of the cost of manufacturing or completing a customer job. They are a loss you take (which you might describe as "eating it" or "taking it in the shorts").

Assume that the defective brackets are normal spoilage. You have a good supplier for your plumbing supplies (a good supplier being a critical issue for anyone in the trades). You know from industry experience that 2 percent of the brackets you purchase may be defective because after all, they're only cheap stampings. The trouble is, you use a lot of them.

At this point, maybe you're asking, why not just go back to the supplier for a refund? Maybe that's not a good idea, because maybe you asked too much from the brackets. Specifically, you've used the brackets in such a way that they sometimes fail. It might simply be that your plumbers are putting too much stress on them (such as bending them more than the cheap metal can take). So a 2 percent failure rate isn't really based on the bracket maker's faulty production. It's based on how your plumbers use the part.

Adjustments are accounting entries posted to make corrections. Spoilage accounting entries may require adjustments. For example, you may have already moved the bracket cost (material) into work in process. When you inspect and find the abnormal spoilage, you may need to remove the cost from work in process and move the costs into a loss account. That entry is an adjustment.

You see an adjustment below for normal spoilage posted to all jobs. To keep things simple, I show the other two spoilage entries as if they were *posted correctly the first time.* Those entries don't show any adjustments, because that would make your brain explode. This approach should make the discussion more clear.

Pinning the normal spoilage on all jobs

The bracket defect isn't unique to one job. The defect could happen on any job, particularly because you use the bracket frequently. To allocate the normal spoilage to all jobs, the cost needs to be posted to *manufacturing overhead.* Those overhead costs are then moved to the work in process. Overhead costs, by definition, can't be traced to a specific product.

The bracket, however, is first considered a material cost put into production. When you write the check for the bracket, you debit (increase) material control and credit (decrease) cash. (You may also credit accounts payable instead of cash.)

The work in process account is assigned material, labor, and overhead costs that are put into production. (For an overview, take a peek at Chapter 4's flow of manufacturing costs.)

If you consider the bracket defect to be normal spoilage, you add the cost to production. Here are the accounting entries:

- Debit (increase) manufacturing overhead control and credit (decrease) material control. The cost of the brackets was originally posted to material control. This entry moves the cost into an overhead account.
- Debit (increase) work in process and credit (decrease) manufacturing overhead control. This entry allocates the cost of the brackets to production.

Now consider that if the bracket is defective, you replace it (true especially if you're using a lot of them on every job). When you buy the replacement bracket, you debit (increase) material control and credit (decrease) cash. One cost is the defective item (normal spoilage), and the other is a material cost for the job.

Posting the normal spoilage to one job

If the bracket defect is considered normal spoilage for *one particular job,* the cost should be added to production. Here are the accounting entries:

- When the brackets are purchased, debit (increase) material control and credit (decrease) accounts payable or cash.
- Debit (increase) work in process and credit (decrease) material control. This entry allocates the cost of the brackets to production *for a specific job.*

Dealing with abnormal spoilage

Unlike normal spoilage, which you expect, abnormal spoilage is a defect you don't expect. The normal spoilage for brackets is 2 percent. That rate assumes that your plumbers are using the bracket for normal use. In fact, you see the phrase *normal use* on packaging for many products.

Abnormal spoilage can happen when a part is used incorrectly. Say that a plumber uses the bracket in completely the wrong way. Not surprisingly, the defect rate (failure rate) of the part is much higher — call it 30 percent. ("Aw, these brackets keep breakin' when I try to turn them into hanging straps." "Well, Joe, they're not supposed to be deformed like that.")

One more time: Abnormal spoilage cost for job costing is posted to a loss account. The idea is that you recognize the expense (loss) immediately. Here are the accounting entries:

- When the brackets are purchased, debit (increase) material control and credit (decrease) accounts payable or cash. This is an entry you make for just about any purchase.
- Debit (increase) loss from abnormal spoilage and credit (decrease) material control by the cost of the abnormal spoilage. This transaction allocates the cost of the spoiled brackets to a loss account.

"Writing down" abnormal spoilage is consistent with the accounting *principle of conservatism.* The conservative approach is to recognize losses as soon as possible. Those losses will make their way into the financial statements. The financial statement reader will see a better picture of business activity.

Reworking and selling a product

Rework is defined as product that is produced, inspected, and found to be defective. The units are then reworked (fixed) and sold as acceptable products to a customer. Other sources define rework as repairing a nonconforming item.

Accounting entries for initial production

Say you manage a home remodeling business. Your production includes materials, labor costs, and overhead.

When you write checks for material, labor, and overhead costs, you debit a control account (material control, for example) and credit cash or accounts payable. As you move costs into production, the work in process is increased (debited), and the control accounts are decreased (credited). You can go over to Chapter 4 for a review of manufacturing costs.

The rationale for job costing is that each job has a different set of costs. So it makes sense to track each separate job on a *job costing sheet.* That sheet is a running list of the material, labor, and overhead you incurred so far for one customer job. See Chapter 4.

Even though each job has a job costing sheet, the cost accounts in your accounting system will be for *all jobs.* For example, labor costs for all jobs will be posted to a labor account.

There are accounting systems that allow you to segregate account balances by customer or job. When you put together your financial statements, the cost account balances will reflect all the jobs worked during the period.

If your accounting system doesn't have job/project management integrated, there are third-party software applications that very likely tie to your accounting software.

Assigning rework to a specific job

After inspecting your job sites, you find some normal spoilage. No front-page news. So you might allocate the cost of rework to a specific job.

Say you're putting up a special wallpaper. The wallpaper is used only for one job. It's not unusual for different remodeling jobs to have completely different material and labor costs. After all, a bath remodel requires different materials from a new kitchen, and even two bathrooms won't be exactly alike.

The wallpaper is 20 inches wide and comes in a 60-foot roll. After putting up the wallpaper, you find that a 3-foot-long area is discolored. The defect is 5 percent of the total roll of wallpaper (3 feet ÷ 60 feet × 100).

Based on your industry experience, you expect a 5 percent defect rate in a typical roll of the wallpaper. You also know the product well enough that you can treat the discolored area with chemicals and fix the color. It takes an employee 30 minutes ($15 of labor cost), and the chemicals (material) cost $50. Here's the journal entry for the rework costs:

> Debit (increase) work in process $65, credit (decrease) material control $50, and credit (decrease) labor control $15

Allocating rework to all jobs

If you determine that normal spoilage should be allocated to all units, the cost of rework should be charged to manufacturing overhead. Overhead can then be allocated to all products, based on the overhead allocation rate.

Say your remodeling business uses two-by-four treated lumber for many jobs during a particular month. You inspect the lumber for knots and other flaws before you use it in production. During the month, you find that about 3 percent of the lumber is defective. Given your industry experience, that defective rate is expected. You judge the defects to be normal spoilage.

Fortunately, your work crews have the experience to rework the lumber so it's usable. Workers sand the wood and fix flaws in its shape or appearance. Your rework cost is labor cost.

Because nearly every job uses some type of two-by-fours, you allocate all normal spoilage for two-by-fours to all jobs.

The good news is that you were able to rework the lumber and use it in production. You incurred more costs, but it's better than investing the time and money to get replacement two-by-fours and incurring the cost of the unused pieces of lumber.

When labor is assigned to a job, you debit work in process and credit either cash or wage payable control. Labor cost for rework is handled differently. When you compute the rework cost, you make this accounting entry:

> Debit manufacturing overhead control, credit wage payable control

There's a final step to get the rework costs into production. The rework costs are in manufacturing overhead control. You allocate overhead cost based on a predetermined overhead rate. You determine a budgeted overhead rate in planning. For more, take a gander at Chapter 8.

If you really want a gold star on your report card, consider budgeting for rework costs when you plan your overhead rate. Huh? Well, bear with me.

As a remodeler, you know that a 3 percent defect rate is acceptable for two-by-fours. You also have some idea of the cost to rework the two-by-fours. Because two-by-fours are allocated to all jobs, you know that the rework cost end up in a budgeted overhead account.

Your knowledge allows you to budget more precisely. Consider the normal spoilage rate for as many costs as you can. Then consider the rework costs for as many costs as you can. You can add the total dollar amount to your budgeted overhead for the year.

Making allocation decisions about scrap

Scrap is defined as material that's left over after production. Scrap has a low sales value, if it has any value at all. You sell scrap "as is." No costs are added to scrap before you sell it to someone. Keep in mind that if you add any costs (by performing more work) on an item, the unit is considered a byproduct.

Typically, the buyer will be another business — a company that can use the scrap to make a different product. The customers who buy your "real" completed products probably won't be in the market for your scrap.

An experienced manager should have some idea about how much leftover stuff a production run generates. But there's a difference between spoilage and scrap.

Again, spoilage has to do with a defective product. Scrap isn't a product at all. Instead, scrap is leftover pieces of items that were used to *make* a product. That's why your normal customers aren't interested in buying scrap. Accountants don't make a distinction between normal and abnormal scrap — it's all scrap.

You need to make decisions about allocating costs and revenue for scrap. Like spoilage, you can allocate scrap to a specific job, but you can also allocate scrap to all jobs.

Accounting for scrap is similar to accounting for inventory. (Head to Chapter 9 for more information.) You need to track where the scrap is — where it is *physically.* You do physical inventory count to verify where all the inventory is located. There's a similar process for scrap.

