

Chapter 11

Answers to Problems

11.1 Conventional wisdom in design for manufacture encourages the rule “reduce the number of parts into the fewest number.” Consider the views (a) locator arm and plate, and (b) combined locator-plate in Fig. P11.1.

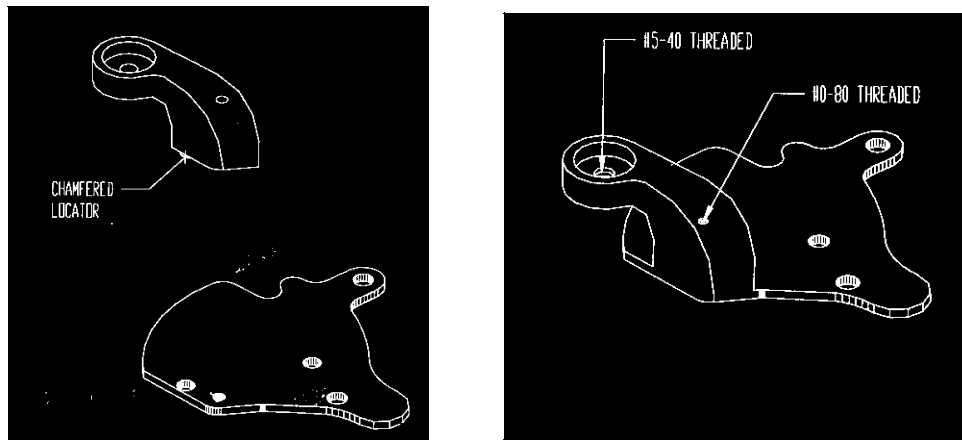


Figure P11.1

Some properties of the material and orders of magnitude for cost are given as

| | 2 Parts | | 1 Part |
|---|--------------------|----------------------------|----------------------------|
| | Locator | Plate | Locator and Plate Combined |
| Primary manufacturing process | Investment cast | Stamped | Investment cast |
| Material | Titanium (T16A14V) | Stainless steel, (17-4 PH) | Aluminum |
| Cost range of magnitude | \$50/lb | \$2/lb | \$3/lb |
| Density, lb/in. ³ | 281.4 | 495 | 169 |
| Young's modulus of stiffness, 10 ⁶ psi | 10-11 | 28-30 | 15-17 |

Discuss keeping the design as two separate parts or combining the two parts into a single component. What effect does quantity have on your thinking? (Hints: If there are two parts, fastening and special holes for that manufacturing operation are necessary. If there is one part, it is a common material.)

What about machining of the separate parts or common part using a computer numerical controlled milling machine? Discuss selection of the two designs for a least cost criterion. Which design do you choose? Why?

Answer:

Titanium is a metal with an excellent strength to weight ratio. Its greatest disadvantage is its light material cost and expensive molding tooling. Aluminum has lower strength, but is still light weight. It is easy to machine, but has high investment tooling cost, similar to titanium. Because aluminum has low stiffness, it needs greater bulk. The thin walls may not be reliable for long term functioning in aluminum. This is an example where it may be less costly to use two parts instead of one. This is a good problem for wide ranging discussion.

11.2 A company has 14.2 million shares outstanding. It pays \$0.32 as an annual dividend. The company reports annual profits of \$20.67 million as its stock closes at \$40. Find the earnings per share, price to earnings ratio, and dividend yield.

Answer:

EPS = $20.67/14.2 = \$1.46$. P/E = Price/share/EPS = $40/1.46 = 27.5$ P/E. Dividend yield = dividend per share/share price = $0.32/40 = 0.8\%$.

11.3 The enterprise is conducting a make vs.. buy analysis where the significant cost elements for the manufacturer are as follows:

| Cost Element | Unit value |
|---|------------|
| Direct labor | \$34.10 |
| Direct material | \$8.40 |
| Variable overhead ratio of labor and material | 100% |
| Additional fixed costs | \$5.00 |
| Profit | \$2.50 |

What is the price of the product? If the plant is operating at full capacity, and a supplier has submitted a bid of \$87.50, is the decision to make the product or buy it from a supplier?

Answer:

| Cost Element | Unit value | Part (a) | Part (b) |
|---|------------|-------------|----------|
| Direct labor | \$34.10 | 34.10 | 34.10 |
| Direct material | 8.40 | 8.40 | 8.40 |
| Variable overhead ratio of labor and material | 100% | 42.50 | 42.50 |
| Additional fixed costs | 5.00 | 5.00 | 5.00 |
| Profit | 2.50 | <u>2.50</u> | |
| Price | | \$92.50 | |
| Make value | | | \$90.00 |
| Buy value from supplier | | | \$87.50 |
| Decision | | | Buy |

11.4 A design and manufacturing company is anticipating a new product where 3200 annual units is the 100% plant capacity. Cost facts are given as

| | |
|----------------------------|-------------|
| Investment cost of project | \$4,100,000 |
| Annual income | \$8,200,000 |
| Operating cost | \$5,384,200 |
| Income tax, all kinds | \$1,319,150 |

Find the profit before income taxes, yield before income taxes, profit after taxes, yield after taxes, unit operating cost before income taxes, and unit operating cost after taxes.

