Final Exam

Weber's Customized Electronics

Overview

Weber's Customized Electronics was founded in 1990. T.J. Weber, an engineer with 20 years in the airline industry, founded the company. The company initially supplied customized electronic components to the military. As the company prospered, the firm expanded by purchasing some of their competitors, and bidding on outsourced business from the commercial airline industry.

By April 2002, Weber's had become a multidivisional corporation (twelve in total) producing a variety of customized electronic components for the airline and automobile industries as well as the military.

The Electronics Testing Division (ETD) is one of the twelve divisions. ETD provides centralized testing for the electronic components produced in the other 11 divisions. ETD was created in 1997 as a result of a strategic reorganization of the company. As Weber's expanded in the 1990's each division separately employed various machinery and personnel to test the integrated circuits (I.C.'s), diodes, transistors, capacitors, resistors, transformers, relays and crystals that were used in the various products. The costs of the machinery and the personnel in each division were substantial, and management believed that consolidating testing into one central division that serviced the other eleven divisions in the corporation would result in substantial cost savings.

ETD was organized as a cost center. The other eleven divisions would provide products to the division to be tested, and the costs of testing these products were transferred back to the divisions at full cost (direct labor cost and allocated burden for overhead, there are no direct materials used in this division). Although ETD is a captive division, the other divisions in Weber's were allowed to use outside testing services if ETD could not meet their cost or service requirement. Furthermore, ETD was permitted to use 20% of their capacity to test the circuits, diodes, transistors, capacitors, resistors, transformers, relays and crystals of outside companies.[1] The department has no budget for advertising or marketing services, thus most outside customers were obtained by word of mouth.

ETD employed approximately 65 hourly personnel and 40 administrative and technical staff members. Budgeted expenses were 7.9 million in 2002 (See Exhibit 1)

Testing Procedures

ETD had tested 30 million components in 2001 and expected to test between 35 and 40 million components in 2002. Component testing was required for two reasons. First, if defective components were not caught early in the manufacturing cycle, the cost of repair could be substantial. Studies indicated that a defective capacitor caught before its use in

[1] The division was expected to make a 15% profit margin on outside business.

the manufacturing process, cost two cents to repair. If the defect was not caught until the product was out in the field, the costs of replacing the capacitor could run in to the thousands of dollars, greatly exceeding the cost of the electronic component. Second, a large proportion of Weber's work was defense related. Military specifications frequently required extensive testing of components used in aerospace and naval products. By 2002, ETD had the ability to test 6500 different types of components. Typically the division would test 500 different components a month and between 3000 and 3500 different components per year. Each division or outside customer would send components to ETD in lots. ETD would then test each lot and the defective pieces would be identified and separated for retooling. In 2002, ETD expected to receive 12,000 lots of components.

ETD performs both electrical and manufacturing testing. Electrical Testing involves measuring the electrical characteristics of the components and comparing these measurements with the component's specifications. For example, the specifications of an amplifier may have called for a 1-volt input to be amplified into a 10-volt output. ETD would deliver a 1-volt charge to the amplifier, and then measure whether the amplifier's output was in conformance with specifications.

Mechanical testing included solderability, component burn-in, thermal shock, lead straightening and leak detection. Solderability involved the inspection of components to ensure they held solder. Burn-in involves the extended powering of components at high temperatures. Thermal shock involves the cycling of components between high and low temperatures. Lead straightening was the detection and correction of bent leads on components. Leak detection involved the examining of hermetically sealed I.C.s for leaks.

Components varied significantly in the number and the type of electrical and mechanical testing procedures they required. This variation resulted in about 200 different standard process flows for the division. One manager in the division was responsible for determining the process flows in the facility. He organized the monthly testing runs based on the different combinations of tests and specifications the customer requests. Based on these combinations, he would determine the routing of the product between testing equipment and the type of tests performed at each station. I.C.s, for example, could follow up to twelve different flows through the facilities. Some of the I.C.'s only require electrical testing at room temperature; others required solderability and leak detection as well as thermal shock and burn-in tests.

