INSTRUCTOR'S MANUAL
TO ACCOMPANY

CAPITAL INVESTMENT ANALYSIS FOR ENGINEERING AND MANAGEMENT

Third Edition

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FOREWORD

This manual consists primarily of solutions to the end-of-chapter problems and exercises. They are the result of the efforts of all four authors and represent our efforts to help students gain closure on the concepts and principles developed in the text. They are organized to follow the chapters of the text.

Following the chapter solutions, are some new additions. First of these is a major section titled Case Teaching Guidelines and Suggestions. This was prepared by Dennis J. Kulonda based on his extensive experience teaching graduate students in Engineering Management. It should be of great educational benefit to instructors (and their students) who wish to use this approach as a means to convey the rich context of capital investment decisions, create a greater sense of realism and motivate understanding of how the pieces of the puzzle fit.

Recommendations for case usage are provided for each of the four sections of the text; however, a detailed segment teaching plan is provided for Part One of the text on Value Creation and Accounting. This especially valuable in that we believe that it helps students develop a solid understanding of the role of the accounting process and its relation to performance measurement and investment analysis. Further it does so with a bare minimum of attention to accounting mechanics and transaction processing. For those who prefer a traditional approach, there are exercises at the end of the chapters.

Cases in subsequent parts of the text provide opportunities to supplement the problem exercises with cases which, as already indicated, enrich the student's understanding of the material. Guidance on interspersing them with chapter exercises is provided.

Finally the last section of this manual contains a glossary of accounting and financial terms which may be duplicated and furnished to the students for general reference or as part of an exercise as outlined in the teaching suggestions.

Your thoughts, comments and suggestions are most welcome.

Bon Voyage!

Dennis J. Kulonda

Editor, Instructor's Manual

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SOLUTIONS TO CHAPTER 1 PROBLEMS

Value Creation and Financial Accounting

1-1 Engineers do not know how to keep books but they must be able to communicate with those who do. Even though the need for debits and credit labeling of transactions is obsolete in today's corporate world, the language and concepts are essential knowledge for any professional.

1-2 Must be a cash accounting (rather than accrual) system.

1-3

Asset

Cash

(1) 100,000	20,000 (3)
(4) 80,000	20,000 (5)
	10,000 (5)
	50,000 (7)
(10) 80,000	

Raw Material

(2) 40,000	30,000 (3)
(6) 30,000	
(10) 40,000	

Plant and Equipment

(3) 20,000	2,000 (7)
(10) 18,000	

Accounts Receivable

(4) 10,000	

Net Income

(8) 62,000	90,000 (8)
(9) 28,000	

Liability & Net Worth

Accounts Payable

(7) 50,000	40,000 (2)
	30,000 (6)
	20,000 (10)

Equity Shares

	100,000 (1)

Retained Earnings

	28,000 (9)

Revenues

(8) 90,000	90,000 (4)

Expenses

(5) 30,000	62,000 (8)
(5) 20,000	
(5) 10,000	
(7) 2,000	

Numbers in parentheses are debits and credits corresponding to the first six transactions for items (1) to (6). Items (7) to (10) are required for closing the books as follows:

7. Show depreciation Charges
8. Close Revenue and expense to Net Income
9. Close Net Income to Retained Earnings
10. Re-total permanent accounts

The resulting income statement and balance sheets are shown below:

Income Statement

Sales		$ 90,000
Mat'l	$ 30,000	
Labor	$ 20,000	
Rent& Admin	$ 10,000	
Depreciation	$ 2,000	
Total Expense		$ 62,000
Net Income		**$ 28,000**

Assets		**Liabilities**	
Cash	80,000	Accounts Payable	20,000
Accounts Receivable	10,000	**Total Liabilities**	**$ 20,000**
Inventory	40,000		
Net Equip	18,000	Treasury Shares	100,000
		Retained Earnings	28,000
		Total Equity	**$ 128,000**
Total Assets	**$ 148,000**	**Total Liabilities & Equity**	**$ 148,000**