Answer:

| | Item | 100 % Capacity |
|----|---|----------------|
| 1 | Investment cost of project | \$4,100,000 |
| 2 | Annual income | \$8,200,000 |
| 3 | Operating cost | \$5,384,200 |
| 4 | Profit before income taxes | \$2,815,800 |
| 5 | Yield before income taxes | 69% |
| 6 | Income tax, all kinds | \$1,319,150 |
| 7 | Profit after taxes | \$1,487,650 |
| 8 | Yield after taxes | 36% |
| 9 | Unit operating cost before income taxes | \$1682.56 |
| 10 | Unit operating cost after income taxes | \$1270.33 |

11.5 Engineering students are planning for the production and sale of a bicycle accessory, called “Warm Cup Holder.” While cold water bottles for bikers are common, cups and bottles for hot beverage are not. The design features a quick release mechanism for safe handling during biking and is stronger than the common bicycle water-bottle receptacle. Sale of the garage-produced product, with ample subcontract purchase of plastic molded parts, is to over-the-counter sales, wholesalers, and from their own web site with UPS delivery of product. A prototype product and completed CAD designs are available. The students have estimated the following information:

| Item | Amount |
|---|-----------|
| Annual units made and sold, number | 16,500 |
| Average price for unit sold | \$21.75 |
| Full variable cost of manufacturing, sales and delivery, dollars per unit | \$6.15 |
| Fixed cost, dollars | \$35,000 |
| Income tax rate | 18% |
| Investment, dollars | \$320,000 |

Find the profit before income taxes, yield before income taxes, profit after taxes, yield after taxes, unit operating cost before income taxes, and unit operating cost after taxes. (Hint: Unit operating cost includes direct labor, direct material, overhead or full variable cost, and fixed cost prorated over number of units.)

Answer:

| Item | Calculation | 100 % Capacity |
|---|------------------------|----------------|
| Investment | | \$320,000 |
| Annual income | $16,500 \times 21.75$ | \$358,875 |
| Variable cost | $16,500 \times 6.15$ | \$101,475 |
| Fixed cost | | \$35,000 |
| Operating cost before income tax, total | | \$136,475 |
| Unit operating cost before income tax | $6.15 + 35,000/16,500$ | \$8.27 |
| Profit before income taxes | | \$222,400 |
| Yield before income taxes | | 70% |
| Income tax, all kinds | $0.18 \times 222,400$ | \$40,032 |
| Profit after taxes | $\$222,400 - 39,960$ | \$182,368 |
| Yield after taxes | | 57% |
| Operating cost after income tax, total | | \$176,507 |
| Unit operating cost after income tax | | \$10.70 |

11.6 An engineering student team has designed and built a prototype “winch” product for raising and lowering a maximum of 200 lb of supplies, food, climbing gear, water, etc. over near-vertical mountain walls. The product is intended for recreational and professional mountain-climbing enthusiasts. The product is composed of aluminum pulleys, gears, stop clamps, rope guides, housing, etc. The bill of material is composed of 18 items. Manufacturing information is estimated as follows:

| Expense | |
|--|----------|
| Direct labor cost, unit | \$53.50 |
| Direct material cost, unit | \$82.15 |
| Variable production cost, unit | \$11.05 |
| Variable sales cost, unit | \$15.25 |
| Annual fixed production and sales cost | \$42,500 |

Market analysis indicates that this innovative technical product will command price and volume as follows:

| | Price | First Year Units |
|-----------------------|--------|------------------|
| Wholesale distributor | \$285* | 325 |
| Internet | \$470 | 200 |

*Suggested over-the-counter retail price of \$480

Advice from investors suggests the following financial obligation for the business:

| | |
|------------------------|-------|
| Yield after income tax | 75% |
| Effective tax rate | 15.5% |

Find the allowable investment to meet yield requirements. Discuss the financial requirement of yield in respect to the opportunity.

Answer:

| Item | Calculation | 100 % Capacity |
|---|-----------------------------------|----------------|
| Annual income | $285 \times 325 + 470 \times 200$ | \$186,625 |
| Variable cost | | \$161.95 |
| Variable cost, total | 161.95×525 | \$85,023 |
| Fixed cost | | \$42,500 |
| Operating cost before income tax, total | | \$127,524 |
| Unit operating cost before income tax | | \$242.90 |
| Profit before income taxes | | \$59,101 |
| Income tax, all kinds | | \$9161 |
| Profit after taxes | | \$49,940 |
| Yield after taxes | | 75% |
| Required investment to match yield | $49,940/0.75$ | \$66,600 |

From comparison of the investment of \$66,600 to the annual fixed cost of \$42,500, there isn't much cushion for mistakes. Perhaps the article should be redesigned to reduce cost.

11.7 A student design/manufacturing team is presenting its production costs to the class jury. The product, an electronic relay that controls the on/off function of a portable radio where the listener/wearer is unable to control the unit through manual control, is voiced activated with commands “on” and “off.” Their summary is given as

| Expense | Fixed Cost | Variable Cost per Unit |
|-----------------------------|------------|---------------------------|
| Annual plant cost | \$62,000 | |
| Direct labor | | \$5.25 |
| Direct material | | \$4.75 |
| Variable production support | | \$2.85 |