Each type of component required separate software development, custom tools, and occasionally custom fixtures were also required. Software, tools, and fixtures were developed by the engineering group, which was made up of specialists in software development, equipment maintenance, calibration and repair, tooling and fixturing, and testing operation. Software engineers developed programs for specific applications. The programs were then retained in the software library for future use. During 2002 ETD has added another 1300 software programs to the library, increasing the total in the software library to over 6500 different software programs. ETD also had an inventory of 1500 tools and fixtures, of which 300 had been developed in the past year. The large number

of tools and fixtures allowed the testing of components with a variety of leads, pin combinations, and mating configurations.

ETD monitored the costs and the processes that were necessary to test the various components Weber's produced, and they often compared their costs to bids from their competitors. On complex parts that require screening, environmental conditioning, the division was consistently cheaper than outside vendors. Where only elementary testing was required, low technology outside laboratories were often cheaper, especially on large lots. The division manager at ETD, Susan Swampscott, believed that the advantage that the division brought customers over the outside labs was that the latter had almost no engineering support, while ETD has engineering resources available to quickly design and implement tests on complex parts in a cost-effective manner. The shift to more technically sophisticated services has prompted a shift in the labor mix from direct to indirect personnel. The division expected to see a crossover between engineering head count and hourly headcount some time in the next three years.

The testing facility was divided into three rooms. The stock room housed administrative personnel, and also was designed for receiving incoming components for testing, and for sorting outgoing products that had already been tested. The main testing room contained the equipment used for electrical testing. The mechanical room contained the equipment used for mechanical testing. 30 people worked in the mechanical room and another 30 people worked in the main testing room. The remaining 5 people worked in the stock room.

Recently there had been some innovations at Weber's that were likely to affect the testing of components. First, Weber's has been moving towards producing high-technology components, creating the need for automatic testing on sophisticated equipment. Automatic testing will lead to longer test cycles and more data per part. For example, digital components are currently tested for up to 100 conditions (a condition is a combination of electrical input and output state). The new generation of digital components is so much more complex that they require the verification of up to 10,000 conditions. These components require expensive highly automated equipment and less direct labor to complete the tests.

Second, in 2002, Weber's adopted a Just-in-Time inventory system for all of its divisions. As part of the adoption of this system, Weber's implemented a vendor certification program, where Weber's engineers verified that vendor's production process would result in pieces of components that met required engineering specifications. As each division determines which of their vendors must be certified, the testing of some of the pieces of Weber's electrical components will be pushed back to the vendor. ETD was expecting to move from the primary tester of several components to a quality inspector of these components. Thus instead of testing every component in a lot, ETD would use statistical sampling and test a percentage of the components to insure that the vendors supplied pieces that met the firms engineering standards. Early indications suggest that the JIT system will lead to an increased number of smaller lots being received by ETD, and vendor certification will reduce the number of tests that ETD will have to perform. ETD

forecasts that over the next three years, 30% of the products produced by Weber's will have been initially tested by certified vendors.

Cost Accounting System

The cost accounting system measures two components of cost: Direct Labor and Overhead. The Overhead costs were accumulated into a single cost pool. All of the overhead costs associated each of the testing rooms, the stock room, and the costs of engineering, software development, and tooling/fixtures development were accumulated in this pool. Total overhead costs were divided by the sum of testing and engineering labor dollars to arrive at a burden rate per direct labor dollar. The division costed each lot of components. The overhead allocated to each lot by multiplying the actual direct labor dollars associated with the lot by the burden rate. Thus the total cost associated with testing a lot of components is the sum of the direct labor and overhead. In 2002, the facility wide burden rate was 145% of each direct labor dollar. (See Exhibit 1 for a description of the overhead costs, and the calculation of the burden rate for 2002.)