Track where the scrap is, and protect it against theft. After all, scrap usually has some sales value. You also need to account for any scrap cost and revenue in your accounting records.

Consider the timing of your accounting entries for scrap. Say you finish a production run for leather purses, and you have leftover scraps of leather. One option is to post accounting entries after *production.* Another option is to record the scrap accounting activity when the scrap is *sold.* Say a maker of leather baseball gloves shows up and buys your leather scraps. You could record the accounting activity when the sale occurs.

Chapter 18

Making Smart Ordering Decisions

In This Chapter

- Managing the cost of goods held for sale
- Considering economic order quantity
- Implementing just-in-time inventory management
- Understanding the supply chain approach to inventory
- Mulling over customer demand issues

Inventory is usually the largest investment for a business. When you consider how you use assets (cash, in this case), it's likely that your inventory requires a big investment. If you're a retailer, you probably spend a lot on money to stock the store. If you're a manufacturer, you have significant materials costs to manufacture your product.

You have other costs for inventory, besides the goods. You incur a cost to *order* inventory as well, and when you receive the goods, someone needs to verify that you received what you ordered. Then (if you're a retailer) you have to stock the shelves and put the rest of the inventory somewhere. That requires investing in space to hold stock. Oh, and don't forget to protect your inventory from theft!

This chapter introduces the concept of *economic order quantity,* a formula that helps you determine how often to buy inventory and how much to order. You mull over *just-in-time purchasing,* and you finish the chapter by looking at the *supply chain approach* to inventory management and the impact of customer demand on the inventory process.

The topics in this chapter are tools to help you manage ordering costs and carrying costs. You use these tools to figure out when to order, how much to order, and how to move costs through production efficiently.

Considering the Costs of Inventory

There's a lot riding on inventory choices. The cost of purchasing inventory may be your largest expense. And when you pay for inventory (which should be done within a reasonable amount of time whether the inventory moves off your shelves or not), the purchase reduces your available cash balance. This section provides cost accounting principles that may help you make good inventory decisions.

Consider the costs you incur for inventory. You know the basic principle: Stuff costs money. However, inventory is more than just writing a check for the items you put on the shelf. If you mull over the following costs, the need for tools and techniques to *control* the costs make more sense:

- **Purchasing cost:** This is the cost of an inventory item less any discounts you receive from the supplier. Purchasing cost also includes the cost of shipping the item to your location. This category is likely to be your largest cost.
- **Ordering costs:** This is the cost you incur for the process of approving, ordering, and receiving the order.
- **Carrying costs:** This is the cost of holding an inventory item and includes the opportunity cost of using assets to buy inventory. If you use assets to buy inventory, you give up the chance to use the assets to do something else. That's an opportunity cost. Head over to Chapter 11 for more.
- **Stockout costs:** An additional cost occurs each time you order an item for a customer when you are out of inventory. This category includes the opportunity cost of losing a customer order due to a stockout.
- **Quality costs:** This is the cost of selling an item that doesn't conform to the customer's needs (which generally means it's broken). Quality costs also include the cost of making sure the item is conforming to your quality standards. Head to Chapter 19 for a detailed analysis of quality costs.

Note that the list includes opportunity costs in two forms. Using cash to buy inventory, rather than for some other purpose, is a *carrying cost.* The cost (in lost revenue) of losing an order because the inventory is not available is a *stockout cost.*

Going through the ordering sequence

Take a walk through the typical ordering process. Say you own a clothing store. You need to order scarves for the upcoming fall season. A supervisor fills out a *purchase order* (PO). The form lists the amount, style, size, and unit cost of the items requested.

A manager must approve the order. He or she reviews it and verifies that the order is in the budget. The manager initials the order (by hand or electronically), which confirms approval.

The purchase order goes to the vendor (the scarf manufacturer or distributor). The vendor fills the order and ships the merchandise. When the shipping/receiving clerk opens the box, he or she finds two documents: a *packing receipt* and an *invoice.* (**Note:** Sometimes the invoice arrives by mail.)

The packing receipt confirms what's in the box — the items that were actually shipped. The manager needs to agree that the items on the packing receipt match the purchase order. This step verifies that the vendor sent what you ordered. If not, it may mean that some items are back-ordered. Perhaps the vendor can't fill the full order, and you have to wait. Generally, this is not a good thing. If the items on the receipt don't match the purchase order, it also may simply be a mistake. Call the vendor, and ask about the discrepancy.

The invoice is the bill. The store manager should verify that the invoice matches the purchase order and the shipping receipt. The manager should initial each document to confirm that they all agree.

Unless you, the owner, are also the manager (as is likely in smaller stores), all three documents (purchase order, shipping receipt, and invoice) now go to you. If you're the manager, you've already seen them. You review the documents to authorize payment, so you initial the documents and send them to the accounting department. An accounts payable clerk (AP clerk) generates a check, which comes back to you for signature. Finally, the check and a copy of the invoice are sent to the vendor.

If you're placing a lot of orders with a vendor every month, expect to see a *statement,* a summary of individual invoices. The process is the same; the owner authorizes payments only if all the invoices shown on the statement match individual invoices.

Your company incurs costs for all of the people involved with the order. The owner, manager, supervisor, and accounting clerk all spend time on orders. The *cost* of that time (salary, benefits, and so forth) amounts to ordering costs.

Carrying costs include your cost to store your inventory. You might store some inventory on the shelves at your clothing store, but what about the rest? You need a stockroom or a warehouse, and that costs money.

Taking a closer look at stockout costs

Stockout costs represent what you lose when an item is out of stock. You need to consider both the short-term and the long-term impacts of a stockout. Assume someone sees a black-and-orange scarf on your shop's website. (Black and orange? They were my high school's uniform colors.) When he or she stops by the store, that scarf is out of stock.

Consider the impact on your business. Maybe you get lucky, and the customer is willing to wait a little for the item. You still get the sale, but you may incur a higher cost for the inventory item because you're placing a small order at the last minute. The purchasing cost might be higher, and you might incur a cost to get the item shipped overnight. So you "saved the sale" but certainly have a lower level of profit.

The lower level of profit in this case means a lower contribution margin (sales less variable costs) for one scarf. For stockout costs, focus on direct costs. You don't consider fixed costs like the lease payment on your building, or indirect costs, like utility costs for the shop. Bear in mind that if you lose sales, you have to spread your costs over fewer units sold. That increases your cost per unit.

You have two types of opportunity costs if an item is out of stock. First, there's *reduced contribution margin* if you fill the order. But there's *lost contribution margin* if you lose the sale. You also risk lost contribution margin on *future orders.* Because the item wasn't in stock, maybe the customer decides to do future business somewhere else. That's why for many stores, customer loyalty is important — the customer will stick with you. It also explains why on the Internet, when a sale is lost, the customer is at another website in an instant.

Bear in mind that opportunity costs aren't posted to your financial statements. That's because the dollar amount of the impact is hard to quantify. You can't put a dollar amount on the amount of business you lose due to items that are out of stock. (However, those losses may trouble you when you go home at night.)

Calculating Inventory Quantity with the Economic Order Quantity Formula

Economic order quantity (EOQ) is a decision tool. It's a formula that allows you to calculate the ideal quantity of inventory to order for a given product. The calculation is designed to minimize ordering and carrying costs. It goes back to 1913, when Ford W. Harris wrote an article called "How Many Parts to Make at Once."

EOQ is based on the following set of assumptions:

- **Reorder point:** The *reorder point* is the time when the next order should be placed. EOQ assumes that you order the same quantity at each reorder point.
- **Demand, relevant ordering cost, and relevant carrying cost:** Customer demand for the product is known. Also, the ordering and carrying costs are certain. A *relevant cost* refers to a cost you need to consider when you make a decision. The term is used throughout this book.
- **Purchase order lead time:** The lead time is the time period from placing the order to order delivery. EOQ assumes that the lead time is known.
- **Purchasing cost per unit:** The cost per unit doesn't change with the amount ordered. This removes any consideration of quantity discounts. Assume you'll pay the same amount per unit, regardless of the order size.
- **Stockouts:** No stockouts occur. You maintain enough inventory to avoid a stockout cost. That means you monitor your customer demand and inventory levels carefully.
- **Quality costs:** EOQ generally ignores quality costs. There's a discussion of quality issues in Chapter 19.

Economic order quantity uses three variables: demand, relevant ordering cost, and relevant carrying cost. Use them to set up an EOQ formula:

- **Demand:** The demand, in units, for the product for a specific time period.
- **Relevant ordering cost:** Ordering cost per purchase order.
- **Relevant carrying cost:** Carrying costs for one unit. Assume the unit is in stock for the time period used for demand.

Note that the ordering cost is calculated per *order*. The carrying costs are calculated per *unit*. Here's the formula for economic order quantity:

> Economic order quantity = square root of [(2 × demand × ordering costs) ÷ carrying costs]

That's easier to visualize as a regular formula:

$$Q = \sqrt{\frac{2DS}{H}}$$

Q is the economic order quantity (units). D is demand (units, often annual), S is ordering cost (per purchase order), and H is carrying cost per unit.

Don't try this at home. You can research this formula, if you like, but be prepared to find the minimum point of the total cost curve by partially differentiating the total cost with respect to Q.

Say your clothing shop also sells men's hiking shoes. The model you sell costs $45 per pair. You sell 100 pairs of hiking boots a month, or 1,200 per year.