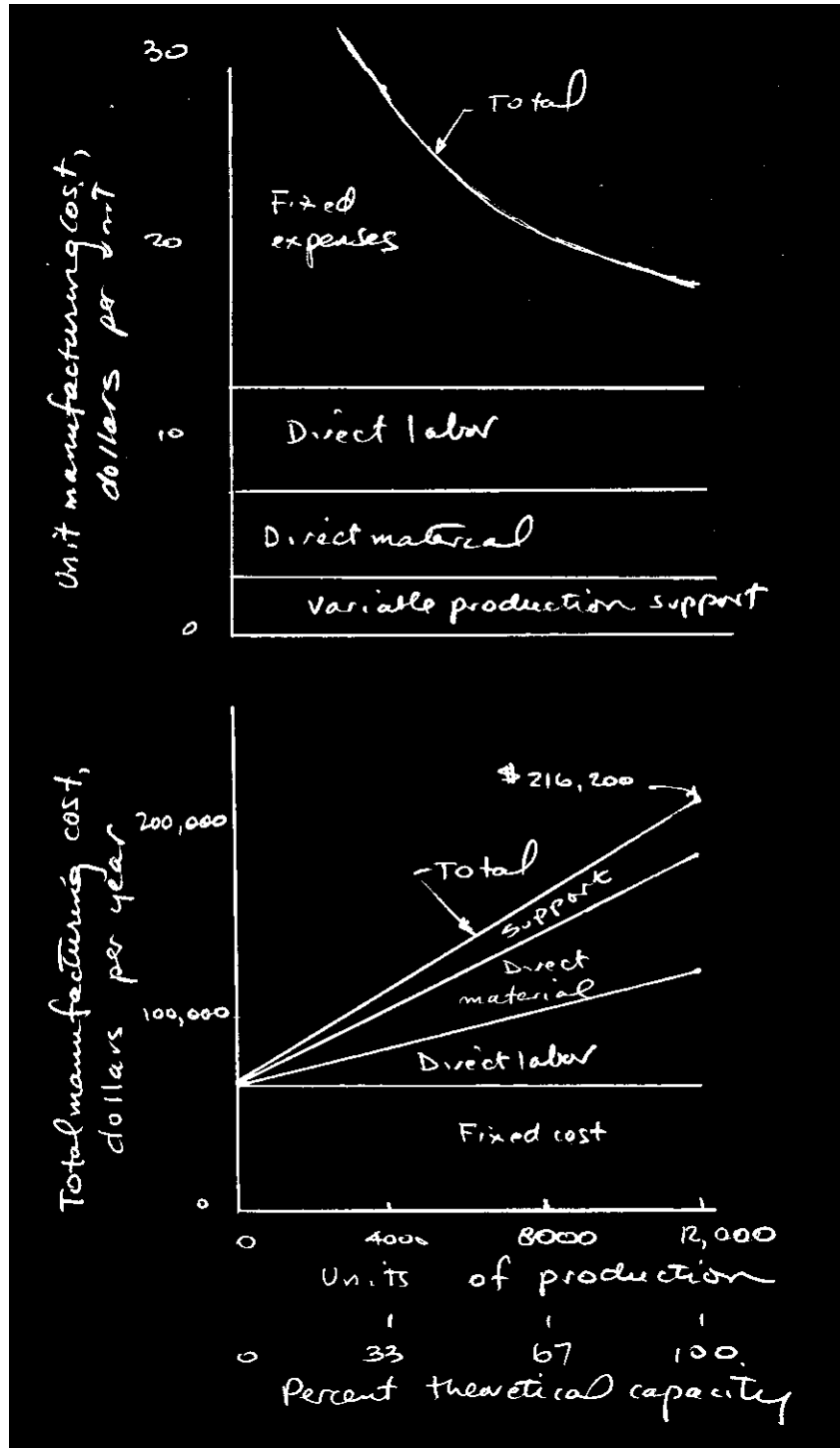
The team believes that 100 percent theoretical capacity of their world class plant is an annual 12,000 units. Plot the total and unit manufacturing cost of the components. Significant production points are 4000 and 8000 units in addition to the maximum capacity of the plant. Let the x-axis be “Units of production” and “Percent theoretical capacity.” (Hints: Note that the problem is dealing only with costs and is overlooking income.)

Answer:

| Expense | Fixed Cost | Variable Cost per Unit | Annual Production Quantity | | | |
|---|------------|---------------------------|----------------------------|-----------|-----------|-----------|
| | | | 0 Q | 4000 Q | 8000 Q | 12,000 Q |
| Percent theoretical capacity | | | 0 | 33 | 67 | 100 |
| Plant cost, total annual dollars | \$62,000 | | \$62,000 | \$62,000 | \$62,000 | \$62,000 |
| Direct labor, unit dollars | | \$5.25 | 0 | 21,000 | 42,000 | 63,000 |
| Direct material, unit dollars | | 4.75 | 0 | 19,000 | 38,000 | 57,000 |
| Variable production support, unit dollars | | 2.85 | 0 | 11,400 | 22,800 | 34,200 |
| Total | | | | | | \$216,200 |
| Fixed cost prorated over Q | | | | \$15.50 | \$7.75 | \$5.17 |
| | | Cost per Unit | | \$28.35 | \$20.60 | \$18.02 |
| | | Total Production Cost | | \$113,400 | \$164,800 | \$216,200 |

Answer continued on next page

11.7 Answer continued



11.8 An investment is \$1 million. The expected profit rate is 12 percent. The effective federal and state tax rate is 40 percent. What is the pretax earning rate required for the project? Find the expected profit plus income tax. What is the expected profit after income tax?

(Hints: Income tax is a tax imposed on net incomes by the Federal and the state government. It is necessary to consider taxes when considering the earning power of a project.)

Answer:

Total percent of investment for expected profit and income tax = (expected profit, decimal)/(1 – income tax rate, decimal)

Total combined rate = $0.12/(1 - 0.40) = 0.20 - 20\%$. (See Chapter 9)

Expected profit + income tax = $0.2 \times \$1,000,000 = \$200,000$.

Total net income before income tax ,

Income tax = $0.40 \times \$200,000 = \$80,000$.

Expected profit = combined expected profit and income tax – income tax = $\$200,000 - \$80,000 = \$120,000$. This value is the expected profit equivalent to 12 per cent of investment or $0.12 \times \$1,000,000 = \$120,000$.