Current Events

In April 2002, Stacy Swampscott, the manager in charge of ETD, was reviewing the results for the division for the first quarter. She realized that this was the second consecutive quarter in which the Aerospace division had reduced the number of components they had sent to ETD for testing. She assigned her assistant manager, Fred Dusseldorf, to find out why aerospace was reducing their use of ETD. Fred had determined that Aerospace was outsourcing testing for some of their components. Furthermore, the division manager of the military department in Weber's had recently suggested that they might outsource some of their testing because ETD's costs were getting a little high. The manager of the Aerospace division had complained to Fred that, "I do not know what you all are paying your people over there, but ABC labs came in at 25% of your cost."

This seemed strange to Susan. Just this quarter, the department had won an external bid for testing components for a defense contractor, Spellman Industries, that does not compete with Weber's. When her production manager, Hank Kellog, had prepared the estimate for the costs of the new job, he had determined that testing on this product would require that the department purchase another machine, that would cost the department approximately $2,000,000. However, similar to the last two external testing jobs, the testing on this component was almost entirely automated, direct labor costs were estimated to be less than $50,000, handling costs were estimated to be less than $15,000, and other engineering and overhead costs associated with this job were expected to be less than $100,000. He also determined that after the job was completed, the machine could be retooled and used to help test some of the military parts for which testing was currently outsourced. Since the machine could be used to test other products in Weber's, her assistant prepared the bid by calculating a revised cost estimate using the 2002 budget, and applying a 20% margin to those costs.

She decided it was time to have a meeting with Fred and Hank to see if she could determine what was happening with the division's costs. Since the aerospace division manager was complaining about her direct labor costs, she asked Fred to analyze the departments labor costs over the last two years focusing on the direct labor costs for aerospace components (Exhibit 2), and she asked Hank to bring his estimates for the bid the department had recently won (Exhibit 4).

The Meeting

Fred: Well Susan, I talked to Ross Watts, the manager in charge of process flows, and I thought we might be onto something by analyzing the labor costs of testing electronics components of the Aeronautics division. Ross indicated that we were testing about 60,000 units a month for this division, and that the testing of Aeronautics Components is mostly a manual process, done on simple machines, and require relatively more direct labor hours.

So the first thing I did was investigate whether the increase in the union rates was larger than we had anticipated. As you can see from this graph (Exhibit 2), last March the line personnel got a 3% raise, so I don't think the slight increase in the wage rate is the driving factor in the difference between our costs and our competitors.

I also looked at the direct labor costs for testing the Aeronautics components. In total, the costs look relatively stable at about $10,000 per month until the 4th quarter of 2001. Then they outsourced the Fetzner boards to ABC LABS, and in January they outsourced the splintners circuits. Thus the direct labor costs associated with testing Aeronautics electronic components dropped.

I also checked the Dl$ per unit tested, and compared it to the average DL$ per unit tested for the company. As you can see in this third graph, the Dl$ per unit tested is higher than the average unit tested in the company, but it is very stable and actually decreasing slightly for the products we test in this division. We implemented a slight change in the process flow that allowed laborers to handle more units per hour. I just don't think our labor costs are the source of the problem. Maybe the costs of our overhead have increased? Or perhaps ABC LABS has figured out a way to do this better?

Susan: I was afraid that it wasn't the direct labor costs Fred. I went and looked at the direct labor costs for our entire department, and they look like they have are expected to go down this year as we bring on more of these automated testing machines. I also looked at the total overhead for the department, and total cost of the department and I don't see much of a change (See Exhibit 3). Since I don't see a large percentage change in costs, our competitors must have made some technological improvement in how they test these electronic components.

Susan: What amazes me is that we seem to be losing some of our divisions as customers but external customers seem to find us to be the low cost bidder. Hank, how did we determine the cost to charge Spellman for their components?

Hank: Well Susan, let me give you some of the basics. First, we are going to be testing about 1,200,000 components a year for Spellman. The machine can handle 30,000 components a week at full capacity, so I figure that we are going to use 80% of the machines capacity running the Spellman job.

