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Marie Kelly

Stephen F Austin State University, kellymarie@sfasu.edu

Nikki Shoemaker

Stephen F Austin State University, shoemakenl@sfasu.edu

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Closing Pandora's Box: Reducing Student Confusion with a Process Costing Simulation

Marie Kelly
Stephen F. Austin State University

Nikki Shoemaker
Stephen F. Austin State University

This paper describes a classroom Process Costing simulation that can be used in both introductory managerial accounting and cost accounting courses in order to help students better understand the principles of process costing and how to apply these principles to a problem. In groups, students work to manufacture candy necklaces for a set amount of time. After the manufacturing time has ended, students work together to determine equivalent units of production, cost per equivalent unit, and total costs for the period. Subsequently, a final class discussion provides opportunities for differences between groups to be discussed and any additional questions to be resolved. The simulation can be used for either the weighted-average method or first-in, first-out (FIFO) method of process costing.

INTRODUCTION

Teaching process costing in introductory managerial accounting and cost accounting courses can seem equivalent to opening Pandora's Box. Students often get confused at the idea of equivalent units and using these equivalent units to determine a product's cost. It is important for students to understand the principles of process costing because many manufacturing environments lend themselves to the use of process costing methods. This paper describes a Process Costing simulation that promotes understanding of the process costing topic by immersing the student in a fabricated production environment and requiring them to perform process costing calculations from this manufacturing work.

The remainder of this paper is organized as follows. First, the Process Costing simulation is described. Second, learning objectives along with guidance on implementation is discussed.

PROCESS COSTING SIMULATION

Students often have difficulty understanding process costing principles. Most introductory managerial accounting and cost accounting textbooks teach job order costing first by illustrating assignment of costs to specific, unique jobs. Subsequently, when students are introduced to process costing, with mass-produced, homogeneous products, confusion often results due to abstract terms such as equivalent units and conversion costs. In order to promote understanding of process costing, this project immerses

students in a simulated production environment. From this hands-on experience, students can visualize the flow of costs through the manufacturing process and better comprehend the associated calculations.

To introduce the activity, students are informed that they are working for a jewelry company that manufactures necklaces. Students are shown an illustration of the final product and split into production groups, with a minimum of five students per group. Each group will include a materials handler, at least three jewelers, and a quality control/packaging employee. All groups will begin the manufacturing process with the same beginning inventory (i.e., the number of necklaces and the percentage of completion of all partially completed necklaces for each group should be identical).

The final product, or necklace, will consist of a string with five iterations of beads (for example, three of cereal A, two of cereal B, one of cereal C) repeated five times. Students are given Worksheet 1 (see Appendix A) along with individual bags containing three partially completed necklaces and the materials to finish the product. One of the necklaces already has three of the five repetitive sequences of beads, so it is calculated to be 60% complete. The other two necklaces only have two of the five iterations, so they are each calculated to be 40% complete. This beginning inventory percentage calculation is provided to students in order to illustrate the method that will be used to compute ending inventory percentages when manufacturing time has elapsed.

Students are instructed that all materials are added at the beginning of the manufacturing process, in order to simplify the simulation and clarify the percentage of completion process for conversion costs. The instructor starts the stopwatch to time the process. A predetermined amount of production time should be established before students are told to begin.

When start time is announced, the materials handler from each group will pass each of the incomplete beginning inventory bags to the three assemblers in their group. The assemblers will use the remaining materials in their bag to complete assembly of the necklace and tie it closed. They will each pass their completed product to the quality control/packaging employee, who will inspect each necklace to make sure it is assembled in the proper sequence, tied correctly, and finally boxed for shipment to customers. As each assembler finishes a necklace, the materials handler issues a new bag of materials for the next piece to start the manufacturing process. This manufacturing process continues until time is called.

Once stop time is announced, all production should be halted. However, if the assemblers are in the middle of a sequence of beads (ex. three of cereal A, only one of cereal B), they should be instructed to finish that sequence (ex. add the other unit of cereal B and the unit of cereal C) in order to clarify calculation of percentages. For example, if one sequence out of five has been completed on a necklace, it will be considered 20% complete, or if four sequences out of five have been completed, it will be considered 80% complete. Students should not be allowed to complete a necklace after time is called unless they are in the middle of the final fifth sequence.

At this point, percentage of completion for ending Work in Process inventory should be calculated in the same way as illustrated for beginning inventory. See Worksheet 2 (see Appendix B).

Once students have their percentage of completion calculations, it is time to complete process costing calculations in order to determine how much cost stays in Work in Process inventory, and how much transfers to Finished Goods inventory. Each student is provided a process costing report with beginning work in process physical units (step one) the same for each group. Work in Process beginning inventory and current period cost figures will be given to them in steps three and four. See Worksheet 3 (see Appendix C).

As each student completes their process costing report, they will compare it to the others in their group and correct any discrepancies. When complete, the instructor writes each group's total cost on the board, and queries the class for an explanation as to why the total dollar amounts were different between production groups. Differences will be due to number of completed necklaces and number of incomplete necklaces, since all groups had the same amount of time allocated to production. To enhance the classroom experience and encourage participation, project points are assigned for student completion of the activity. By combining classroom lecture of difficult material with group learning simulations, we believe students will improve their understanding of complex managerial accounting concepts.