11.9 The present value of bonds paying semiannual interest is approximated using the following equation:

$$P_0 = \frac{I}{2}(P/A, \frac{i_b}{2}, 2n) + M(P/F, \frac{i_b}{2}, 2n)$$

where P_0 = value of bond at present time, dollars

I = annual interest, dollars

M = maturity value of bond, dollars

i_b = interest rate desired by bondholder, decimal

n = annual periods, number

A \$1000 bond has semiannual payments and the coupon rate is 10%. If the required rate of return is 20%, find the value of the bond for a 25 year period. For a 15 year period.

Answer:

For a 25 year period:

$$P_0 = 50(P/A, 10, 50) + 1000(P/F, 10, 50) = 50(9.9148) + 1000(0.0085) = \$504$$

For a 15 year period:

$$P_0 = 50(P/A, 10, 30) + 1000(P/F, 10, 30) = 50(9.4269) + 1000(0.0573) = \$528$$

11.10 What is the current market price of a \$1000 par 5 % coupon rate bond if interest is paid annually or semiannually, and there are 12 years to maturity. The required rate of return is 10 %.

Answer:

Annually:

$$P_0 = 50(P/A, 0.10, 12) + 1000(P/F, 0.10, 12) = 50(6.1446) + 1000(0.3186) = \$626$$

Semiannually:

$$P_0 = 25(P/A, 0.05, 24) + 1000(P/F, 0.05, 24) = 25(13.7987) + 1000(0.3101) = \$655$$

11.11 A company sold an issue of 10% bonds 6 years ago. Each bond has a face value of \$1000 at maturity, and is due in 14 years. It pays interest twice a year. Even as interest rates are climbing, the bond can be sold on the market for \$1100. If buyers expect that their money to earn 10% compounded semiannually, and they must pay a brokerage charge of \$20 to purchase each bond, is the proposed selling price reasonable?

Answer:

Semiannual interest payments amount to 5% of the face value of the bond, or $0.05 \times 1000 = \$50$, and \$1000 will be redeemed in 14 years, or 28 half-year periods. The present value of the cash flow when the desired nominal amount is 5% per 6-month period is

$$\begin{aligned} P_0 &= \$50(P/A, 5\%, 28) + \$1000(P/F, 5\%, 28) \\ &= \$50(14.898) + \$1000(0.25510) \\ &= \$1000 \end{aligned}$$

Since the price of the bond is \$1120, the proposed price is not reasonable, and the buyer should take his/her money elsewhere.

11.12 Find the current market value of a 20-year, 10 % coupon rate bond with a par value of \$1000, if interest is paid annually for current market rates of 15% or 5%. What are the current market prices if everything is the same except that the bond has only 10 years to maturity. Discuss the relative influence of changing market interest rates on the market prices of short-term versus long-term bonds.

Answer:

At 15% for 20 years to maturity:

$$P_0 = I(P/A, i_b, n) + M(P/F, i_b, n) = 100(P/A, 15\%, 20) + 1000(P/F, 15\%, 20) = 100(6.259) + 1000(0.061) = \$687$$

At 5% for 20 years to maturity:

$$P_0 = 100(P/A, 5\%, 20) + 1000(P/F, 5\%, 20) = 100(33.066) + 1000(0.377) = \$3684$$

At 15% for 10 years to maturity:

$$P_0 = 100(P/A, 15\%, 10) + 1000(P/F, 15\%, 10) = 100(20.304) + 1000(0.247) = \$2277.$$

At 5% for 10 years to maturity:

$$P_0 = 100(P/A, 5\%, 10) + 1000(P/F, 5\%, 10) = 100(12.578) + 1000(0.614) = \$1872.$$

11.13 Find the stock and bond value for a company having outstanding bonds and stocks. The outstanding bonds amount to \$3,000,000 and the issued par value is \$1000. Existing market value for the bonds is \$1030. There are 6000 shares of stock, and its current market value is \$160 each.

Answer:

| Type | Calculation | Result |
|-------|----------------------------|---------------------|
| Bonds | $3000000/1000 \times 1030$ | \$309,000 |
| Stock | 6000×160 | <u>960,000</u> |
| Total | | <u>\$1,269,000.</u> |

11.14 Construct an annual income statement for the company Enterprise Ltd. The all-inclusive federal and state income tax rate is 30%. What is the final net income after taxes? What is the addition or subtraction for the year profit or loss to retained earnings for the balance sheet?

Stocks and bonds have been issued for Enterprise including bond interest, 5 % coupon rate for 900 certificates, par value of \$1000; preferred stock, 7% rate, 3000 shares at \$100 each share; and common stock, \$1 dividend for 14,000 shares currently valued at \$50 each.

| Closed Account | Amount |
|---|-------------|
| Utilities | 60,000 |
| Interest from owned securities | 95,000 |
| Fees for consulting and engineering | 85,000 |
| Salaries | 1,250,000 |
| Sales from products | \$6,250,000 |
| Equipment lease | 72,000 |
| Supplies | 125,000 |
| Manufacturing costs not included elsewhere to produce product | 2,100,000 |
| Patent royalty from designs | 150,000 |
| Rent | 48,000 |
| Travel & hotel | 50,000 |

Answer:

Enterprise Ltd.
Income Statement
End of Year

| | |
|--------------------------------|---------------|
| Income | |
| Sales from products | \$6,250,000 |
| Fees | 85,000 |
| Royalty | 150,000 |
| Interest from owned securities | <u>95,000</u> |
| Total income | \$6,580,000 |
| Expenses | |
| Manufacturing costs | \$2,100,000 |
| Salaries | 1,250,000 |
| Utilities | 60,000 |
| Equipment lease | 72,000 |
| Rent | 48,000 |
| Travel & hotel | 50,000 |
| Supplies | 125,000 |
| Bond interest | <u>51,750</u> |
| Total expenses | \$3,756,750 |
| Income less expenses | \$2,823,250 |
| Taxes at 30% | 846,975 |
| Profit after taxes | \$1,976,275 |
| Preferred stock deduction | 21,000 |
| Common stock deduction | 14,000 |
| Addition to retained earnings | \$1,941,275 |

11.15 There are many methods for raising capital for an invention. An entrepreneur will find it necessary to prepare a balance sheet and profit and loss statement for different circumstances of the business opportunity. The following parts are not complete in all details, but the student needs to pay attention to the financial sheets for their differences and similarities.

(a). An entrepreneur has determined a balance sheet and profit and loss statement for an investment, which are as follows:

Balance Sheet Statement

| | | | | |
|---------------------|-------------|----------------|--|-------------|
| Fixed assets, plant | \$1,660,000 | Owner's equity | | \$1,660,000 |
|---------------------|-------------|----------------|--|-------------|

Profit and Loss Statement

| | |
|---------------------------------------|-----------|
| Income from engineering design, plant | \$240,000 |
| Operating cost | 110,840 |
| Gross profit | \$129,160 |
| Income tax of individual entrepreneur | \$37,940 |
| Net profit after income tax | \$91,220 |

Find the entrepreneur yield. (Hints: For this case assume that the entrepreneur has the full amount of money for the project. Though not a part of this problem, the income tax is determined as for an individual.)

(b). Assume that the entrepreneur has in hand \$1,460,000, and she raises another \$200,000 in an unsecured loan from a friend for 6 % yearly. Balance sheet and income statement are as follows:

Balance Sheet Statement

| | | | | |
|---------------------|--------------------|------------------|--|----------------|
| Fixed assets, plant | <u>\$1,660,000</u> | Owner's equity | | \$1,460,000 |
| | | Loan from friend | | <u>200,000</u> |
| | \$1,660,000 | | | \$1,660,000 |

Profit and Loss Statement

| | |
|---------------------------------------|---------------|
| Income from engineering design, plant | \$240,000 |
| Operating cost | 110,840 |
| Gross profit | \$129,160 |
| Interest on \$200,000 loan at 6% | <u>12,000</u> |
| Net profit subject to income tax | \$117,160 |
| Income tax | 32,920 |
| Net profit after income tax | \$84,240 |

Find the entrepreneur's yield. (Hints: The analysis does not provide for paying back the loan. If the investor desires to repay the loan, it must be done out of the profit. If the payment of the loan is made, and is considered a financial expense, the effect is to increase the investor's equity in the project, and an unwarranted increase in the yield.)

(c) The entrepreneur chooses to raise funds via bonds as secured funds where the plant and design provides the mortgage collateral. The investor will invest \$260,000 into the enterprise, leaving the remainder as units of \$500 per bond at a rate of 5 percent. Balance sheet and income statement are as follows:

Balance Sheet Statement

| | | | | |
|---------------------|--------------------|--|--|------------------|
| Fixed assets, plant | <u>\$1,660,000</u> | Owner's equity | | \$260,000 |
| | | Funded debt, first-mortgage bond issue | | <u>1,400,000</u> |
| | \$1,660,000 | | | \$1,660,000 |

Problem continued on next page

11.15 Problem continued

Profit and Loss Statement

| | |
|---|-----------|
| Income from engineering design, plant | \$240,000 |
| Operating cost | 110,840 |
| Gross profit | \$129,160 |
| Interest on bond issue, \$1,400,000 at 5% | 70,000 |
| Net profit subject to income tax | \$59,160 |
| Income tax | 13,380 |
| Net profit after income tax | \$45,780 |

Find the entrepreneur's yield. (Hint: Taxes for the investor are calculated as an individual, and are not shown.)
(d). The enterprise is incorporated with capital raised as common and preferred stock. Balance sheet and income statement are as follows:

Balance Sheet Statement

| | | | |
|---------------------|--------------------|--|----------------|
| Fixed assets, plant | <u>\$1,660,000</u> | Stock, common, 12,600 shares at \$100 | \$1,260,000 |
| | | Preferred stock, (7 %, 400 shares at \$1000) | <u>400,000</u> |
| | \$1,660,000 | | \$1,660,000 |

Profit and Loss Statement

| | |
|--|----------------|
| Income from engineering design, plant | \$240,000 |
| Operating cost | <u>110,840</u> |
| Gross profit subject to income tax | \$129,160 |
| Income tax at 25% | 32,290 |
| Net profit after income tax | \$96,870 |
| Dividend on preferred stock, \$400,000 at 7% | 28,000 |
| Net profit on common stock | \$68,870 |

What is the yield on the preferred stock? Find the yield on common stock.

Answer:

- (a). Investor's yield = $91,220/1,660,000 = 5.5\%$.
(b). Investor's yield = $84,240/1,460,000 = 5.76\%$. Note that the yield has increased because the interest on the loan is considered an expense reducing taxes.
(c) Investor's yield = $45,780/260,000 = 17.6\%$
(d) Yield on preferred stock is 7%, the stated yield on the face of the stock certificate. Yield on common stock = $68,870/1,260,000 = 5.4\%$.