1-4. Initial Balances

Cash	
100,000	

Inventory	
100,000	

Plant and Equipment	
400,000	

Cost of Goods	

Accounts Payable	
	50,000

Equity	
	550,000

Revenues	

Transactions During the year

Item #	Item	Debit	Credit
1	Labor Cost	Inventory in Process $100,000	Cash $100,000
2	Materials	Inventory in Process $150,000	Cash $150,000
3	Depreciation	Inventory in Process $50,000	Plant and Equipment $50,000
4	Production	Finished Goods Inventory $300,000	Inventory in Process $300,000
5	Sales and Product Delivery	Cash $600,000	Sales Revenue $600,000
		Cost of Goods $300,000	Finished Goods Inventory $300,000
6	Equipment Purchase	Plant & Equipment $200,000	Cash $200,000
7	Closing Entries	Net Income $300,000	Cost of Goods sold $300,000
		Sales Revenue $600,000	Net Income $600,000

T Accounts After Transactions:

Cash

100,000	100,000 (1)
(5) 600,000	150,000 (2)
	200,000 (6)
250,000	

Finished Goods Inventory

100,000	300,000 (5)
(4) 300,000	
100,000	

Plant and Equipment

400,000	50,000 (3)
(6) 200,000	
550,000	

Cost of Goods

(5) 300,000	300,000 (7)

Inventory in Process

0	
(1) 100,000	300,000 (4)
(2) 150,000	
(3) 50,000	
0	

Accounts Payable

	50,000

Equity

	550,000

Net Income and Retained Earnings

(7) 300,000	600,000 (7)
	300,000

Revenue

(7) 600,000	600,000 (5)

Long Corporation

Income Statement for Year 1
(Amounts in $)

Sales	600,000
Cost of goods sold	300,000
Net income before tax	300,000
Tax	0
Net Income After Tax	300,000

Long Corporation

Balance Sheet at end of Year 1
(Amounts in $)

ASSETS	
Cash	250,000
Inventory	100,000
Plant & Equipment	550,000
TOTAL ASSETS	900,000
LIABILITIES	
Accounts Payable	50,000
EQUITY	
Original Equity	550,000
Retained Equity	300,000
TOTAL LIABILITIES & EQUITY	900,000

Solution Notes to Point out

1. This solution assumes that this was the first operating year; hence retained earnings is the same as net income for the first year.

2. The company capitalization grew by the amount of retained earnings. We create value when we make profits.

3. Good example to point out difference in cash positions, that is

   a) Cash Flow from operations is $350,000 (Revenue of $600,000 less materials and labor at $150,000 and $100,000 respectively).

   b) Cash Flow from new equipment investment is a negative $200,000 resulting in a net cash flow of $350,000 - $200,000 = $150,000. Look at initial and ending balance sheets to see change in cash position is $150,000.

1-5

Assets		**Liabilities**	
Cash	$ 150,000	Current Liabilities	$ 40,000
Raw Mat'l	100,000	Debt	450,000
Finished Goods	50,000	Retd Earnings	610,000
WIP (in-process mat'l)	100,000	Stock	400,000
Fixed Assets(P&E)	1,100,000		
Total	**$ 1,500,000**	**Total**	**$ 1,500,000**

Net Working Capital = Current Assets – Current Liabilities
= (150,000+100,000+50,000+100,000) – 40,000
= $ 360,000

Current Ratio = CA/CL = 400000 / 40000 = 10.0

1-6

EZ Machine Shop
PROFIT and LOSS Statement for 9 Months Ending September 30
(Amounts in $)

Gross Sales	700,000	
Less: returns	40,000	
Discounts	10,000	
Net Sales		***650,000***
Material Expense	210,000*	
Salaries	120,000	
Rent	80,000	
Total Operating Exp		*410,000*
Net operating Profit		
(Earnings Before Interest and Taxes – EBIT)		***240,000***
Interest Earned	2,000	
Interest Paid	5,000	
Taxable Income		***237,000***
Income Tax	47,000	
Net Income after Tax (NIAT)		**190,000**

Note sequence of computations with net sales first, then operating profits then Net Income and finally net income after tax.

* Inventory Jan 1 + Purchases – Purchase Returns – Inventory Sep 30
120000 + 270000 – 20000 – 160000 = 210,000

1-7

	East Coast	West Coast
ROA = Net Income After Tax / Total Assets	[200 - 0.4(200)] / 1000 = 120 /1000 = 12%	[750 – 0.4(750) / 5000 = 450 / 5000 = 9%
ROIC = Net Income After Tax / Investment Capital	120 / (1000 – 250) = 16%	450 / (5000 – 1500) = 12.9%
EVA = Op Income - IncTax- Invested CapCost	120- (10% * 750) =+ 45	450- (10%*3500) = +100

East Coast has higher returns on assets and invested capital but West Coast has a higher EVA. Why does this happen? Because East Coast under-invests. By focusing on high returns they are potentially by-passing projects that would add economic value.