In determining a rate to charge Spellman, I figured that since we were going to use 20% of the machines capacity on internal orders, the best thing to do was to estimate the costs of adding the Spellman business and then revised the budget to include the expected cost of the Spellman job. (See Exhibit 5) I figure Spellman will use $50,000 in direct labor costs. Some of these costs will be from hiring an additional part time worker, and some of these costs will be from using the excess capacity created when we lost our Aerospace's components. I also estimated additional overhead associated with this job to be $315,000 and the new burden rate is 1.533, so I come out with total costs of about $126,000. I then used a margin of 20%, and I come up with revenues of $151,200. When I divide this by the 1,200,000 units, I get a rate of 12.6 cents per component tested. I rounded up to 13 cents a unit.

I also analyzed how this job will affect the machine hours available for testing. As you can see from this exhibit, we had 33,201 hours in the main room, and 17,203 hours of machine time in the mechanical testing room. The new machine will annually provide an additional 2000 hours of testing time to the Mechanical room, since all the tests on the Spellman components will be done there. This year I expect the Machine will be used exclusively on the Spellman job. In the future we will have 400 hours of excess capacity to take on additional work.

Susan: Hank, that seems reasonable to me. I'm lost as to how we can be beating our competitors in one set of tests and losing in the other. Perhaps we need to bring in an expert to figure this out. Fred, why don't call that consultant that just graduated from Sloan maybe she/he can help us.

Exhibit 1

Panel A: Estimates of Direct Labor and Overhead costs for the ETD Division

2002 Budgeted Expenses		
Direct Labor		$3,260,015
Overhead:		
Indirect Labor	859,242	
Salary Expense	394,211	
Supplies and Expenses	538,029	
Services[2]	245,226	
Personnel Allocations[3]	229,140	
Service Allocations[4]	2,448,134	
Total Overhead Expenses[5]		4,713,982
Total Budgeted Expenses		$7,973,997
Expected profits from servicing external customers[6]		$300,000
Burden rate = (4,713,982)/(3,260,015) = 144.6%		

[2] Includes Tool Repair, Computer expenses, Maintenance Stores, and service cost transfers from other divisions

[3] Includes the costs of indirect and salaried employees fringe benefits, the personnel department, security, stores/warehousing, and holidays/vacations.

[4] Includes Building occupancy, telephones, depreciation, information systems, and data control.

[5] The cost accounting department estimates that $1,426,317 of the overhead costs is variable, $1,288,000 of the costs is related to depreciation, and the remaining $1,999,665 is other fixed costs. Breakouts of these costs are provided in Panel A

[6] ETD is a cost center, the transfer price to the other divisions is full cost. Thus for all of the testing done on Electronic components produced by divisions within Weber's the expected revenues for ETD is equal to expected costs. For ETD's external customer's, the division is expected to markup the costs by 15% to determine the selling price of their service. Any profits above the 15% margin are allocated to a profit sharing pool for the senior managers of the division. For Fiscal 2002, the average margin for servicing outside customer is expected to be 20%, expected profits on external customers is $300,000 and $75,000 is expected to be available for profit sharing.

