

# Alternative Costing Methods: Precision Paint Shop's Dilemma

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*"We invested a great deal of time and money into developing the activity-based costing (ABC) system, and now I am not sure if it provides the information we really need for long-term decision-making purposes," Amy Wesling, plant manager of Precision Paint Shop's (PPS) Southern Plant, told her administrative team. "The ABC data helped us understand our costs better, but now I'm wondering if it's the right information to serve as the basis for helping us achieve our strategic goals."*

## COMPANY DESCRIPTION

Precision Paint Shop (a fictionalized version of an actual Midwest company) is a privately-held custom coater (painter) of automotive components for original equipment manufacturers (OEMs) and tier 1 and tier 2 suppliers. The company has annual revenues of \$90 million per year, with \$35 million in sales from the Southern plant, which specializes in spray topcoat applications.

PPS specializes in the application of a series of coatings. Raw metal parts are received on consignment from the customer, finished with the desired application(s) of paint and other coatings, and shipped back to the same customer. The product lines consist of a large number of combinations of paint colors, types of coating, and paint finishes. Figure 1 provides a diagram of the production process, and "PPS's Production Process" (Sidebar 1) provides a narrative of the production process.

Historically, PPS accepted most of the work assignments offered. Prices were market driven, and management used a form of standard costing to evaluate product profitability.

Over the past three years demand had significantly increased, especially in the higher-grade coatings. In fact, the product mix flip-flopped from 80% low-gloss (LG) finish two years ago to 85% high-gloss (HG) finish in the current year. Unfortunately, along with the increase in volume came a decrease in profits.

The immense number of combinations of coatings and color created complexity for the company. Also, the parts to be painted varied in size and shape, further complicating the painting process. The end result was that four characteristics—coating, color, shape, and size—were instrumental in determining the complexity of the operation. This variety initiated a mix of activities unique to each job. The very nature of the painting process and the need for a near-100% perfection level in the industry resulted in a high level of inspections, refinishing, rework, and scrap. Complexity had driven up overhead costs, leaving direct materials accounting for only 26% of total manufacturing costs.

## THE COSTING SYSTEM

Recently had PPS moved away from a conventional standard costing system to ABC. The change was made to better understand the costs associated with painting the various products. The ABC analysis revealed the fundamental differences that existed between the different mixes of product characteristics. Table 1 provides an illustrative comparison of two versions of a bumper: an LG finish and an HG finish. After the ABC analysis, Chad Leaders, plant accountant, provided a report showing a significant

change in the reported profitability levels of the various product lines. Table 2 summarizes the types of changes that took place. Once implemented, the ABC information was used to negotiate product pricing and to report financial performance.

## PLANNING FOR CAPACITY USE

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The conveyor line was definitely a constraining resource of the painting process. Through her knowledge of theory of constraints (TOC), Mandy James, production supervisor, had developed a method for factoring in the various process elements into demand levels on conveyor capacity. Using bumpers as an example, she presented the template appearing in Table 3, and compared an LG bumper to an HG bumper. The template starts with the quality issue. The greater the percentage of defects, the lower the yield rate (YR) for a production run. The more complex shapes and finishes have lower yield rates than those that are less complex. LG bumpers currently have a YR of about 95%, while HG bumpers run about 92%.

Defective products can be worked on in-house, and some can be recovered. For bumpers, the recovery rate (RR) is about 5% of units started. Since the recovered bumpers are brought up to an acceptable quality level, they contribute toward meeting customer demand and put no further demand on the conveyor capacity. The YR and RR can be combined to determine how many products must be processed to generate one unit of acceptable quality, which is called the run factor (RF). The RF is equal to  $1/(YR+RR)$ . If  $YR+RR=1$ , as with the LG bumper, then only one unit must be put on the conveyor to ultimately yield one unit of acceptable quality. The RF for the HG bumper is 103% (computed as  $1/(92\% + 5\%)$ ), meaning PPS must paint 103% of the total bumpers required to yield enough bumpers of acceptable quality to satisfy customer demand.

Since the conveyor line is the constraint, the time a product spends on the conveyor is an important issue. Line speed can vary from 10 to 18 feet per minute, depending on the size and shape of the product being painted. Mandy considers 18 feet per minute to be the standard time unit for the conveyor line. A complexity factor (CF) ranging between 1 (for fastest line speed) and 1.8 (for slowest speed) is determined for each product family and added to the calculation of demand. The CF is computed by dividing the standard line speed of 18 feet per minute by the line speed required for the specific product, so a faster line speed results in a CF closer to 1. The line speed of the HG bumper is currently 12 feet per minute, resulting in a CF of 18/12

= 1.5. The CF is then multiplied by the RF to get the total constraint demand factor (DF).