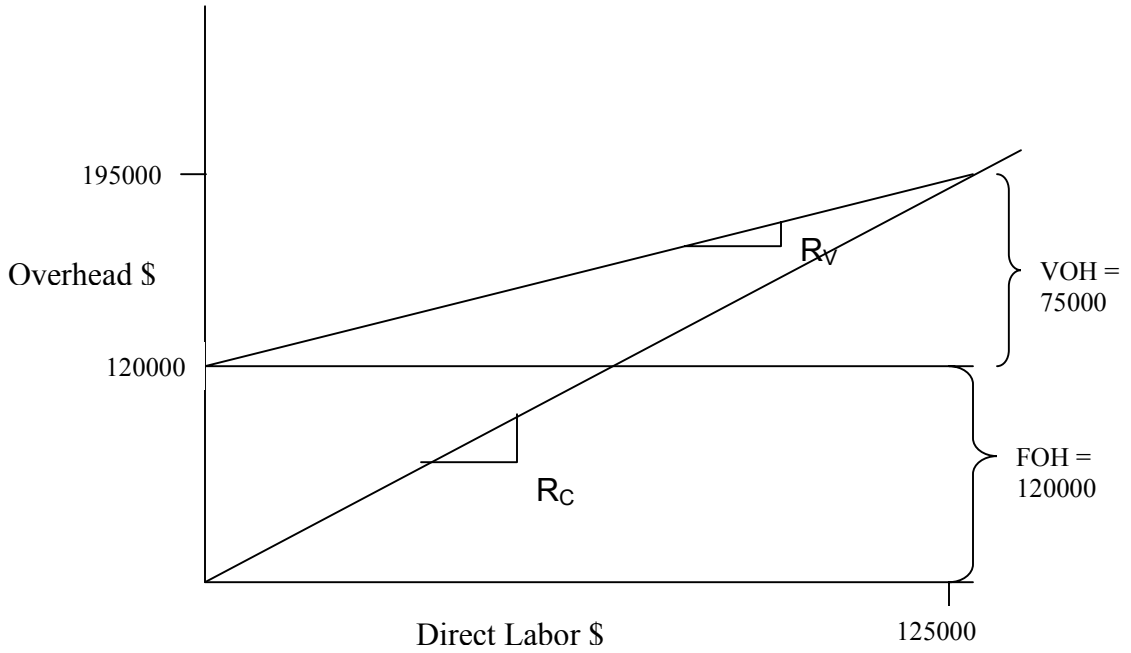
ROE can't be calculated at the plant level. Equity is a corporate concept and could be allocated to plants only with great difficulty and many arguments about its validity.

If, as suggested in the text , the first 2 indicators are calculated on operating income (before tax) the value of the return percentages will change but the ranking discrepancy remains.

SOLUTIONS TO CHAPTER 2 PROBLEMS

Cost Measurement and The Cost Accounting System

2-1



Variable Overhead Rate = R_v = 75000 / 125000 = 60% of Direct Labor

Costing Rate = R_c = 195000 / 125000 = 156% of Direct Labor

Should use the 156% rate to cover all overhead costs.

2-2 Allocation Ratio = $ 8000 / 1350 sq.ft
= 5.93 $/sq.ft

	Sq Feet	Allocation* ($)
Drop Area	300	1777.78
Conveyor 1	100	593.00
Conveyor 2	150	889.50
Bench Area	800	4744.00
Total	**1350**	**8000.00**

*Allocation = sq.ft (5.93 $/sq.ft)

2-3 (a) Budget Allowances

Cost per square foot = $ 67000 / 31100
= $ 2.154 / sq.ft

Power bill per KWH = $ 17800 / 56350
= $ 0.316 / KWH

Maintenance assumed to be 100% variable
Energy assumed to be 100% variable

For Energy, (Budget Allowances)
Forging 8300 x 0.316 x 115% = $ 3015
Machining 43000 x 0.316 x 115% = $ 15620
Finishing 3050 x 0.316 x 115% = $ 1108
Packing 2000 x 0.316 x 115% = $ 727
Total = $ 20470