CHALLENGE PROBLEMS

11.16 PN 8871 is to be analyzed for a make-versus-buy decision. The labor estimate is as follows:

| Operation | Unit labor cost |
|-----------|-----------------|
| 1 | \$0.0006 |
| 2 | 0.0130 |
| 3 | 0.0130 |
| 4 | 0.0007 |
| 5 | 0.0068 |

Direct material and material overhead = \$0.0084 per unit. Variable overhead is 75% of direct labor, and fixed cost is \$0.05 per unit. This company believes that the part deserves a profit of \$0.025. (Hints: Each of the subparts of the problem are independent. There are no quantity considerations.)

- Find the total cost and price of the component as if there is no make-versus-buy comparison.
- If the company's plant capacity is underutilized, is the decision make-or-buy for a vendor's price = \$0.075?
- For 100% plant utilization, what is the decision for a supplier's \$0.118 price?
- If the plant chooses to make the article while at under capacity, it will incur a 15% increase in direct wages owing to marginal costs of inefficient production. What is the decision for a supplier's \$0.105 price?
- Evaluate the choices for a nonrecurring initial fixed price of tooling designed, manufactured, and paid for. Those initial costs for 2500 units were \$25. What are the nonquantitative considerations of this sunk cost? Also, perform the analysis as if the \$25 has not been spent.

Answer on next page

11.16 Answer

Answer:

| Element | Question (a) | Question (b) | Question (c) | Question (d) |
|--------------------|---|---------------|---------------|---------------|
| Operation | \$0.0006 | \$0.0006 | \$0.0006 | |
| 1 | | | | |
| 2 | 0.0130 | 0.0130 | 0.0130 | |
| 3 | 0.0130 | 0.0130 | 0.0130 | |
| 4 | 0.0007 | 0.0007 | 0.0007 | |
| 5 | <u>0.0068</u> | <u>0.0068</u> | <u>0.0068</u> | |
| Total labor cost | \$0.0341 | \$0.0341 | \$0.0341 | \$0.0392 |
| Variable OH at 75% | 0.0256 | 0.0256 | 0.0256 | 0.0294 |
| Material | 0.0084 | 0.0084 | 0.0084 | <u>0.0084</u> |
| Fixed cost | 0.0500 | Not used | 0.0500 | |
| Profit | <u>0.0250</u> | Not used | Not used | Not used |
| Price | \$0.1431 | | | |
| Make value | | \$0.0681 | \$0.1181 | \$0.0770 |
| Vendor price | | \$0.075 | \$0.1180 | \$0.1050 |
| Decision | | Make | Buy | Make |
| Question (e) | There is no change to the decisions as the tooling cost is already paid for, and is a sunk cost, and is not relevant to the decisions. | | | |
| Question (e) | If the money has not been spent for tooling, then it does figure in the analysis, and the make cost is increased by $25/2500 = \$0.01$ per unit, and the make value increases by this amount. This assumes that the tooling cost by the supplier is a separate consideration. The make analysis under the additional \$0.01 is given below: | | | |
| Make value | | \$0.0781 | \$0.1281 | \$0.0870 |
| Decision | | Buy | Buy | Make |

11.17 A company is considering the raising of capital by one of three means: 30-year bonds, preferred stock or common stock. It will select the best financing method on the basis of minimum cost after taxes. The \$1000 bonds have a 6% annual coupon rate. The \$100 preferred stock has a guaranteed dividend rate of 6%. Common stock is anticipated to have a \$50 stock value and dividends are expected to be \$1.50 per share. All values are annual. The desired amount of financing for the first year is \$15,000,000. Assume that the company is raising the money itself, without the assistance of an underwriting firm, thus avoiding that cost of raising the money, and furthermore, the three methods are assumed to be substantially equal in the cost of financing. The all-inclusive federal and state tax rate is 40%.

Find the preferred financing method.

Answer:

| Security Type | Rate | Price | Amount of Financing First Year | Interest or Dividend Cost | |
|----------------------------------|-----------------|--------|--------------------------------|---------------------------|------------------------|
| | | | | Before Taxes | After 40% Tax Rate |
| 30-yr bond (15,000 certificates) | 6% interest* | \$1000 | \$15,000,000 | \$900,000 | \$540,000 ¹ |
| Preferred stock (150,000 shares) | 6% dividend | 100 | 15,000,000 | 900,000 | 900,000 ² |
| Common stock (300,000 shares) | \$1.50 dividend | 50 | 15,000,000 | 450,000 | 450,000 ³ |

- ¹. Bond interest for a company is a deductible expense, and the taxes reduce the cost of this method of financing by the product of taxes times total interest, or $0.40 \times 900,000 = 360,000$; then the cost of the financing to the company would be $900,000 - 360,000 = 540,000$. This assumes that the corporation is earning net income rather than net loss.
- ². The dividends paid to preferred stock holders are not a deductible expense to the company.
- ³. The dividends paid to common stock holders are not a deductible expense to the company. Preferred method because cost is the least among the three methods.

The market will probably demand a higher rate of return for the bonds than for the preferred stock, since bonds do not tend to have much upside potential, whereas preferred stock has a potential to increase in value.

11.18 Construct a balance sheet for the company Enterprise Ltd., third quarter. The closed ledger accounts, bonds and stock information are given as follows:

| | |
|---|-------------|
| Retained earnings, end of second quarter with profit included | \$1,020,000 |
| Finished goods inventory | 250,000 |
| Total fixed assets | 2,150,000 |
| Preferred stock, 7%, 3000 shares at \$100 each | |
| Short term borrowing, leases and rentals | 80,000 |
| Cash on hand | 300,000 |
| Bonds, 5 _ % coupon rate, 900 certificates at \$1000 each | |
| In process materials | 100,000 |
| Common stock, 14,000 shares at \$50 each | |
| Purchased materials inventory | 200,000 |

(Hint: Set up a balance sheet having the appropriate formal heading, and with Assets, Liabilities, and Net Worth, referring to chapter 4, Accounting Analysis.)