Your ordering cost is $50 per order. You added up the total time spent by everyone who's involved in the ordering process, and you figure that the combined time to process each order is one hour. Based on average salary and benefit costs, you assign a $50 cost per order.

The carrying cost per unit is $3. That rate covers the occupancy costs and insurance where the inventory is stored. The amount also accounts for the opportunity cost of carrying the inventory.

Based on the data for the hiking boots, here's your economic order quantity:

> Economic order quantity = square root of [(2 × demand × ordering costs) ÷ carrying costs]
>
> Economic order quantity = square root of [(2 × 1,200 × ($50)) ÷ $3]
>
> Economic order quantity = square root of [$120,000 ÷ $3]
>
> Economic order quantity = square root of 40,000
>
> Economic order quantity = 200

You just determined that the ideal order level is 200 units. At that level, you minimize ordering and carrying costs.

Figuring a Favorable Reorder Point

The *reorder point* is the time when you should place your next order. You use reorder point to avoid running out of inventory — a stockout situation. Lots of bad things can happen if there's a stockout.

To keep life simple, assume that the demand level is known — you know how much product you're likely to sell. You also know the order lead time.

The reorder point formula requires a unit of time. That time period can be a week, a month, or a year. The choice is up to you.

Here's the formula for reorder point:

Reorder point = number of units sold per unit of time × order lead time

Say you manage a hardware store. One of your products is a 20-ounce straight claw hammer. You decide to use one week as your unit of time. Your weekly demand level is 70 hammers. Your purchase order lead time is three weeks. Here is your reorder point for hammers:

Reorder point = 70 units × 3 weeks

Reorder point = 210 units

When your inventory level falls to 210 units, you order more hammers. You want to make sure that you don't run out before your next order arrives. Now consider *how many* more hammers. The number you order is the economic order quantity (EOQ).

Introducing safety stock: Creating a cushion

Safety stock (also known as *reserve inventory)* is the amount of inventory held at all times. You maintain the safety stock inventory, regardless of the purchases you make using EOQ. This inventory serves as a buffer against stockouts.

You maintain a safety stock to address uncertainty in the ordering process. There are several uncertainties related to purchases and inventory levels:

- **Demand:** If actual demand is higher than planned, you can sell your safety stock and avoid a stockout.
- **Purchase order lead time:** You might have a longer lead time than planned. Maybe your order takes four weeks to be delivered, rather than three weeks. If the increased lead time sharply reduces your inventory levels, you can sell your safety stock.
- **Suppliers:** Safety stock can help you meet demand if a supplier can't deliver your required purchase. A supplier may run short of product. An unusual situation (weather, or material shortage, for example) may prevent the supplier from making or shipping your product in a timely manner.

Computing safety stock

Safety stock is computed as

Safety stock = excess demand expected × purchase order lead time

Say you manage a discount store. As you prepare for the back-to-school season, you need to stock backpacks. The red mountain backpack has always been a big seller. You already determined demand for the backpack and other factors, including the economic order quantity.

As you set up your back-to-school store displays, you mull over creating a safety stock. You start by checking weekly sales from previous years, and you notice that the higher sales level has happened several times; sales have been 100 units higher than your weekly planned sales. You determine that safety stock should be 100 backpacks.

The purchase order lead time for the red mountain backpack is three weeks. Based on the data, here's your safety stock:

Safety stock = 100 backpacks per week × 3 week lead time

Safety stock = 300 backpacks

You plan to hold 300 backpacks in stock *in addition to* your regular inventory level. The 300 units are your hedge against a spike in demand or a supplier's delay in shipping product to you. If something unusual happens, you're still able to fill orders. Note that your safety stock is a separate calculation from economic order quantity.

Evaluating Prediction Error

A *prediction error* occurs when actual costs differ from your estimates. You've seen the concept of *variance* throughout the book — a variance being a difference between planned results and actual results.

You calculate the cost of a prediction error in these steps:

1. Compute economic order quantity (EOQ).
2. Calculate the relevant total cost based on your planned amounts.
3. Because you determined that your estimate is incorrect, plug in the actual data and recalculate relevant total cost.
4. Compare the relevant total cost you planned with the relevant total cost using actual data.

Calculating relevant total costs

Say you manage a large chain of sporting-goods stores that sells a light windbreaker. The jacket is popular with runners and bikers.

Here are your planned estimates for the month: Monthly demand is 10,000 jackets. The ordering cost is $70 per order. Carrying costs total $3 per unit. You calculate an economic order quantity (EOQ) of 683.13 units.

Here's the formula for relevant total cost:

Relevant total cost = [(demand × ordering cost) ÷ EOQ] + [(EOQ × carrying cost per unit) ÷ 2]

The calculation is in the form of two fractions. Compute one fraction at a time and then add them to get relevant total cost. Here's the monthly relevant total cost for the windbreaker:

Relevant total cost = [(demand × ordering cost) ÷ EOQ] + [(EOQ × carrying cost per unit) ÷ 2]

Relevant total cost = (10,000 × $70 ordering cost) ÷ 683.13 + (683.13 × $3) ÷ 2)

Relevant total cost = ($700,000 ÷ 683.13) + (2049.39 ÷ 2)

Relevant total cost = $1,024.70 + $1,024.70

Relevant total cost = $2,049.40

The relevant total cost for the windbreakers is $2,049.40 for the month. You can't purchase a fractional unit, so you round down to from 683.13 to 683 units.

Note that you can simplify calculating relevant total cost. You get to the same total cost amount by multiplying EOQ by the carrying cost (with a slight rounding difference):

Relevant total cost = EOQ × carrying costs

Relevant total cost = 683.13 units × $3 carrying cost per unit

Relevant total cost = 683.13 × $3

Relevant total cost = $2,049.39

This version of the formula is easier, so consider using it. I provide the more complex formula earlier in this section so you can see how more components for relevant total costs fit together. This version of the formula simplifies the calculation for you.

But then you learn that there's a prediction error. You determine that your actual ordering cost is $85. The cost is higher than the $70 in your plan. All of the other assumptions are correct. Your new relevant total cost is $2,258.32. That actual amount is $208.93 higher than the amount using the planned ordering amount ($2,049.39). The impact of the higher ordering cost is $208.93 for the month.

You could plug in actual results for any of the variables in the relevant total cost formula. When you recalculate the relevant total cost, you see the dollar impact of your prediction error.

Acting on a prediction error

When you find a prediction error, you need to consider whether or not to take action. If your actual results differ from your plan, it may not be that big of a deal. You need to consider the size of the difference and how you use the data. Consider the relevant total cost explanation in this section.

When the actual ordering cost is plugged into the formula, the prediction error is $208.93. Well, consider how large that difference is as a percentage of the original relevant total cost:

Prediction error as a percentage of relevant total cost = $208.93 ÷ $2,049.40

Prediction error as a percentage of relevant total cost = 10.19 percent

Most accountants would consider a 10 percent change to be meaningful. That means that difference should be investigated. If you can determine why the difference occurred, you may be able to reduce your costs and increase profit. At the least, you can use the new figure of $85 in future planning.

You need to find out why the ordering costs increased. Maybe you have a new person processing orders. Because that person is still learning his or her job, orders may be processed more slowly. When the new employee learns the process, he or she should work faster. Your ordering cost should go back down.

Consider the *total dollar amount* of the change as well as the percentage change. You might conclude that a $208 difference isn't worth taking the time to investigate. The dollar amount is too small, regardless of the percentage change.

This analysis requires judgment. When you meet with other managers in planning, consider a *scope amount.* Auditors use the term *scope* to mean the dollar amount above which a difference must be investigated. Differences or exceptions below that amount won't be analyzed.

Scope is usually based on a percentage of some total. If, for example, you're analyzing accounts receivable, you might investigate any difference greater than 5 percent of the total receivable balance. If your receivables total $500,000, you investigate any exception over $25,000 (5 percent of $500,000).

Buying more and ignoring EOQ

Your purchasing manager may buy more inventory than the economic order quantity amount. That's because the manager's performance criteria are different from the company-wide goals and criteria. The manager and the company's goals aren't aligned. This situation is referred to as a lack of goal congruence.

Goal congruence is defined as consistency or agreement of individual goals with company goals. Everyone in the organization needs to be rowing in the same direction. That process gets tough when you start to set up evaluation criteria for employees. Your staff members have different jobs with different levels and kinds of responsibility. As you set up goals for everyone, the company-wide goals can get lost.

Say preventing stockouts rewards the purchasing manager. The manager avoids stockouts by — you guessed it — buying more inventory than the company really needs. So the manager's order size is higher than the economic order quantity (EOQ).

As the old saying goes, "It's no skin off his nose." The opportunity cost of tying up more dollars in inventory isn't posted to the financial statements. The manager buys more than enough inventory, so that he or she avoids a stockout. Bottom line: The purchasing manager gets a good job evaluation (an important goal for him or her) because stockouts never happen.

If the manager buys more inventory than the EOQ, there are impacts at the company-wide level: carrying costs, ordering costs, and opportunity cost.

The carrying cost is higher. If you buy more inventory than needed, you need to store it, insure it, and protect it against theft.

Also, if the purchasing manager panics every time inventory levels decline, he or she may place frequent orders. That activity increases total ordering costs. The whole point of calculating EOQ is to *minimize* carrying costs and ordering costs. The purchasing manager's actions don't allow the company to benefit from using EOQ.