LEARNING OBJECTIVES AND SIMULATION IMPLEMENTATION

Learning Objectives

Several specific learning objectives are provided by this Process Costing simulation to enhance student outcomes. The first objective reinforces the calculation of conversion cost equivalent units to a continuous production process by utilizing a kinesthetic learning instrument. Requiring students to compute percentage of completion by counting necklace bead assembly at a specific cutoff point develops student understanding of equivalent units of identical products at different levels of completion.

The second learning objective facilitates student comprehension of how to apply costs to similar physical products at separate stages of the production process. Each material has a definitive cost, however, conversion costs create complications when labor and overhead must be allocated to unfinished products. By applying concrete costs using equivalent unit estimates, students are able to visualize a cost per equivalent unit, despite the fact that they may have eight incomplete necklaces that approximate five complete products. Realizing that per unit cost can be calculated on incomplete units significantly influences student understanding of the process costing method.

Finally, students gain awareness of an end goal, which is to assign costs to finished goods from completed products, or retain costs in work in process inventory for incomplete products. By physically producing the necklaces themselves, students gain an understanding of the development of the product, and their perception of how and why costs are assigned becomes more tangible. The progression of costs flowing through the manufacturing process becomes clear and quantifiable.

Implementation Guidance

Courses

This simulation was designed for both introductory managerial accounting and cost accounting courses. If desired, the simulation can be used to promote understanding of both the weighted-average and first-in, first-out (FIFO) process costing methods. It can be implemented in medium-sized classes. Students attending these courses include accounting, economics, finance, management, marketing, and general business majors.

This project simulation is normally presented in class following the process costing chapter lecture. The project's placement at this point in the course allows the student to have been introduced to the basic principles of process costing prior to completing the simulation. Project points are included within the overall points awarded during the semester for the class, in order to persuade students to attend and participate.

Materials

The materials for the simulation are listed below in Table 1. Prior to using the simulation in class, all beginning inventory items will need to be constructed. For example, beginning inventory for each group of students could be three necklaces that are 60% complete for conversion purposes, or one necklace 60% complete and the other two at 40% completion (as noted in the simulation example above). Before class, the instructor would gather all the materials for each of the three necklaces. Each set of materials would go in a separate plastic bag and the instructor would make each necklace up to its completion point (i.e., three of the five iterations for 60% completion, two of the five iterations for 40% completion, or any variation of repetitions). Materials cost is approximately \$30.00

TABLE 1
LIST OF MATERIALS

-
- Candy and/or cereal for necklaces (need at least three different items)
 - Food grade yarn
 - Plastic bags
 - Plastic gloves or food prep gloves
-

FIGURE 1
EXAMPLE OF NECKLACE



FIGURE 2
EXAMPLE OF BEGINNING INVENTORY



In-class Implementation

The project takes approximately one hour of class time to complete. Each group of students starts with the same beginning inventory. However, the final process costing calculations will vary between groups due to differences in manufacturing performance. Time can be spent at the end of class discussing why these differences occurred and how they influenced the final cost of the product.

APPENDIX A

**WORKSHEET 1
BEGINNING INVENTORY**

# Physical Units	% Complete for Conversion		
1	x 60%	= .60	
2	x 40%	= .80	
	Total	1.4	
		÷ <u>3 units</u>	
		.4666	= 47% complete

APPENDIX B

**WORKSHEET 2
ENDING INVENTORY**

# Physical Units	% Complete for Conversion		
	x %	=	
	x %	=	
	x %	=	
	Total		
		÷ <u>3 units (# of assemblers)</u>	
			= % complete

APPENDIX C

WORKSHEET 3

UNITS Process Costing Production Report (Weighted Average Method)			
Step 1:			
Units to be accounted for:	Physical Units		
Beginning Work in Process	<input style="width: 100px; height: 20px;" type="text"/>		
Started into Production	<input style="width: 100px; height: 20px;" type="text"/>		
Total units	<input style="width: 100px; height: 20px;" type="text"/>		
Step 2			
Equivalent Units			
Units accounted for as follows:	<u>Materials</u>	<u>Conversion</u>	
Completed and transferred	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>	
Ending Work in Process	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>	
Total units	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>	
Step 3: Cost per Equivalent Unit			
	<u>Materials</u>	<u>Conversion</u>	<u>Total Cost</u>
Cost of beginning inventory	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>
Current period costs	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>
Total cost of units in process	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>
Equivalent units	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>
Cost per equivalent unit	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>
Step 4: Reconcile Work in Process			
Cost to be accounted for:	<u>Materials</u>	<u>Conversion</u>	<u>Total Cost</u>
Beginning Work in Process	\$ <input style="width: 100px; height: 20px;" type="text"/>	\$ <input style="width: 100px; height: 20px;" type="text"/>	\$ <input style="width: 100px; height: 20px;" type="text"/>
Current period costs	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>
Total costs	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>
Cost accounted for as follows:			
Units completed and transferred	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>
Ending inventory	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>
	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>	<input style="width: 100px; height: 20px;" type="text"/>