Answer on next page

11.18 Answer

| Enterprise Ltd. | | | |
|----------------------|--------------------|-------------------------|--------------------|
| Balance Sheet | | | |
| Third Quarter | | | |
| Assets | | Liabilities | |
| Current Assets | | | |
| Cash | \$300,000 | Bonds | \$900,000 |
| Inventory | 200,000 | Short term | <u>80,000</u> |
| In process materials | 100,000 | Total | 980,000 |
| Finished goods | <u>250,000</u> | | |
| Total current assets | 850,000 | Net Worth | |
| Total fixed assets | 2,150,000 | Preferred | 300,000 |
| | | Common | 700,000 |
| | | Retained | <u>1,020,000</u> |
| | | | 2,020,000 |
| Total assets | \$3,000,000 | Total L & NW | \$3,000,000 |

11.19 A student team submits a bookstand prototype and a CAD dithered rendition to the buyer of a commercial mail catalog that specializes in “tools for the serious reader” for purchase consideration. The bookstand, called “Futura,” will handle small and large books, measures 5 x 6 x 7 in., weighs 2 lb, folds down for storage, is made of formed and brushed stainless steel and has protective felt feet. The catalog buyer responds, saying that the supplier also deliver the product in a paper box having the appearance of gift wrapping. The catalog will list the product for sale at \$29.90, and they are prepared to offer \$14.95 a unit. The buyer indicates a probable order of 20,000 units yearly for the foreseeable future.

The team finds that the plant requires equipment such as a shear (sizing the blanks), press brake (forming), flat sander (wire brushing the finish), and a 20 ft conveyor and benches for assembly. Tooling is necessary for piercing, blanking and forming. The student team is renting a 2000 ft² factory, hiring two machinists and is managing service, sales, book keeping, billing, design, and supervision. Estimates are found as follows:

| Expense | Fixed Cost | Variable Cost per Unit |
|--|------------|------------------------|
| Annual plant cost including power, heat, insurance, depreciation, maintenance, working capital, etc. | \$75,000 | |
| Direct labor | | \$1.25 |
| Direct material | | 1.75 |
| Variable management support by student team | | 1.00 |

The team borrows \$195,000 from relatives and friends. A Certified Public Accountant indicates that the combined federal and state income tax rate will be 17.5% for their likely profit range of business.

Plot plant capacity versus total operating costs and unit operating costs and find the break even point of operation graphically. What is the yield on investment before and after income taxes?

(Hints: Use plant capacity of 0, 25, 50, 75, and 100% where maximum capacity is 20,000 annual units. Two plots are required.)

Would you invest in this opportunity? Why or why not?

Answer on next page

11.19 Answer

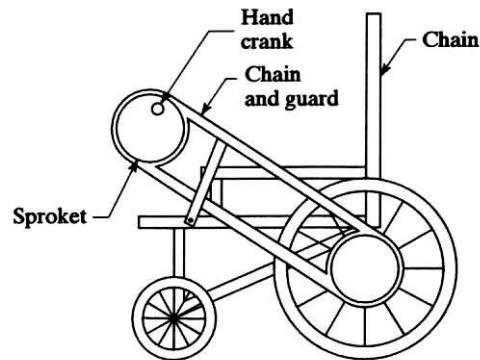
Invested value of project cost and plant is
\$195,000

| Percentage of plant capacity | 0 | 25 | 50 | 75 | 100 |
|--|------------|------------|------------|------------|------------|
| Units produced and sold, annual number | 0 | 5,000 | 10,000 | 15,000 | 20,000 |
| Income (Price of bookstand = \$14.95 per unit) | 0 | \$ 74,750 | \$ 149,500 | \$ 224,250 | \$ 299,000 |
| Unit price | | \$ 14.95 | \$ 14.95 | \$ 14.95 | \$ 14.95 |
| Total fixed cost (rent, taxes, heat, power, depreciation) | \$ 75,000 | \$ 75,000 | \$ 75,000 | \$ 75,000 | \$ 75,000 |
| Fixed expense per unit of production | | \$ 15.00 | \$ 7.50 | \$ 5.00 | \$ 3.75 |
| Direct labor (1.25) and direct material (1.75) per unit | | | | | |
| Total direct labor and direct material (Units x 3.00) | 0 | \$ 15,000 | \$ 30,000 | \$ 45,000 | \$ 60,000 |
| Management cost per unit, \$1 variable | 0 | \$ 5,000 | \$ 10,000 | \$ 15,000 | \$ 20,000 |
| Total variable manufacturing cost 1.25 + 1.75 + 1 = 4) | 0 | \$ 20,000 | \$ 40,000 | \$ 60,000 | \$ 80,000 |
| Variable manufacturing cost | | \$ 4.00 | \$ 4.00 | \$ 4.00 | \$ 4.00 |
| Total variable and fixed manufacturing cost | \$ 75,000 | \$ 95,000 | \$ 115,000 | \$ 135,000 | \$ 155,000 |
| Unit cost, \$ per unit | | \$ 19.00 | \$ 11.50 | \$ 9.00 | \$ 7.75 |
| Net profit before taxes | | | \$ 34,500 | \$ 89,250 | \$ 144,000 |
| | \$(75,000) | \$(20,250) | | | |
| Yield on investment before taxes | -38.5% | -10.4% | 17.7% | 45.8% | 73.8% |
| Taxes, federal and state, rate = 17.5% | 0 | 0 | \$ 6,038 | \$ 15,619 | \$ 25,200 |
| Unit taxes | | \$ - | \$ 0.60 | \$ 1.04 | \$ 1.26 |
| Net profit after taxes and including depreciation | \$(75,000) | \$(20,250) | \$ 28,463 | \$ 73,631 | \$ 118,800 |
| Yield on investment after taxes and including depreciation | -38.5% | -10.4% | 14.6% | 37.8% | 60.9% |
| Total unit costs plus unit taxes | | \$ 19.00 | \$ 12.10 | \$ 10.04 | \$ 9.01 |

