MEDICAL DIAGNOSTICS, INC.

Kristin Scott, President of Medical Diagnostics, Inc. for eight years, is faced with a decision regarding the modernization of one phase of the company's production process. Medical Diagnostics, Inc. produces a variety of radiological imaging systems, and Scott's decision concerns the company's Scanner Division.

The entire production process in question spans three operating departments in two divisions, and it involves a total of three machines. The ultimate product is a radiological scanner sold primarily to hospitals by the Scanner Division. The scanner is used as one component for sophisticated radiological testing systems.

The Scanner Division, which assembles the scanner, buys a part called a setmeter from the Meter Division. The setmeter consists of a precision metal part that is produced by the Meter Division on a precision metal-cutting machine (Machine 1). This operation takes place in the Metal-Cutting Department of the Meter Division.

The setmeter is then transferred to the Adjustment Department of the Meter Division, where the setmeter is finished by performing an adjustment operation. The adjustment is partly performed by an adjustment machine (Machine 2). The machine currently in use is now five years old. Both the Metal-Cutting Department and the Adjustment Department of the Meter Division work only on setmeters. All of the output is transferred to the Scanner Division for use on the radiological scanner.

The Scanner Division manufactures several other components for the radiological scanner. After receiving the setmeters from the Adjustment Department of the Meter Division, the Scanner Division assembles the final product and ships it to customers.

The Scanner Division uses a highly-specialized assembly machine (Machine 3) in the final assembly of radiological scanners. This machine is now several years old and is not performing well. It is difficult to keep appropriately adjusted, and, therefore, frequently breaks setmeters during the final assembly process. When this happens, the entire scanner is ruined. During the last year, the breakage rate has reached an intolerable level. This has prompted Scott to look at the modernization question.

The setmeter transfer price to the Scanner Division is based on absorption standard cost, plus a 20 percent profit for the Meter Division. The standard cost sheet for the setmeter is shown below.

Exhibit 1: Meter Division's Cost-Based Transfer Price for Setmeters

Metal-Cutting Department:		
Raw materials (10 units @ $15)	*$150*	
Direct labor (10 hours @ $16 per hour)	*160*	
Overhead (10 hours @ $10 per hour)	*100*	*$410*
Adjustment Department:		
Direct labor (2.5 hours @ $24 per hour)	*$ 60*	
Overhead (2.5 hours @ $12 per hour)	*30*	*90*
Total standard cost		*$500*
Add: 20% markup for profit		*100*
Transfer price to Scanner Division		*$600*

The Meter Division is able to buy raw materials on an "as needed" basis, so the raw-material cost is variable with respect to the number of setmeters produced. Currently there is no inventory of raw material. Direct labor in both the Metal-Cutting Department and the Adjustment Department is paid on a piece-rate basis, so this cost is also variable. Variable overhead in the Meter Division consists mostly of fringe-benefit costs that are related to direct labor, together with other variable costs that are very sensitive to direct-labor usage.

Overhead cost is allocated to the setmeter in the Meter Division by using a flexible overhead budget to determine a standard-cost rate per direct-labor hour. As shown in the standard cost sheet above, the overhead rate is $10.00 per direct-labor hour in the Metal-Cutting Department and $12.00 per direct-labor hour in the Adjustment Department. The flexible budget for overhead in the Metal-Cutting Department is $150,000 fixed cost plus $4.00 per direct-labor hour. The $150,000 fixed cost budget is the straight-line depreciation on the metal-cutting machine (Machine 1). This machine has a remaining tax life of five years and is also expected to be operable for that period. The $4.00 per direct-labor hour variable overhead, as explained in the paragraph above, is composed mostly of fringe-benefit cost on direct labor and is a variable cost. The denominator volume is 25,000 direct-labor hours in the Metal-Cutting Department.

The flexible overhead budget in the Adjustment Department used to determine the standard overhead rate of $12.00 per direct-labor hour is $50,000 fixed cost plus $4.00 per direct-labor hour for the variable overhead charge. The fixed component of $50,000 is entirely composed of annual straight-line depreciation on the adjustment machine (Machine 2). This machine has a remaining tax life of five years and it is expected to be operable over that period. The denominator volume in the Adjustment Department is 6,250 direct-labor hours.

The Scanner Division receives the setmeters and assembles the radiological scanners with the standard costs given below.