Finally, larger purchases use up more cash. As a result, the opportunity cost is higher. The more you spend on inventory, the less cash you have for other purposes. You pass up other business opportunities. The company is paying more carrying cost and has less cash for other business purposes.

The solution is to evaluate the purchasing manager using multiple criteria. For example, you may want to evaluate the manager on the company's required rate of return on investment (ROI) as well as the "no stockouts" criterion. Return on investment is addressed in Chapter 12.

A required rate of return is used to calculate opportunity costs. The extra dollars that the manager is using to buy inventory *has a cost.* Required rate of return computes a cost for the money used by the purchasing manager.

When you raise money to run your business, investors who provide the funds to you have an expectation about what they will earn on those funds. Slide on over to Chapter 1 for more on rates of return.

If the purchasing manager is evaluated on stockouts *and* required rate of return, he or she has to strike a balance. The manager wants to avoid stockouts. However, he or she doesn't want to overspend on inventory. If you explain things to the manager, he or she will probably see the benefit of EOQ and use it. Later, you evaluate the manager using both criteria.

Practicing Just-In-Time Purchasing

Just-in-time purchasing (JIT purchasing) is the strategy of purchasing goods so that they're delivered just as they're needed to meet customer demand. With JIT, when you get customer orders, you plan purchases. You purchase the minimum number of items to meet customer demand. JIT purchasing typically results in more smaller orders and frequent deliveries.

The goal of JIT purchasing is to reduce the carrying cost of inventory. Less inventory on hand means you pay less in storage and insurance costs. JIT also requires less cash in the short term.

Operating cycle is the average period of time from when you purchase inventory to when you collect cash for the sale. Say your operating cycle is 75 days. With JIT purchasing, you're buying less inventory, and therefore you're using less cash. As a result, you're not under as much pressure to collect cash.

Kicking around JIT benefits and risks

There are several benefits to JIT purchasing, but there are risks, too. You need to manage the process carefully. If you don't, you may have stockouts. Stockouts can lead to lost business — both short-term and long-term.

Two big factors can drive down the cost of your inventory: technology and long-term contracts. That's a benefit.

Using technology can sharply reduce your ordering and carrying costs. Technology allows you to create and approve purchase orders, update your inventory records, and pay for inventory electronically. Technology also allows many firms to have access to real-time inventory quantities. This change reduces the number of hours your staff spends on inventory. Fewer staff hours mean less expense.

Another big factor is long-term contracts. If you contract long-term with a supplier, you lock in an inventory price and the amounts to be purchased over time. You eliminate price fluctuations, which makes planning easier. You may also be able to secure discounts by entering into a long-term contract. Other benefits, such as superior quality expectation and on-time delivery, are expected with a long-term contract.

Of course, it's important that the long-term contract provides enough inventory to meet your needs. If you need to buy more product over and above the supplier contract, you'll probably pay higher unit costs. That's because you may be buying at the last minute, and you'll also be buying a much smaller amount than what's in the contract. A supplier, therefore, is likely to demand a higher price for these "extra" orders.

Here are two risk factors to consider before implementing JIT purchasing:

- **Carrying costs:** JIT purchasing allows you to carry fewer inventory items. Some of your carrying costs may be fixed — at least in the short term. If you carry less inventory, you won't need as much storage. But if you have a lease on storage space, you're paying the same amount for storage until the lease ends. JIT purchasing means that you spread the same lease cost over *fewer* units in inventory. The carrying cost per unit *increases.*
- **Ordering costs:** With JIT purchasing, you place smaller orders more frequently. Your supplier may need to *increase* the cost per order to cover their costs. For example, if you change from 10 orders a month to 100, the supplier may need to add some fixed costs. The fixed cost might include more staff or an upgraded computer system to process so many more orders.

JIT purchasing works, not only for retailers, but also for manufacturers. Toyota implemented *Kanban,* which (generally speaking) is a scheduling system for JIT production. It applies to the purchasing of materials that flow into the factory and incidentally to the flow of work-in-process from one department to the next.

Putting in a JIT purchasing system

Okay, say you decide to approach your supplier about moving to a JIT purchasing arrangement. The supplier needs to deliver smaller shipments more frequently. You request a price quote based on new, different levels of purchasing activity. This section compares the financial impact of your current purchasing system with a JIT purchasing system.

Laying out purchasing costs

Say you manage a large chain of sporting-goods stores. You're considering the impact of JIT purchasing for many products. At the moment, you're evaluating baseball bats.

Here's some information regarding baseball bat purchases:

- **Purchasing costs:** The cost per baseball bat is $100 for both your current purchasing method and JIT purchasing.
- **Ordering costs:** The cost per order is $150 for both purchasing methods.
- **Opportunity costs:** Company management has decided on an 8 percent required rate of return on investment. That 8 percent rate applies to any use of capital, including inventory purchases. This is the minimum return that the company expects from the money it has invested. If this return is not achieved, there are likely better alternatives for the company's cash.

- **Average inventory:** *Average inventory* is defined as the average value of inventory during a certain time period. Average inventory is (beginning inventory + ending inventory) ÷ 2. Currently, your average inventory is 10 percent of annual sales, or 2,000 bats. Under JIT, your average inventory will decline to 200 units.
- **Carrying costs:** You also incur costs for insurance and storage. Carrying costs total $15 per unit.

Table 18-1 compares your current purchasing costs with JIT purchasing costs.

Table 18-1 Current Purchasing Costs versus JIT Purchasing Costs

Total Costs			Current	JIT
Purchasing costs	**Cost**	**Units**		
	$100/unit	20,000	$2,000,000	$2,000,000
Ordering costs	**Cost**	**Orders**		
	$150/order	20	$3,000	
	$150/order	200		$30,000
Opportunity costs	**Cost**	**Inventory**		
8% rate	$100/unit	2,000	$16,000	
8% rate	$100/unit	200		$1,600
Other carry costs	**Cost**	**Inventory**		
	$15/unit	2,000	$30,000	
	$15/unit	200		$3,000
Total costs			**$2,049,000**	**$2,034,600**

JIT purchasing saves you $14,400 in costs ($2,049,000 current costs less $2,034,600 JIT purchasing costs).

Using JIT purchasing, the number of orders increases from 20 to 200. Purchase ordering costs increase from $3,000 to $30,000.

The opportunity cost multiplies the 8 percent rate × $100 unit cost × the average inventory. Note that the average inventory for your current process is 2,000 units; so, the opportunity cost for your current purchasing system is much higher than with JIT ($16,000 versus $1,600).

Carrying costs are $15 per unit. When you cut the average inventory with JIT, you also reduce carrying costs ($30,000 current versus $3,000 JIT).

Pinning down stockout costs

Before you decide on JIT purchasing, consider other costs. Stockout costs weren't included in Table 18-1. Those costs are more difficult to quantify.

The financial impact of a stockout is hard to pin down, but you can develop some data. You can probably identify *individual* stockout situations. Your store managers can track customers who ask for out-of-stock items. The total stockout cost would be the number of customers requesting an out-of-stock product multiplied by the cost you incur to get them the product.

Table 18-1 shows that the ordering cost is $150 per order. All suppliers give their clients a cost quote for placing small, last-minute orders. Now this is a different cost for a different service.

Say that the minimum cost for *any* order is $30. As stockouts occur, you place last-minute orders for small amounts — sometimes two bats, sometimes ten. You estimate a stockout cost per item of $5 per bat.

You forecast 50 customer orders placed when bats are out of stock. The total stockout cost would be $5 per unit × 50 orders = $250.

You can't quantify the opportunity cost of future lost business due to stockouts. Sure, you may be able to "save the order" by ordering the product when it's out of stock. The customer gets the product, but not as soon as he or she wanted it. That experience may mean that he or she will do business somewhere else going forward.

Turning to customer returns

Customer returns are another cost that you should include in your JIT purchasing cost decision. A *return* happens when a customer buys a product and isn't satisfied with the product's performance.

At that point, the customer may check to see whether the product is under warranty. Recall that a *warranty* is a commitment by the seller of a product (well, often the manufacturer, not the retailer) to repair an item at no cost to the buyer. Some products are covered under warranty and some are not; others have limited warranties. You find a super-cool discussion of warranties in Chapter 19.

You've probably purchased a product with paperwork explaining the warranty. If you buy a car, a refrigerator, or a new computer, the product comes with written warranty information. You know how long the warranty lasts and what repairs are covered.

Warranties are often touted in marketing a product. The best example is car commercials. Maybe you're told that the car has a "100,000-mile power train limited warranty." The car company is selling peace of mind: "We'll fix the car if it breaks, Mr. or Ms. Customer." (Note that an automobile dealership is a peculiar combination of retailer and manufacturer's representative. The automaker warranties the work, but the local dealer does the repair.)

A chain of car dealerships in my area uses a great tag line in its commercials. It ends each commercial with "If your car isn't right, we'll make it right — free." That simple line says a lot about quality and service. The car dealers might make a mistake, but they will do everything they can to fix it. The correction won't cost the customer a dime. That's what you want to hear from a supplier.

There are other warranties that are less formal. Instead of a detailed written agreement, warranties are assumed or implied. Say you pay $15 for a pair of reading glasses. You go out to your car and notice that the nosepiece on one side of the glasses is broken. So you go back into the drugstore and exchange them. (That just happened to me yesterday, so I thought it would make a good example.)