For Maintenance, (Budget Allowances)
Forging 13000 x 115% = $ 14950
Machining 23500 x 115% = $ 27025
Finishing 3450 x 115% = $ 3968
Packing 500 x 115% = $ 575
Total = $ 46518

For Floor Space, (Budget Allowances)
Forging 5000 x 2.154 = $ 10770
Machining 20000 x 2.154 = $ 43080
Finishing 4000 x 2.154 = $ 8620
Packing 2100 x 2.154 = $ 4530
Total = $ 67000

Summary of March Budget Allowances

Cost Center	March (DLH)	Sq Ft.	Floor Space ($)	Maintenance ($)	Energy ($)
Forging	3580	5000	10770	14950	3015
Machining	10032	20000	43080	27025	15620
Finishing	5460	4000	8620	3968	1108
Packing	2133	2100	4530	575	727
Total	**21205**	**31100**	**67000**	**46518**	**20470.00**

(b) Budgeted Overhead Costing Rate

Note: All rates are to be calculated at 100% of budget volume

Normal DLH (@100%) = (DLH @ 115% x 100) / 115
i.e. (3580 x 100) / 115 = 3113
(10032 x 100) / 115 = 8723 and so on.

Floor Space charge is taken from the previous table in section (a). Since it is entirely fixed.

Maintenance cost remains the same as in the given table in the problem since it is stated at 100% (i.e. normal) volume.

Electricity (normal KWH) is also given at 100% in the table in the problem. Hence to calculate electricity charge in dollars we have,

Normal KWH x $ 0.316 per KWH

i.e. 8300 x 0.316 =$ 2623, and so on.

Total OH @ 100% = sum (floor space, maintenance and electricity)

i.e. For Forging $ 10770+$ 13000+$ 2623 = $ 26393

Blanket Rate for each Dept = Total OH rate (for each dept) / Normal DLH
i.e. For Forging $ 26393 / 3113 = $ 8.478 /hr, and so on.

	Normal DLH	**Floor Space Charge ($)**	**Maintenance ($)**	**Electricity ($)**	**Total OH @ 100%**	**OH Rate ($/DLH)**
Forging	3113	10770	13000	2623	26393	8.478
Machining	8723	43080	23500	13580	80160	9.189
Finishing	4748	8620	3450	964	13034	2.745
Packing	1855	4530	500	633	5663	3.053
TOTALS	**18439**	**67000**	**40450**	**17800**	**125250**	**6.793**

2-4

Job	Machining Hrs	Finishing Hours	Total Hrs	Machine OH cost	Finishing OH Cost	**Total OH Cost**
1	1	10	11	$9.189	$27.45	**$36.64**
2	9	2	11	$82.7	$5.49	**$88.19**

OH rate = $6.792 / DLH
OH cost = 6.792 * 11 = $74 .72

Use of OH Rate would overcost job1 and undercost job 2.

2-5

	DL $	O/H rate (%)	OH Cost ($)
Machining	23000	225	51750
Other Depts.	89000		150000
Totals	**112000**		**201750**
Overall OH Rate	$\frac{\$201750}{\$112000} = 1.8013$		

Overall Overhead Rate = 180%

2-6 Maintenance cost assigned for broaching A123

Present System:

$800000 / 400000 DLH = $ 2 / DLH

Cost of Broaching 1 unit
= 0.4 DLH/part x $2 /DLH = $ 0.80 per unit

Proposed System:

Maintenance cost for broaching
20% x 800000 = $160,000

$160000 / 20000 = $8 per DLH

Cost of broaching 1 unit
0.4 DLH /part x $ 8 per DLH = $3.20 per unit

Thus, the maintenance overhead rate and cost assigned would be increased by a factor of 4.

`

2-7. If Mike staffs with 27 people per shift for the 20 days, he will incur labor charges of

$$27\ \text{men} \times \frac{3\ \text{shifts}}{\text{day}} \times \frac{20\ \text{days}}{\text{April}} \times \frac{8\ \text{hrs}}{\text{shift}} = 12960\ \text{man hours}$$

as an allowance for 12900 hours to make the production schedule exactly. Thus, Mike will run over budget. Although this seems unfair, he can overproduce to keep his operators busy. As he produces more, his actual budget allowance will increase. There is no need to adjust the standard over head allowances for the fact that his schedule does not work out to an integral number of people.