The DF is actually a demand placed on the conveyor per unit of finished good of a particular part type. Because parts can vary in shape and size, PPS needed a standard unit of measure to compare product profitability that factored in the total demand placed on the conveyor. The square footage of each part was chosen as the measurement unit because it represents the surface area of each part that's coated. As a result, the DF is divided by the total square footage of a particular part (e.g., a bumper) to yield the bottleneck demand factor (BDF), which is the demand factor per square foot of a particular size, shape, and finish. The profit level per square foot of finished good is divided by the BDF to yield the profit per throughput unit (P/TU) on the conveyor. Table 3 shows the LG bumper has a lower profit per unit (\$10 per bumper, or \$1 per sq. ft.), but after adjusting for the respective demands on the conveyor, the LG bumper has a higher P/TU.

## DECISION POINT

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Management of PPS used ABC to obtain a better understanding of the "true" cost of the products in order to help make better pricing decisions. Management now wants to be more proactive in the use of costing information to help develop and implement organizational strategy in an environment where the demand exceeds current productive capacity. Based on the opening question posed by Amy, PPS's management was attempting to move away from merely trying to assign costs more accurately to using the cost information to support strategic decision making. Specifically, Amy wants to make strategic decisions about which product lines to promote and pursue. She is aware of the ABC process of assigning cost of resources to activities, but considers this an operational rather than strategic issue. She isn't clear about whether ABC supports strategic decision making.

Mandy pointed out that the conveyor line was being fully utilized and jobs were being turned down because of the capacity constraint. She thought the capacity issue should drive any strategic decisions and that Amy should adopt the principles of TOC and throughput costing for strategic decision making. Mandy supported her position with the following example. "HG bumpers are a big part of production," she said. "We evaluated whether or not to increase the line speed when HG bumpers are being painted. The increase in speed will reduce the yield rate from 92% to 90%. There will be more defects, but the

RR will increase to 6%, and, as Table 3 shows, the P/TU will increase and the finesse costs per unit would actually decline.” (See Sidebar 2, “Finessing.”)

Chad disagreed with Mandy’s recommendation. Using Table 1, Chad noted that the HG finishes have higher reject rates, require additional painters, more colors, more inspections and maintenance costs, and slower line speed. The HG products are also treated as they pass through Stations 3 and 4. Since some of the costs related to resource demands are fixed costs, throughput costing shouldn’t be used because these fixed costs would be ignored. He offered an alternative, resource consumption accounting (RCA), which he had heard about at a recent local IMA chapter meeting. He thought RCA might be what Amy needed, but he wasn’t entirely sure. Chad presented Amy with a brief description of the costing method. (See Sidebar 3, “Basics of RCA.”) He offered to learn more about RCA by attending a continuing education session offered by IMA, but Amy wanted more information before making the investment in having Chad attend the session.

#### **ABOUT IMA**

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## **SUGGESTED RESOURCES**

Chwen, Sheu, Ming-Hsiang Chen, and Stacy Kovar.

“Integrating ABC and TOC for Better Manufacturing Decision Making.” *Integrated Manufacturing Systems*, May 2003, pp. 433-441.

Grasso, Lawrence P. “Are ABC and RCA Accounting Systems Compatible with Lean Management?”

*Management Accounting Quarterly*, Fall 2005, pp. 12-27.

Keys, David, and Anton van der Merwe. “Gaining Effective

Organizational Control with RCA.” *Strategic Finance*, May 2002, pp. 41-47.

Resource Consumption Accounting Institute website,

<http://www.rcainstitute.org>

van der Merwe, Anton, and David Keys. “The Case for

Resource Consumption Accounting.” *Strategic Finance*, April 2002, pp 31-36.

## SIDEBAR 1: PPS'S PRODUCTION PROCESS

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PPS operates two 8-hour shifts, 240 days per year. The paint process involves a monorail conveyor line that moves at line speeds of 10-18 feet per minute, depending on the application and part complexity. The total paint cycle time is about 2.5 hours. The production schedule is created based on customer requirements, line speed, minimum lot (or batch) size, and the availability of racks. The material handlers bring the raw parts and racks to the line and loaders rack each part, making sure it is racked properly so that when it enters the E-coat tank a proper electrical ground is attained.

### THE PAINT PROCESS

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The part is first treated with chemicals (pre-treatment stage), a sequence of washing and rinsing to remove any grease or dirt and to prepare the part for paint adhesion with a phosphate spraying. Next, the part is submerged in a 20,000-gallon e-coat tank. As it comes out of the tank, it is sprayed with fresh, deionized water to rinse off any "dragout" paint clinging to the parts, thereby eliminating appearance defects. The part then moves through four paint booths. Depending on the part type, however, all four booths may not be used.

- Booth 1 has five automatic spray guns that apply primer. A part may or may not receive a primer coating, which provides additional protection against chipping and rusting.
- Booth 2 has two manual sprayers as well as automatic sprayers that paint basecoat or enamel topcoat.
- Booth 3 has one manual sprayer and an automatic spray gun that apply clearcoat. Only high-gloss products receive the glossy, shiny clearcoat finish.
- Booth 4 has two manual sprayers and automatic spray guns that also apply clearcoat for parts that require two coats.