As a customer, you assume that *any* item you buy (for any dollar amount) should operate as it should for a reasonable period of time. If a business isn't willing to fix or replace all items when they don't work, it loses current and future business. And dissatisfied customers often tell others. (Groan! That, unfortunately, is "the kind of advertising that money just can't buy.")

Say your bats have a one-year warranty for any defects. That warranty assumes normal use of the bat. If a customer slams a bat against a tree 1,000 times, that's probably not considered normal use. Aside from that, you recognize that some bats can be defective in materials or workmanship. At this point you judge (based on experience) how many bats will be returned under warranty and how much it will cost to repair them or replace them.

You project that 2 percent of the 20,000 bats in Table 18-1 will be returned under warranty (2 percent × 20,000 = 400 bats). Each returned bat is estimated to cost you $40. Your cost for the customer return is 400 bats × $40 = $16,000.

Now, a $40 repair on a $100 retail item seems unreasonable. As the manufacturer, you need to consider changing your bat design or production. That's because the warranty repair cost is pretty large compared with the retail price of the item.

The repair scenario holds true for many small retailers. Sewing machine centers and vacuum cleaner stores come to mind. They have their own repair facilities "in the back." For other items, the customer usually sends the broken item to a regional repair facility or the manufacturer.

Adjusting total purchasing cost

As seen in Table 18-1, average inventory for the current purchasing system is 2,000 units. The current system assumes that you place 20 orders per year. That's one order every two or three weeks. You don't incur any stockout costs.

Your supplier has time to carefully inspect each item before it ships to you. As a result, all the products you receive work properly. All products you sell under the current purchasing system operate properly, so you don't incur any costs for customer returns.

In reality, no purchasing system can eliminate the issue of a product breaking *after* the customer buys it. Hey, stuff just happens. You'll deal with customer returns using any purchasing system. Now, for a moment, focus only on customer returns due to product defects that were there *before* the customer received the item.

The JIT purchasing system requires that you place smaller orders more often. With JIT purchasing, your supplier ends up sending many more orders. You should plan for some errors in inspection. The more orders you place, the greater chance that some items weren't inspected carefully.

You may be able to require the supplier to cover the customer return costs, if the return is due to their inspection error. This example assumes that you (the seller) cover the cost.

Take a look at Table 18-2, which shows your JIT purchasing costs (from Table 18-1) with stockout costs and customer return costs thrown in.

Table 18-2 JIT Purchasing Costs with Stockouts and Returns

Type of Cost	*Amount*
Subtotal — JIT purchasing cost	$2,034,600
Stockout costs	$250
Customer returns costs	$16,000
JIT purchasing cost	**$2,050,850**
Current purchasing costs	$2,049,000
Total JIT less current cost	**$1,850**

Now that you've added stockout and customer return costs, total JIT purchasing cost is now *higher* than your current system's cost. At this point, you probably shouldn't move to JIT purchasing because "There ain't no money in it."

SCM and Customer Demand Issues

Supply chain management (SCM) is a management tool you can use to improve your ordering, manufacturing, and inventory processes.

Supply chain management is the technique of analyzing and monitoring the movement of raw materials, work-in-process, and finished goods — from origin to the final consumer.

As you implement SCM, consider how and when your customers order products. After all, customer demand determines when to make something (if you're a manufacturer) or order something (if you're a retailer). Customer demand starts the process. SCM helps you make the process more efficient.

Pulling apart the supply chain

The *supply chain* is the group of companies that contribute to the flow of goods from a product's creation to the end customer. Every company in the supply chain can help the overall process. When that happens, you might save money, improve products, or increase sales — all of which are the equivalent of making money. Do an Internet search on "supply chain management" to learn a lot.

When more companies than just your company are involved, as is usually the case, you're dealing with "the extended enterprise." It makes sense, because everything affects everything else. Many different people "touch" a product before it reaches the customer.

A principal concept of supply chain management (SCM) is that companies in a supply chain exchange information about fluctuations. The fluctuations include availability, timing, shipping, and seasonal variability.

With supply chain management, you try to manage all activities that affect you. This could include sourcing (materials for manufacturing or finished goods for retailing), production (improving efficiency, eliminating bottlenecks, or increasing capacity), and logistics management (usually shipping, but also inventory management for both manufacturers and retailers). Check the table of contents of this book to find various chapters on these topics.

Analyzing demand

You no doubt already know that demand varies. The world has uncertainties. Whereas some demand changes are predictable, others may come as a surprise.

You need to get the best handle possible on when customers buy your products and even *why* they do. That knowledge lets you plan your inventory levels more effectively.

Here are some possible sources of demand variation:

- **Variable customer demand, seasonal:** Demand predictability varies by season. Summer and the holiday season, for example, show predictable increases in customer demand for swimsuits and toys, respectively. You need to stock up before the season.
- **Variable customer demand, based on a product:** You may be surprised at high demand for a single product. For example, envision a retail clothing store that sells jeans — and men's jeans in certain styles in particular. Say you notice that men's prewashed, straight-legged jeans in size 32-34 *always* sell out. You can't sell more of what you don't have. The demand for jeans may be generally predictable, but the demand for a single style/size is a surprise. You need to compensate to take advantage of the popularity of this style/size.
- **Variable purchasing patterns:** There are many products that customers use steadily, maybe every day or week. But for whatever reason, the customers seem to buy the product randomly. So the customer *uses* the product steadily but doesn't *buy* it steadily. Consider giant packages of toilet paper or paper towels.
- **Variable demand affecting suppliers:** A material supplier may have a reduced supply of what you need because of demand from your *competitors*. Say you were the first to manufacture motorcycle jackets from rip-stop nylon, but now all your competitors are using the material. The material may become less available. You need to compensate by increasing your orders or finding additional suppliers.

When you combine the concepts of supply chain management with your customer demand patterns, your operate more efficiently — and meet the needs of your customers.

Chapter 19

Quality: Building a Better Mousetrap

In This Chapter

- Considering the cost of delivering a quality product
- Changing production to improve quality
- Measuring customer satisfaction
- Reducing production time and delivery time
- Using time to differentiate from the competition

You can use cost accounting to improve your performance in delivering a quality product in a timely manner. Quality is a necessity — not a luxury — as technology now allows customers to research online how companies perform. They can post complaints, too. If your product is defective, word will get around. Also, customers don't like to wait. If you don't get your product to the client quickly enough, the client might tell his or her friends about the negative experience (or, for that matter, post the complaint on Amazon or Facebook).

This chapter addresses quality issues in a business. Assume that you manage a business — and you're concerned about quality. You consider how to measure quality. You look at how your business operates from the time you get an order until you ship your product to the client. In this chapter, you also assess customer satisfaction to see if your efforts to improve your processes are making a difference.

Your goals are to consistently deliver a quality product and improve your response time. If you accomplish these two goals, you can count on growing your business and earning a reasonable profit.

Considering Quality Benefits and Costs

Quality is defined as the features and benefits of a product, based on customer expectations. Customers have expectations about a product when they buy it and use it. When you meet or exceed customer expectations, that's quality.

Many companies (Xerox Corporation, for example) emphasized this concept in the 1980s. Quality is *not* about "goodness." Quality is *not* about providing extra features (fine as they may be) that customers don't want. Quality is about fully meeting customer expectations.

Listing the benefits of quality

Obviously, quality benefits a business. If you deliver a quality product, satisfied customers will come back. This is super, as all business owners should love repeat business.

Achieving customer satisfaction costs money, but it's far less expensive than spending marketing dollars to find *new* clients. You don't pay nearly as much in marketing and sales costs for repeat clients.

Producing a quality product may actually *lower* your costs. When you focus on quality in production, you pay more attention to your production process. You're likely to figure out how to work smarter. As you gain knowledge about production, you can remove unnecessary costs *without compromising quality.* You also are able to make products with fewer defects.

A friend of mine owns a landscaping company. He works hard and does quality work. I referred a neighbor to him, and then I ran into my neighbor a few days later. She had checked a consumer website, and the site listed several negative comments about the landscaping company. Ouch! It turns out that my friend wasn't following up with customers in a timely manner. Although not everything posted on this website was true, there were a number of comments that talked about the lack of follow-up. As a result, my neighbor hired *another landscaper.* Be careful. This is the age of "review sites," such as Yelp! (for restaurants) and Angie's List (for everything else).

Quality (meaning features and benefits of a product) is made up of more than just form, fit, and finish. To meet customer expectations, you must also be extraordinary in *timeliness* and *follow-up.*

Listing the costs of quality

Obviously, quality costs a business. The *cost of quality* is defined as anything related to creating, maintaining, and improving a product's quality. The definition also includes anything related to negative consequences of not producing a quality product.

The cost of quality includes the cost to prevent defective products in your production system, the costs of providing superior design, timely delivery, and customer follow-up. It also includes defective products and even lost customers if quality is poor.

Also included in cost of quality is the cost is buying (for retailers) or holding (for manufacturers) inventory to meet the needs of customers. After all, you want enough product on the shelf when customers show up to buy. If your shelves have "voids," or your finished goods inventory is empty, you will fail on timely delivery.

Consider the full production/delivery process. First, you perform market research to find out what customers want and need. You then design a product that meets those wants and needs. The design is the "recipe" for making your product.