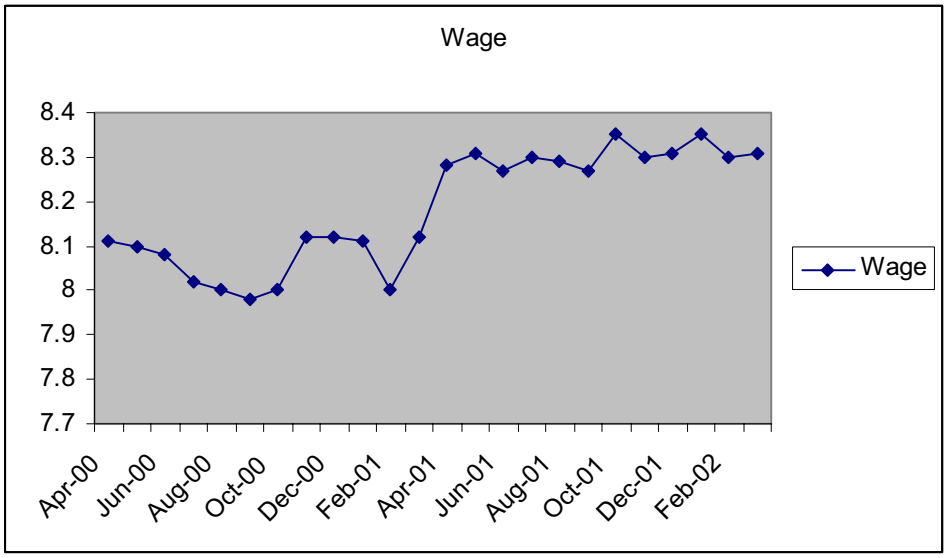
Exhibit 1

Panel B: Budgeted Overhead Expenses for each of the three rooms in the ETD Division for 2002

	Variable	Depreciation	Other Fixed Costs	Total Costs
Main Test Room	887,379	88,779	1,126,958	2,103,116
Mechanical Test Room	443,833	808,103	674,327	1,926,263
Total for Test rooms	1,331,212	896,882	1,801,285	4,029,379
Engineering, admin and storage	95,105	391,118	198,380	684,603
Total Costs	1,426,317	1,288,000	1,999,665	4,713,982

Exhibit 2

Analysis of Average hourly wage rate per direct labor hour for the employees in the Electronics Testing Department.



Analysis of Direct Labor Cost of testing Aeronautics Electronic components

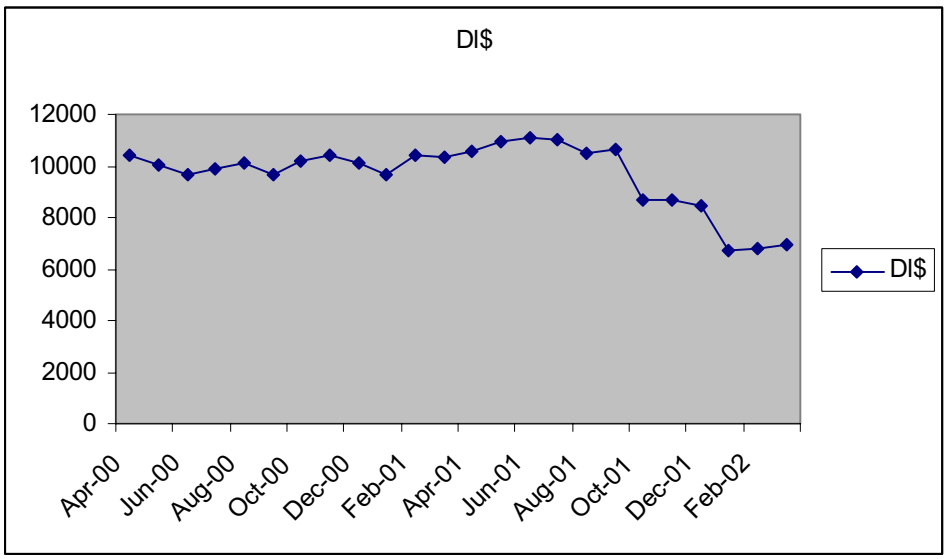


Exhibit 2

Analysis of average direct labor cost per electronic component tested for the Aeronautics Division compared to the average direct labor dollar per unit for the entire ETD department.