While low-gloss products are being painted, booth 3 and booth 4 painters are idle and the spray guns are turned off. Depending on the product line, the part receives a basecoat (high gloss) or an enamel topcoat (low gloss). After these processes, the paint is cured in another oven. As the product arrives back at the unload/load area, it is date-stamped, unracked onto a floor conveyor, inspected, unloaded, and packaged.

## THE SETUP PROCESS

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A five-minute setup "gap" is required when changing paint colors. This gives line workers the time to change the tooling racks, modify the line speed, purge the line of the old paint, and run the new paint through the system.

As the setup gap nears the paint booths, paint containers with the required colors are transported to the paint booth. While the last part from the prior color is painted, the paint lines are quickly purged of the old paint, flushed with solvents to clean the paint lines, and new paint is sprayed through the spray guns to obtain the desired consistency. As the gap ends and the raw parts appear, the painting begins again.

### QUALITY ASSURANCE OR REWORK PROCESS

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The primary sources of rejections are: dirt and dust in the manual hand sprayers, old equipment, and the nature of the industry. High-gloss products, which are much more expensive to reprocess, have substantially higher rejection rates than low-gloss products.

Rework mostly requires sanding. The product is sanded down to the e-coat primer and then moved to the line for reprocessing. Some products are sent to an outside stripper. Some defects can be corrected by finessing, which eliminates the need for complete reprocessing. Finessing allows the defect to be buffed out on parts that have the clearcoat glossy finish. Parts are considered "saved" when they can be unloaded along with the other painted good parts.

## SIDEBAR 2: FINESSING

Currently PPS finesses approximately 100,000 bumpers per year, or about 5% of bumpers run on the conveyor. If the line speed is increased, the decline in the yield rate would create about 20,000 additional bumpers that the finesse department could work on. The finesse department can handle 125,000 units per year when operating at maximum efficiency, and the variable costs for finesse are less than \$0.02 per unit, so the increase in units worked wouldn't generate much change in the total costs even though the computed cost per unit does change. The table provides the supporting detail.

**Finesse Cost Per Unit at Various Defect Levels**

	Annual Cost	Units	Cost Per Unit
Current Defect Level	\$480,000	100,000	\$4.800
Defect Level with			
Increased Line Speed	\$480,400	120,000	\$4.003
Practical Capacity to			
Handle Defects	\$480,500	125,000	\$3.844

## SIDEBAR 3: BASICS OF RCA

Resource consumption accounting (RCA) is based on costing methods developed by German companies and the activity costing philosophy of ABC. RCA takes a resource-based view of an organization and looks closely at the quantity of resources consumed and the underlying nature of the cost of those resources. Some of the key characteristics of RCA are the treatment of idle capacity, the use of costs other than historical, and the ability to group and track cost information at various levels. This comprehensive management accounting system can lead to improved decision support by providing more accurate product costs and a better understanding of the interrelationships between processes and costs.

**Table 1**  
**Summary of Items Affected by the Need for High- or Low-gloss Finish on a Bumper**

	High Gloss	Low Gloss
Rejection Rate	high	low
Number of Colors	high	low
Batch Size	low	high
Number of Painters	high	low

**Table 2**  
**Number of Products That Had Changes in Calculated Profit Margin from Standard Costing to ABC**

Negative Margin	Positive Margin
← 3 became more negative	→ 5 became more positive
7 → moved from negative to positive	
1 → became less negative	← 10 became less positive

**Table 3**  
**Using Capacity Demand to Rank Profitability**

Product	Yield Rate (YR)	Recovery Rate (RR)	Run Factor (RF) = 1/(YR + RR)	Speed	Complexity Factor (CF) = 18/speed	Demand Factor (DF) = (RF x CF)	Sq. Ft. per Unit of Product (Sq. Ft.)	(BDF) Bottleneck Demand Sq. Ft. = (DF/Sq. Ft.)	Profit per Unit of Finished Product	(P/TU) Adjusted Product Profit per Throughput Unit Profit per Sq. Ft. /BDF
<b>Compare Two Bumper Finishes</b>										
Low-Gloss Bumper	95%	5%	100%	15	1.20	1.20	10	.120	\$10.00	\$8.33
High-Gloss Bumper	92%	5%	103%	12	1.50	1.55	10	.155	\$12.00	\$7.76
<b>Evaluate a Process Change</b>										
Current Process High-Gloss Bumper	92%	5%	103%	12	1.50	1.55	10	.155	\$12.00	\$7.76
Change Speed and YR	90%	6%	104%	13	1.38	1.44	10	.144	\$12.00	\$8.32

**Figure 1**  
**Diagram of the production process**