Retailers have a similar task, as selecting well-designed products is the recipe for stocking what the customer wants and needs.

Of course, there are design compromises, except famously in the case of Apple products, which have a reputation for uncompromised design. Apple can afford it; it has big margins because of high prices, low manufacturing costs, and fanatic buyers.

Now comes the hard part. Your production department has to make a product that *conforms* to the design — every time. Customers expect not only a superior product design, but one that works, too! If your product doesn't conform to the design, you end up with a defective product. Cost accountants call defective products *spoilage*.

Here are four specific costs related to quality. Several of these topics relate to the spoilage, scrap, and rework discussion in Chapter 17:

- **Prevention costs:** The cost to prevent *nonconforming items* from being produced. Prevention cost also includes the cost of designing a quality product. Materials and workmanship have to be "to spec," following specifications. This isn't quite the same as appraisal costs (explained in the following bullet point). Prevention costs occur *before* the product begins assembly or manufacturing. Prevention costs include verifying that materials are as ordered and that machines are producing parts within the correct tolerances.

You find plenty of examples of conformation in real life. For example, the City of Los Angeles maintains a lab that tests asphalt for the streets to make sure it meets the city's specifications. Inspectors check out the material, not the finished road. The asphalt needs to hold up to heavy street traffic and changes in temperature.

- **Appraisal costs:** *Appraisal costs* are the costs of the inspection process. You inspect products during production to determine if they're defective. A variant of inspection is the work of the quality engineering department (also known as the shake-and-bake department). In some companies, the products are stressed and strained. Tests include subjecting them to heat, cold, shock, water, humidity, and the famous drop test. That's where a fully loaded pallet of cartons is dropped from about 12 feet to hit the concrete below.
- **Internal failure costs:** When a unit is found to be defective, you incur costs to repair *(rework)* it *before* you ship it to a client. You may actually have to dispose of the product if it can't be repaired. Ultimately, one of your goals is to reduce or eliminate failures.
- **External failure costs:** *External failure costs* are costs you incur *after* you ship a defective product to a client. *Warranty work* or *replacement* is no fun. Obviously, you prefer to recognize and repair a defective product before it gets in the hands of a customer. External failure costs can also include the cost of a lawsuit from a customer or even the cost of a losing a customer. These are often the most costly costs of quality and the most difficult to quantify.

Taking steps to ensure quality

You can take steps to produce a quality product. They are simple but not necessarily easy.

Start with a good product design. Plan a product with fewer moving parts, for example. The product is easier to build, and there is less chance for human error in production.

Perform scheduled maintenance on your machinery and equipment so tolerances are maintained and breakdowns are rare. These costs are prevention costs.

Verify that the product operates properly in testing. Product testing should start before production and continue throughout the manufacturing process. Say you're producing yo-yos. During product testing, you notice that the string knots up when the yo-yo is used. So you change the type of string. Based on additional testing, the change fixes the knotting problem. When you start production, you won't produce defective yo-yos. Product testing is a prevention cost.

Get a handle on defective products. Internal failures are due to something that created a defect in production. You find that something didn't go as planned; maybe there was a machine malfunction, or there was an employee error. When you find defects, take steps to reduce them. If possible, rework the defective units.

Complex products require more thorough testing. For example, do you know who some of the best saxophonists in the world are? The men and women at Conn-Selmer band instruments in Elkhart, Indiana. A sax has many tight-fitting parts and a complex array of valves and levers. The testers play each new horn like mad, and they do a thorough job. I know this because I saw the video on *Sesame Street.*

Compiling a Cost of Quality Report

A *cost of quality report* lists your costs related to quality. Your goal is to list all of the costs of quality, both direct and indirect costs, and *allocate* those indirect costs to each unit produced. The direct costs, by definition, are traced to your product. (Note that a cost accountant isn't having a good day unless he or she is listing and allocating something.)

Assume your product is a ten-speed adult road bike. Here are the costs related to quality again, but this time they are specific to your bike production:

- **Prevention costs:** Your design team improves the bike's ability to shift from one gear to the next. This smoother shifting puts less strain on the bike chain. As a result, the chains last longer and don't break as easily.
- **Appraisal costs:** Each bike is inspected before it leaves your factory. An inspector shifts through all of the gears on the bike. He or she checks the ease of adjusting the height of the seat and verifies that each wheel can be removed and locked back into place.
- **Internal failure costs:** You find an internal failure with some of the metal bike wheels you just produced. A small piece of metal was left exposed on the inside of the wheel. When you insert and pump up a rubber tire tube, the metal piece punctures the inner tube. Your staff is able to remove the piece before bikes are shipped to customers. However, there's a labor cost.
- **External failure costs:** Your bike's frame and parts have a limited warranty. A production run of bikes has chains that are breaking (good bike design but bad sourcing of the chain). It turns out that the master link holding the chain together is failing. Because the bikes are already in customer hands, you issue a *recall,* and each customer takes the bike to the local bike shop for repairs. You must reimburse the bike shops for repairs and pay them a fee.

Taken together, individual findings constitute a *cost of quality report.* Because all of these costs are indirect, you will *allocate* costs to each bike. So you must come up with a cost allocation base. You need some level of activity you can use to allocate the costs to each bike. There's a crystal-clear discussion about cost allocation in Chapter 5, if you need more in this topic.

You can use hours worked to allocate all four of the costs covered earlier in this chapter. In each case, someone needs to *do something* to prevent a defect or to repair a defect. Yes, there are some material costs involved (that new master link for example). The activity that's driving the indirect cost is labor hours.

Use bike inspections as a cost allocation example. Your latest production run is for 2,000 bikes. The inspection requires 15 minutes (one quarter of an hour) of labor per bike. Your labor rate for inspectors is $30 per hour. Here's your cost allocation rate for each bike:

cost allocation rate = 0.25 hours per bike × $30 per hour labor rate

cost allocation rate = $7.50 per bike

This cost ultimately is built back into the total cost of each bike and affects the product's profitability.

Go on to compute a cost allocation rate for each of the other indirect costs related to quality. You spread the costs over the total production, which works the costs into your product pricing and profit calculations.

Putting Quality Practices in Place

I recently worked with a food distributor. When a food company wants to get a product on the shelves at grocery stores, it calls the food distributor. It's a business with heavy competition and small profit margins.

The owner noticed that one of the local grocers stopped placing orders for a type of salad dressing. In fact, the orders had stopped months earlier. Because the food distributor works with hundreds of products, he didn't notice right away.

When he followed up, he found out that a competitor offered a slightly lower price. Price isn't part of quality, *but service is.* The competitor's sales/delivery people also visited the grocery store more often. They made sure that the product was in stock and properly displayed on the shelf.

The lesson: Pay attention! If you don't constantly pay attention to your customer's needs, your customer may very well do business with someone else. You lose the revenue and profits from the business. When the customer

leaves, it is very difficult to get the business back. The local grocer got what it wanted and needed from the competitor. "But I didn't know" should never be an excuse.

Grocery stores love it when a vendor checks stock and restocks as needed. You see this mainly with the bread delivery person. A *vendor* is a company that supplies a product or service to another company. In this case, the vendor is a food distributor to grocery stores. The store saves on labor, and a specialist handles the work. Can you apply this to your operation?

Companies that grow over the long term put quality into every part of their business. Put simply, quality represents doing things the right way — nearly every time you do them.

Quality in job costing

There's a quality component to job costing. Many tradespeople (plumbers, carpenters, and roofers, for example) use job costing. These are typically smaller companies with lots of competitors. Delivering a quality product can make the difference between keeping a client and losing the client to a competitor.

In many cases, companies use job costing to provide the customer a cost estimate (a detailed listing of all work needed on a project). Each job is assigned estimated costs for labor, materials, and overhead.

Here's where quality comes in: Smart companies like yours invest time to generate an accurate job estimate. The number of labor hours is well thought out (no wild ballpark estimates). The cost of materials is based on current prices and industry knowledge.

The result: The project's actual costs should be close to the estimated costs. That shows the customer that you know what you're doing. By the way, preparing a quality estimate tends to ensure the right profit margin for you. Investing the time to create an accurate estimate allows you to deliver a quality product — with a cost that is close to your estimate.

Taking a spin through inventory

Your product needs to meet your client's expectations. Yes, of course. A customer should feel that the product's price is reasonable. Yes, of course. But the first thing about a product is that there *is* a product. Your product has to be in your inventory. This section looks at the concept of inventory and quality.

The main points are obvious. Maintain inventory to supply your customers' needs. And maintain inventory with no defective products. It goes without saying, but I'll say it anyway: Inspect your products before they go into finished goods inventory. Ideally, no customer should ever receive a defective product.

Okay, it can happen: Even with the best intentions, a bad unit can slip into the finished goods inventory. Say the product stops working after the unit is shipped to a customer. Your company should have an excellent written policy for addressing this issue. To provide quality (after the fact), you should have a *limited warranty.* A *warranty* is a promise to repair or replace a product for a limited amount of time, assuming normal use. A real-life example is Amazon's Kindle, a very reliable e-book reader. A friend of mine received one that flat-out didn't work. Amazon replaced it instantly, no questions asked.