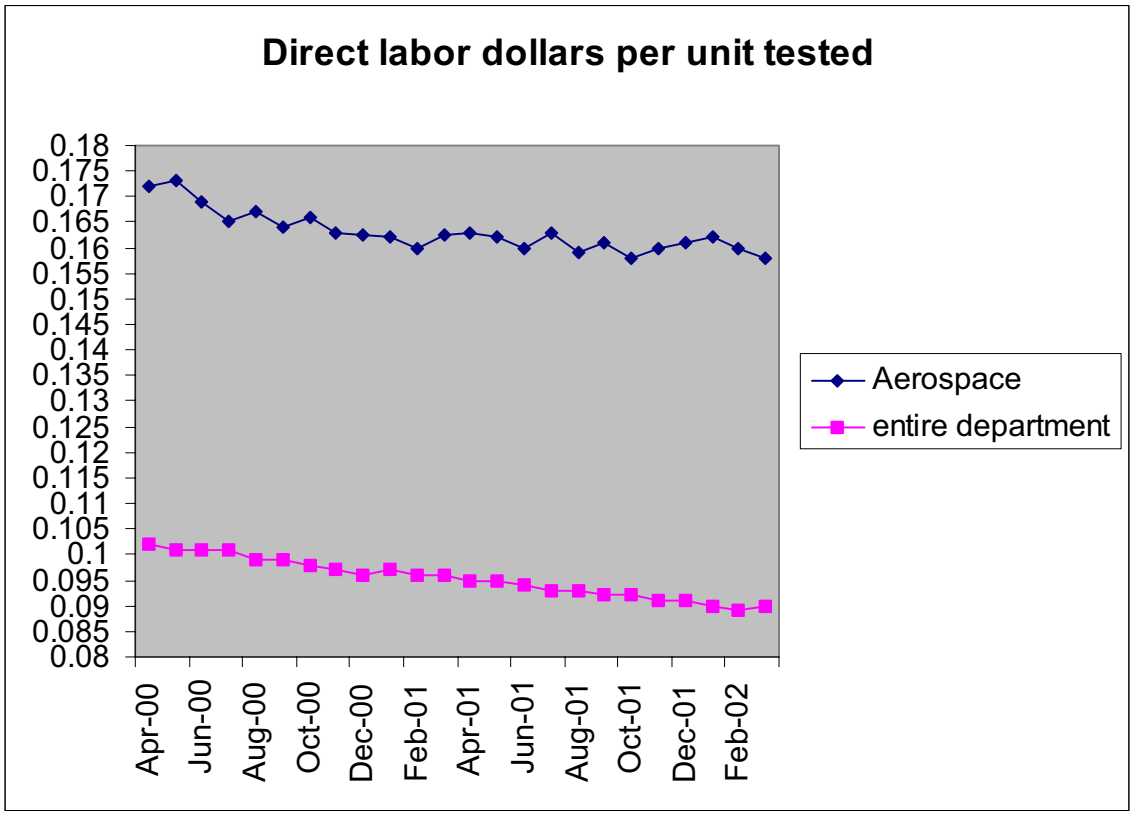


Exhibit 3

Comparison of 2001 Actual results and 2002 budget			
	2001 Actual	**2002 Budget**	**Percentage Change**
Direct Labor	$3,766,012	$3,260,015	-13.4%
Overhead:			
Indirect Labor	811,028	859,242	+5.9%
Salary Expense	320,045	394,211	+23.1%
Supplies and Expenses	602,230	538,029	-10.6%
Services[7]	246,006	245,226	-0.3%
Personnel Allocations[8]	243,498	229,140	-5.8%
Service Allocations[9]	2,275,034	2,448,134	+7.6%
Total Overhead	4,497,891	4,713,982	+4.8%
Total Expenses	8,263,903	$7,973,997	+3.5%

[7] Includes Tool Repair, Computer expenses, Maintenance Stores, and service cost transfers from other divisions

[8] Includes the costs of indirect and salaried employees fringe benefits, the personnel department, security, stores/warehousing, and holidays/vacations.

[9] Includes Building occupancy, telephones, depreciation, information systems, and data control.