11.20 A student team is developing a design concept to ease the movement of a wheel chair. Now the occupant moves the chair by hand grabbing an outer soft-rubber wheel, rolling the wheel forward about 15 - 25°, releasing the wheel and quickly repeating the motion sequence. With a crank motion and a kinematic mechanism where mechanical leverage is improved, the chair is able to move forward or backward more effortlessly and is ergonomically compliant, according to the team. While the work to move the chair depends on a number of physical conditions, exercise is enhanced.

The concept visualizes a hand crank mounted on the arm of the chair and connected by chain and sprockets to the wheel. Major assemblies include front and rear wheel and frame attachment, hand crank, frame and chain guard. Figure P11.20 provides a preliminary side view.

Figure P11.20.



. Using the Internet develop a marketing plan for the product. The product is visualized as an after-market sale How many units do you believe can be sold, if a marketing service believes that the potential sale is 0.25% of the wheel-chair catch basin of users, and what is the possible sale price and design-to-cost for the attachment? Consider a survey of college student wheel chair users to help sharpen your recommendations. What advice can you give to the engineering team as they consider final design and specifications of the product. (Hint: Consider design synergy between bicycles and this application.)

Answer:

This is an open-ended problem with many variations. There is no one answer that can be given here.

PRACTICAL APPLICATION

Form a team for this application. Your instructor will define the limits and operation of the team for a design-for-profit assignment. Select a simple product and with a team conference approach construct a tree that is representative of the product. (Hint: Visualize the assembly process first, finding any major or minor assemblies before those assemblies are reduced to components.)

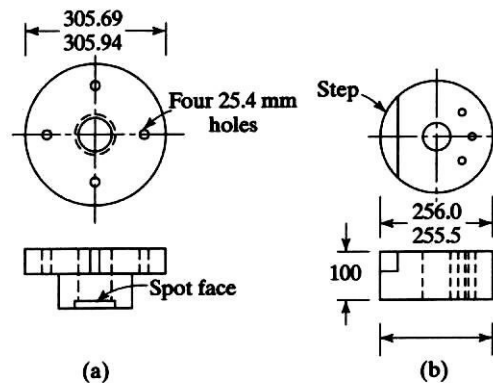
The product can be a real object, or it may be from a design that you are considering in another course. Notice the subassemblies through reverse engineering. Take the product to the component level, suggesting a part number for each part. Then estimate a cost for each subassembly level and component. What is the price of the product? Use the market price, if available, and reduce it to an appropriate cost for production. Show the tree as the result of the assignment.

(Hints: Keep the product simple. An example that is simple is a finger-nail clipper.)

CASE STUDY: ROUND PLATE INC.

Round Plate Inc. makes and sells round plates. This company has standardized its product lines into two families, shown as A and B in Fig. C11.1. These plates are used in many applications, such as bearing plates, post rests, flanges, bases, and any engineering design that starts with 10 - and 12 in. round bar stock and ends with similar shapes. Manufacturing operations are limited to turning, drilling, tapping, reaming, step milling, and grinding.

Figure C11.1



Mr. Edward Lyell, owner of the shop, tells any potential investor, "I can win any bid starting with standard bar stock and concluding with no more features than shown on the sketches." He has been talking to you about investing in his company.

A registered and legal financial prospectus about Round Plate says that future capitalization with infused shareholders' investment will result in a modern factory of the future equipped for vertical market penetration in the round plate business. This factory will feature standard pallets, fixtures, grippers, and robots for the loading and automatic machining of the bar stock. Round Plate's operation is a garage-style cell.

The prospectus gives the number of outstanding shares, income and balance sheet for the past year, strategy for a 25% control of the market, and pledges for an after-tax yield of 47% on the investment of \$1,250,000. The prospectus claims that Round Plate will employ only the president, maintenance operator, tool room grinder, computer programmer, manufacturing engineer, robot maintainer and teacher, accountant and bill collector, and finally a material handler for shipping product, raw stock receiving and chip and waste removal. All work is computer numerical controlled and does not require any direct labor for the operations.

"We will operate the night shift without anybody," boasts Lyell. "Even the lights are out," he says. "This is a good time to buy shares." He looks at you expectantly.

A pause and then you reply. "Well, everything sounds pretty good, and I do like your ideas. But I don't buy into businesses without first sleeping on it. I'll see you tomorrow and we will go over some details."

That night you begin to ponder the offer. You mutter, "What are the critical engineering and manufacturing requirements for this business? What is necessary for success in this enterprise?"

Continue your questioning attitude and develop other questions for Mr. Lyell. Develop your questions along these general groupings: (1) Equipment and ancillary support for tooling, material movements, controls, and machine vision, (2) Market strategy and factors for the round plate business, and (3) Enterprise plan. Conclude by preparing a written page on "due diligence" that you as an investor need to use for assessment.

Answer:

This is an open-ended problem with many variations. There is no one answer that can be given here.