You want to see quality? I'll show you quality. At one time, the warranties for Magnalite cookware and Fenwick fishing rods were simple: *forever.* Times have changed, however. Fenwick seems to now have a limited warranty. Magnalite is now warrantied for only *50 years.*

You have some choices on how a repair is done. If a company local to the customer can repair the product, you can reimburse them for the cost and pay them a fee for their trouble. Another choice is for the customer to ship the item to you or to a repair vendor (sometimes called a regional service facility) that does the work. The item is shipped back to the customer after repair. Customers may prefer the local option; in that way, the item stays in town. They also have a local contact that can explain the repair. There's no shipping involved, either.

Customer Satisfaction: Measuring and Improving It

For a retailer, *customer satisfaction* is a measure of whether or not the customer has had a first-class buying experience (and why or why not). For a manufacturer, customer satisfaction is a measure of the customer's happiness with the product and maybe the buying experience. The measurement is your report card from the customer. So you're wise to ask your customers how things went. This section shows you how to measure customer satisfaction and suggests how you might improve it.

Satisfied customers tend to be repeat customers, whereas unsatisfied customers go elsewhere. Repeat customers can have a *huge positive impact* on your business. You save time and money when you sell to them, because you're not investing as much in marketing and sales costs to find *new* customers.

In more personal lines of manufacturing, retailing, or service, if you've worked with a client before, you understand what he or she wants. Maybe a client prefers a phone call rather than an email. The customer might prefer ordering on a certain day of the week. Your experience with the customer means you can improve your level of service. This is easy, not hard.

The road to getting repeat business starts with offering quality. That should be reflected in your advertising, website design, and live customer service. Of course, the product itself should be well designed, well made, and delivered in a timely manner. You can try to beat your breast about quality while delivering a shoddy product (as, frankly, some of the largest corporations have been seen to do), but don't fool yourself. Smart customers usually see through phonies in an instant.

Customer satisfaction's non-financial measurements

Non-financial measurements of customer satisfaction don't make it into your financial statements, but the information is critically important. The measurements help you to continue producing products that customers buy over and over, long-term.

Here are some examples of non-financial measurements that reflect customer satisfaction. A couple of them reflect product quality before the item leaves the plant.

- **Market research:** Research gives you information about customer tastes, preferences, and satisfaction with your product. You are likely to see comments about changes or updates your clients want. You can use surveys, watch Amazon ratings, conduct focus groups, establish email dialogues, or conduct personal interviews. To find out how you're doing, just *ask* your customers.
- **Defective units:** A listing of the types of product defects and how often they occur. Information about the number of defective products you catch before shipping shows an internal problem. Information about the number of defective products that are shipped to customers suggests that there's a customer satisfaction problem and/or an external failure problem with the product.
- **Customer complaints:** This report might include information about slow delivery, orders damaged in shipping, or poor customer service. Be *especially sensitive* to complaints about poor customer service. Some companies have abused customers so much that (and I'm not making this up) the customers create websites and Facebook pages such as "I hate ACME Corporation."

- **Timely delivery data:** This report contains information about the percentage of deliveries considered to be on time. It should show the average number of days or hours to deliver a product to the customer.
- **Process yield:** The *process yield* is defined as the percentage of good units produced (good units produced ÷ total units produced × 100). Good units, of course, are units you can sell to customers.

If you stay sensitive to non-financial measurements of customer satisfaction or quality and make changes, there are several benefits:

- The measurements are easier to understand than financial measurements. You also find that explaining non-financial measurements to other people is easier.
- Customer feedback is very easy to understand and is your *most critical short-term quality concern.* Trust me, you sometimes see and hear shocking stories. Think "Your product arrived in a crushed carton!" "Your customer service agent was extremely rude." "Your rep never called back, as promised." "I had to call six times to get someone to talk to me." You need to fix the problem for the individual customer and to make some aggressive changes in the area causing the problem.
- The quality measures identify weaknesses in your production system. Non-financial weaknesses are easier to identify than plowing through financial data. If the report says that production line 3 is producing the most defects, you shoot for improvements in line 3. Taking action is easier because the reports are clear.
- Non-financial measurements of quality make it easier to monitor the results of your production changes. It's simple to do some before-and-after analysis. Say that production line 3 had 100 defects per month before production changes. You can count the defects after the change and determine if the defects decreased. Pretty clear.

There's great value in internal reports. Say you make automobile tires and get a report showing defects found during the final inspection of the tires. The data divides the defects by type (steel belt defect, tire tread defect, and so forth). You use that report to change your production process. The information never makes it to your financial statements. The "outside world" (shareholders, creditors, and so forth) never sees the report, but the report helps you create a better product. Selling a better product likely leads to better results on your financial statements.

Also, keep in mind that a company's *annual report* includes the financial statements and other information. Many times, the "other" information includes a letter from the chief executive officer (CEO). That letter might include comments on internal reporting issues. Say the firm had a large issue with a defective product. The cost of the defect was significant. The CEO might explain that the defect has been addressed and is not expected to cause problems going forward.

The CEO letter appears in the annual report, but it's not part of the financial statements. The *cost* of the defect would certainly get posted to the financial statements. Take a spin through Chapter 17 for more on accounting for defects.

Is measuring customer satisfaction worth the effort?

All this customer satisfaction, quality, and defect information is great, but you need to consider the cost of gathering it and compare that to the benefit of having it. Do the benefits justify the costs?

The benefit could be that you will likely find improvements you can make in your business. The improvements could lower costs and increase customer satisfaction.

Say you're able to change your production to reduce the number of defects per production run. The changes cuts the number of defects from 2 percent of production to 1 percent. That also means that the process yield becomes 99 percent of production, so 99 of every 100 units produced are good units.

Sounds awesome, but consider the costs of those changes. Assume that a 1 percent increase in good units means that $10,000 worth of additional good units are available for sale. Super! Assume the cost to improve your production of good units is $50,000. Not so super. So $10,000 in additional good units has an initial cost of $50,000. Now mull over whether the additional cost is worth the additional good production. Bear in mind that the $50,000 cost may generate more good units for several years, or it may make it easier to retain customers in the long run. That's the thought process on costs and benefits.

Doing More in Less Time

Many companies use time as a competitive strategy. Those companies shorten length of time from the customer order to product delivery. Imagine "squeezing" the process into a shorter time period. The faster response time may become a big selling point. "You can get that product from us sooner, Mr. or Ms. Customer."

Producing products in less time may cost more, but it may also produce cost savings. There's the possibility, too, of increasing revenue through repeat business from satisfied customers.

This section takes a look at several issues related to company performance and the concept of time.

In the high-tech pharmaceutical world, the time problem begins with design, not manufacturing. The cliché is "time to market is *everything*." Whereas the approach can enhance competitiveness, it can occasionally produce disastrous results.

Analyzing performance related to time

Customer response time or *lead-time* is the period between when a customer places an order and when you deliver the product. A shorter response is generally a good idea, but a time driver may delay your process.

A *time driver* is any factor that changes the speed of an activity. These are the factors that speed up your response time or slow it down. Speeding up is no problem, but slowing down can be a big problem. Here are some time drivers:

- **Customer specifications:** It may take time to determine exactly what your clients want. The more complex the product, the longer this may take. Often, a sales or marketing department tells a production department about customer specifications. That's a good start, but it takes more effort to develop detailed specifications.
- **Waiting for parts or supplies:** You may have a delay in getting a part or specific material to produce the product. This is where having a good supplier is invaluable. If your supplier gets you the things you need in a timely manner, you can avoid this type of delay. Some corporations mandate that parts will be dual sourced, just in case one supplier runs into unexpected trouble.
- **Bottlenecks:** When your workload exceeds your production capacity, you have a *bottleneck.* Capacity means having available labor, machines, and factory space to make the product. If you're operating at capacity, in theory, you can't handle one more order until you clear out current orders. And *special orders* can't be processed, either. You can't take on special orders unless you have excess capacity. See Chapter 11. Operating at capacity will lengthen the customer response time for new orders.
- **Uncertainty about total customer orders:** If you have customers that come back and order regularly, great! But sometimes, you're unsure whether a customer will reorder, but you want to have available capacity and product in case the customer *does* reorder. Uncertainty makes it difficult to plan production and inventory requirements. You may need to delay production until you get the issues figured out.

"We have clearance, Clarence." "Roger, Roger." "What's our vector, Victor?"

Those are lines from the outrageously funny film *Airplane.* If you've never seen the movie, consider buying or renting it. Now back to our regularly scheduled program. Commercial airline flight times are a great example of companies using time as a competitive strategy. Airlines are very sensitive to their on-time performance results. Airlines compete with one another based on performance numbers. One way to perform well is for the airline to set flight departure and arrival times that it can meet easily. But there needs to be some balance, because people like to have a lot of flights to choose among.

A typical flight from St. Louis to Chicago is about 50 minutes. It's an important route for St. Louis. Many longer flights (international flights, for example) out of St. Louis connect through Chicago.

Now, if a fly-by-night airline (no pun intended) offers a flight time of 2 hours, the airline will always make it to Chicago with time to spare. However, the airline is likely to lose business. Its competitors will list a flight time that's much shorter. The competitors may occasionally be late, but customers are probably far more satisfied.

A business traveler might be okay with a late arrival once every ten flights for a 50-minute flight. That's much more attractive than 100 percent on-time record for a 2-hour flight to the same destination.

On-time performance is a how-often measurement, a metric that shows how often your product or service was delivered *when it was promised*. On-time performance results in more satisfied customers. Even if your delivery times are relatively long, good on-time performance removes any uncertainty from the customer's mind.