Exhibit 4

Panel A: Cost analysis of Purchasing new machine to test Spellman's Electronic Components

Cost of Purchasing Unibridge E34r capicitor flux testor	
Cost of New Machine	$2,000,000
Depreciation Rate[10]	$200,000
Direct Labor Costs[11]	$50,000
Handling Costs	$15,000
Engineering Salary	$25,000
Other Overhead Charges	$75,000

Panel B: Effect of purchasing E34r Capacitor Flux Testor on available machine hours for testing

	Expected total Machine Hours for 2002	Capacity provided by E34r Capacitor Flux Testor[12]	Revised 2002 estimate of machine hour capacity
Main Test Room	33,201	0	33,201
Mechanical Test Room	17,103	1,500	18,603
Total	50,304	1,500	52,304

[10] Depreciation is done over 10 years on a straight-line basis assuming no residual value.
[11] Instead of bringing in an additional full time employee, the division will hire a part time employee for approximately $20,000 per year, the rest of this cost will be from the excess capacity that we have from losing the testing of Aerospace products.
[12] Since the Machine is being purchase in April, only 75% of the machine's annual capacity is available. In addition all of the 1500 hours will be used on testing the external product.

Panel C: Revised Budget including the costs of doing the Spellman job

Revised Budget			
	Additional Costs of E34r Capacitor Flux Testor	**2002 Budget**	**Revised Budget**
Direct Labor[13]	$20,000	$3,260,015	3,280,015
Overhead:			
Indirect Labor	0	859,242	859,242
Salary Expense	25,000	394,211	419,211
Supplies and Expenses	0	538,029	538,029
Services[14]	25,000	245,226	260,226
Personnel Allocations[15]	15,000	229,140	244,140
Service Allocations[16]	250,000	2,448,134	2,698,134
Total Overhead	315,000	4,713,982	5,028,982
Total Expenses	335,000	7,973,997	8,308,997
Revised Burden Rate = 5,028,982/3,280,015 = $1.533 per direct labor hour			

[13] Instead of bringing in an additional full time employee, the division will hire a part time employee for approximately $20,000 per year, the rest of this cost will be from the excess capacity that we have from losing the testing of Aerospace products.

[14] Includes Tool Repair, Computer expenses, Maintenance Stores, and service cost transfers from other divisions

[15] Includes the costs of indirect and salaried employees fringe benefits, the personnel department, security, stores/warehousing, and holidays/vacations.

[16] Includes Building occupancy, telephones, depreciation, information systems, and data control.

Exhibit 5

Representative data on the costs and machining time for 1 lot of 10,000 components for 5 different components tested at ETD

		Machine Hours		
Product	Direct Labor Dollars	Main Room	Mech. Room	Total
ICA	917	8.5	10.0	18.5
ICB	2,051	14.0	26.0	40.0
Capacitor	1,094	3.0	4.5	7.5
Amplifier	525	4.0	1.0	5.0
Diode	519	7.0	5.0	12.0

Questions

Consider yourself to be the consultant that ETD hires to come help them address the problems that the division is facing. Prepare a report to Susan that highlights the problems that Weber's currently has and proposed solutions. In your report you should address the following questions.

1. What are the important issues in the ETD division of Weber's Electronic Components? How would you predict the problems in the ETD division would affect the other divisions in Weber's?

2. What steps would you suggest ETD implement to rectify these problems? What are the advantages and disadvantages of your proposed system? What other information would you need to help in your recommendation?

3. Exhibit 5 provides data on 5 representative products. What are the costs of the 5 representative products in the current system? What will the costs be when the firm takes on the Spellman job? If you have proposed any changes to the cost accounting system, what are those changes, and what are the costs of these products under your system?

4. How profitable do you think the Spellman job will be? What price would have you charged to make a 20 percent margin? Does the excess capacity that the machine provides affect your analysis? How?

5. Susan also asks that you include a section in your report that provides suggestion for changes in ETD and/or in the firm that could be provided to the CEO.

Remember be clear and concise in your write up. If you need to make any additional assumptions, then be explicit in identifying your assumptions. Please provide schedules supporting any calculations you make. If you elect to email me your solution, your entire write up must be contained in a single, printer friendly document.

** This document refers to a case from Harvard Business School.