Exhibit 2: Scanner Division's Standard Cost Per Radiological Scanner

Setmeter (1 @ $600)	$ 600
Materials (15 units @ $15)	225
Direct labor (6 hours @ $20 per hour)	120
Overhead (6 hours @ $14 per hour)	84
Total standard cost of scanner	$1,029

The cost details on the setmeter have already been explained. The other materials are purchased on an "as needed" basis, so the cost is variable and no inventory is carried. The flexible budget for overhead is $180,000 fixed plus $2.00 per direct-labor hour. The fixed portion of the overhead ($180,000) is the straight-line annual depreciation on the assembly machine (Machine 3). This machine, like the other two machines, has a remaining tax life of five years and could be operated for that period. The variable overhead of $2.00 per direct-labor hour is the fringe-benefit cost on direct labor. Denominator volume is 15,000 direct-labor hours.

The variance from standard cost has been high in the Scanner Division. This is because of the recent increased breakage rate due to the poor condition of the assembly machine. Last year, 2,500 setmeters were transferred, but only 1,500 scanners were produced and shipped. The breakage rate, then, was about 40 percent on the setmeters. That is, 2,500 scanners were put into production, but only 1,500 could be shipped because 1,000 were ruined in the Scanner Division. This breakage rate is very costly to the company, because it occurs at the end of the production process in the Scanner Division after all costs have been incurred. The entire scanner is ruined. Spoiled scanners cannot be reused or reworked, and the cost of disposal is equal to their salvage value.

The general manager of the Scanner Division can acquire a new, improved assembly machine, which will reduce the breakage to zero. This would allow the Scanner Division to meet its regular annual demand of 1,500 scanners without having to order 2,500 setmeters in order to obtain 1,500 scanners. Furthermore, the new machine would perform the adjustment function now done by the Meter Division. This would enable the Meter Division to scrap the adjustment machine (Machine 2) and reduce the direct-labor hours per setmeter in the Adjustment Department from 2.5 hours to 1.5 hours. Since only part of the adjustment is performed by Machine 2, the department will not be completely eliminated. The salvage value of the adjustment machine (Machine 2) is $100,000 now, but if this machine were operated for five more years, the salvage value would be zero.

The new assembly machine would also allow the Scanner Division to reduce its direct labor on the radiological scanner from 6 hours to 5 hours. The Scanner Division could also scrap the old assembly machine (Machine 3). This old machine has a net salvage value now of $200,000. If the old assembly machine (Machine 3) were operated for another five years, the net salvage value would equal zero.

The new assembly machine is expected to have a useful life of five years. In contrast to the straight-line depreciation being used for tax purposes on Machines 1, 2, and 3, Medical Diagnostics, Inc. will use sum-of-the-year's-digits depreciation on the new machine for tax purposes over the five-year period. The investment cost is $2,250,000, and the estimated salvage value five years hence is zero.

The Scanner Division's general manager has not been carrying an inventory of setmeters, but now he feels that a safety-stock inventory will have to be established if the breakage rate continues, since the breakage does not occur evenly throughout the production period. The general manager of the Meter Division has indicated that 1,000 setmeters would be an appropriate level. This safety-stock inventory would be at a constant level throughout the five years, but could be sold separately for a lump sum without loss at the end of that time. If the modernization program is not undertaken, there will be no delay in normal production to produce the needed 1,000 units of safety stock. The entire plant is ordinarily shut down for a two-week vacation in December. However, the crews required to produce the safety stock (so as to have the inventory available at the beginning of the year) have agreed to shift the timing of their vacations. This would make it possible to use the shut-down period to produce the inventory at the ordinary production cost, thus avoiding any abnormal costs. The physical storage and handling costs of this inventory are considered negligible. Of course, if the production process is modernized, the safety-stock inventory is not necessary.

Required: Prepare a discounted-cash-flow analysis to advise the President of Medical Diagnostics, Inc. on whether to proceed with the modernization program. Use a 12 percent after-tax cost of capital and a 40 percent tax rate in your analysis. You may assume that all annual cash flows and their related income-tax effects take place at the end of the year in question, and that any investment-type cash flows take place at the beginning of the first year. You may also assume that the annual demand for radiological scanners will remain at 1,500 per year for the next five years.

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