In business as in life, it's better to promise only what you can deliver. You need enough time to produce, test, and ship what the customer wants. That means that your delivery dates and times should be reasonable. Try to avoid asking for a redo. Keep in mind that delays in delivery times frustrate your customers and make you look a little silly.

Calculating average waiting time

Average waiting time is defined as the average amount of time before an order is processed. Here are the factors you use to compute average waiting time:

- Average number of orders waiting to be processed
- Manufacturing time per order
- Machine capacity

Say you manage an oil-change shop. Your basic service is an oil- and fluid-change service for cars. During the process, you also check on other maintenance items, such as a clean air filter. The typical customer requires 20 minutes to service the vehicle.

You use three garage bays to work on cars — that's your order (machine) capacity. You can work on three cars at a time. On average, you have two cars waiting to be serviced. You can perform a simple calculation of average waiting time:

average waiting time= (orders waiting to be processed × time per order) ÷ (order capacity)

average waiting time = (two orders waiting × 20 minutes per order) ÷ (3 order capacity)

average waiting time = 40 minutes ÷ three orders

average waiting time = 13.3 minutes per order

Now, keep in mind that this is a simplified version of the concept. The formula is something you may be able to do in your head. The calculation should be simple, so you can recalculate the numbers as things change. There are more complex versions, but they aren't very useful for this book.

Adding in manufacturing lead-time

Adding a new product will add revenue and costs. To analyze a decision to add a new product, you calculate *manufacturing lead-time.* The lead-time is the average waiting time plus the manufacturing time. The term represents the time from order placement until the product is complete.

Here's the formula for manufacturing lead-time:

manufacturing lead-time = average waiting time + manufacturing time

Consider the relevant cost and revenue when the new product is added. Say you own a pastry company. Here are some issues to consider when you add your new line of customized cookies:

- **Revenue:** Revenue increases based on sales of the new product. The revenue is relevant revenue.
- **Variable costs:** Consider the amount of material (flour, sugar, and so on) required for the cookies. You also incur labor costs. Material and labor costs are relevant because total variable costs change when you add the new product.

- **Carrying cost of inventory:** Assume that the customized cookies are delivered quickly, usually the day they're made. You pay a driver to make deliveries, so there's no need to store cookies anywhere. If you have to store the new product somewhere for a short time, you incur a *carrying cost.* Head on over to Chapter 9 to find out more about carrying cost.
- **Capacity costs:** If you bake more pastries and don't add any baking capacity (number of baking ovens, for example), you have a longer waiting time to start each batch of cookies or cakes. So the added waiting time is a relevant issue. The waiting time is a cost, in the sense that you risk losing business if customers consider the wait to be too long. Tough to figure!

Eliminating the Constraint of the Bottleneck

The *theory of constraints* (TOC) essentially says that a chain is no stronger than its weakest link. A production bottleneck is a weak link. You can apply the theory of constraints to maximize income by eliminating *bottlenecks* in production.

One simple definition is that a bottleneck occurs when your workload exceeds your production capacity. But there are many ways a bottleneck can happen.

Imagine that you're a highway planner. You forecast traffic flow, and you may plan more lanes on some stretches of highway to reduce bottlenecks and congestion. In your business, TOC applies to your forecasting and planning production processes.

To literally see a bottleneck in action, open a bottle of ketchup and turn it upside down. The bottle's narrow neck prevents the ketchup from flowing. But never fear! Food processors have answered the call by moving to wide-mouth containers and squeeze bottles. You can do the same (metaphorically speaking) with your business.

Fewer bottlenecks mean increased contribution margin

It's hard enough to make an honest buck; don't let bottlenecks hold you back. If you can eliminate bottlenecks and operate more efficiently, you generate contribution margin dollars faster. (Recall that *contribution margin* is sales less variable costs. See Chapter 3). Assuming that demand is available for your product, the faster you are able to produce goods, the more sales you can make and, hence, the greater contribution margin. A bottleneck is something that prevents you from producing the product more quickly. The converse, of course, is also true: More bottlenecks mean decreased contribution margin.

The more production you can push through your system, the more items you have to sell. Production also increases your variable costs (direct materials and direct labor), but that's okay; those increases are to be expected.

Your goal is to produce efficiently so you make as many sellable units as possible. Here's how you accomplish this:

1. Find the biggest bottleneck, the part of the production process that holds up producing a product. When you need the production line for multiple products, the bottleneck can hold up *all* production. Look for the stage of the production process with the most work in process (partially completed units) waiting for further processing. (Stroll over to Chapter 4 for a work in process explanation.)
2. Eliminate the bottleneck. Make clearing the bottleneck your first priority. Getting product through the bottleneck is job one.
3. Find the next biggest bottleneck. Repeat as needed.

You clear the bottleneck by increasing efficiency, but how you do that varies depending on the situation. The next section has several examples.

The Businessperson's Dream is to manufacture and sell products so well the market is *saturated.* Every unit is sold. Additional units go unsold until the marketing department finds a way to increase demand.

Clearing bottlenecks

Obviously, bottlenecks slow down production, or they wouldn't be called bottlenecks. Here are some ways to clear them:

- **Look for inefficiencies in the bottlenecked department.** You may have a capacity problem. Maybe there's too little labor, or the machines are too slow. Maybe machines are breaking down too frequently. Consider upgrading machines or hiring more employees.
- **Increase incoming units from other departments.** Say you have too few work-in-process units (partially completed units) coming in from another department. Fix the situation, and the bottlenecked department runs more efficiently. This means that you have to look at that other department to see why its outputs are inadequate.
- **Decrease incoming units from other departments.** Slowing production in the non-bottlenecked departments supplying the bottlenecked department may help. The bottlenecked department won't be overwhelmed by work in process units. The goal is to give the bottlenecked area enough, but not too much, work in process.

Stay with me on this reasoning. It seems counterintuitive to ask a department to produce less, but if your sales projections are accurate, you don't need too much product. Further, your sales projections determined how much material to buy. Ah, so the non-bottlenecked department is making the right quantity of product. However, it's delivering it *too fast.* Now you can't make money by asking that department to slow down. Consider alternative uses of labor and machines in the non-bottlenecked department to divert some of the productivity.

- **Eliminate idle time in the bottleneck.** *Idle time* is when production slows or stops. You're paying salaries and other costs, but you're not getting the production you expect. Remember that an absent employee can make a machine idle, and a broken machine can make an employee idle.
- **Reduce setup time.** Any production area spends time on setup and then production. Any other time is probably idle time. If setup time is taking longer than expected, consider spending resources to reduce the time. For example, maybe you make improvements to a machine, so setup is faster — or you buy a new machine. If the cost savings (long-term) from reduced setup time is more than the cost of the machine, the purchase makes sense.
- **Consider outsourcing.** When you hire someone else to perform a task, you are *outsourcing*. Mull over whether or not you can shift production to another department (or, in some cases, another line in the same department). You may also consider outsourcing the bottlenecked product. Step on over to Chapter 11 for more on outsourcing.

  You need to perform some analysis to determine if outsourcing makes economic sense. Consider whether the cost paid to the outsourcing company is more or less than the cost of fixing the bottleneck. Consider whether the bottleneck is a short-term or a long-term problem. If outsourcing is cheaper, the decision makes long-term sense. If outsourcing is more expensive, that's another story.

  Although you can outsource in the short run to get rid of the bottleneck, it's probably not the right decision over the long term. Keep in mind that outsourcing has non-financial considerations, such as employee morale and productivity.
- **Eliminate defective products.** Ensure that you're producing as many good units as you can. Defective products require reworking, with the dubious benefits of slowing production and increasing costs.

Prioritize which units you produce first. Fill your customer orders first by producing the units they ordered. Your customer orders produce immediate revenue, and revenue is part of the contribution margin formula.

You can still make some allowance for ending inventory, but produce it last. Of course, ending inventory doesn't generate immediate revenue, but when you open the doors on the first day of the next month, you have some inventory to sell. That way, customer orders coming early in the month are filled early in the month without waiting for new production.

There may be a workaround that's superior to outsourcing. Call it *insourcing*. Say you're a garment manufacturer, and you have a bottleneck in the shirt-sewing department due to an issue with a machine. You also manufacture cargo pants, and a sewing machine in the cargo-pants department performs a similar task.

If the pants machine can be set up to handle the shirts, that machine can be a short-term solution for your shirt bottleneck. That assumes, of course, that pants department can do without that machine for a short time.

Using equipment or staff from other departments isn't a long-term solution to the bottleneck. Those departments have their own production needs. They can't afford to do without their resources for very long. At some point, their own productivity will suffer.

You should inspect work in process *before* you start production in the bottlenecked department. An inspection allows you to remove defective units from production. (They're defective, so why spend the effort on finishing them? They'll only get rejected later.) Fewer units in production reduce the size of the bottleneck. In Chapter 17, the inspection point is usually at the *end* of production. In this case, an extra inspection up front likely reduces the number of goods in production.

The long-term solution to a bottleneck is analysis using activity-based costing (ABC; see Chapter 5). Consider the activities related to the costs you incur. That analysis includes a review of how efficiently your departments work. The process considers whether costs (labor, machine, and so on) are used to produce the maximum number of goods possible. ABC analysis can help resolve the bottleneck problem long-term.