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UNIT 15 INTEGRATING WORKING CAPITAL AND CAPITAL INVESTMENT PROCESSES

Objectives

The objectives of this unit are to:

- Emphasise the need for intergrating the working capital and capital investment processes
- Highlight how working capital *per se* becomes an investment proposition.
- Discuss models suitable for integrating the processes of working capital and capital budgeting
- Examine the operational validity of the integration exercise.

Structure

- 15.1 Introduction
- 15.2 Working Capital as an Investment
- 15.3 Models for Integration
- 15.4 Summary
- 15.5 Key Words
- 15.6 Self Assessment Questions
- 15.7 Further Readings

15.1 INTRODUCTION

Capital investment creates the need for additional investment in inventory, accounts receivable and cash, through-out the life of the plant and equipment. It is normally assumed that an investment in working capital assets also causes a comparable expansion in current liabilities. The theoretical models for evaluating capital investment alternatives implicitly assumes the costs resulting from changes in the working capital components or the cash benefits following from these components are imbedded in the cash flow of the investment. The implicit inclusion of working capital components in the capital investment model is correct theoretically, but having the capability to measure the explicit contribution of working capital components to cash inflows and outflows provides a powerful tool for management.

There are several reasons for identifying the costs and benefits created by the working capital components and linking them explicitly into the total investment planning process. More than likely in the early life of an investment it is operating below capacity; while later in the life cycle, there is often an increase in operating capacity. Thus, throughout the life of an investment, there is often a continuing growth of investment in working capital. Furthermore, the discounted cash outflows related to cash, receivables and inventories can range from a modest to a major proportion of the total cost of an investment. Also the source of financing for these current assets, either long or short-term, can affect the cash flow patterns of an investment. The need for additional investment in working capital is dependent on

the type and size of investment' the size and growth of the market, the growth of the relative market share and length of the planning horizon. Additionally, the impact of inflation can create a drag on cash flows if the price increases related to Labour and materials are always leading the price increase for the products sold by a significant margin. Finally, within many corporations the management of the working capital components is usually separate from the capital investment and long-run financial planning systems. Continuous communication between operating and strategic management are vital to the long-term success of a firm, but communications are often infrequent or nonexistent. These observations indicate the need for a planning model that explicitly integrates the working capital components into the capital investment decision-making process.

15.2 WORKING CAPITAL AS AN INVESTMENT

Working capital is well recognized as an important decision area within the firm. Yet working capital does not seem to occupy a very prominent place within the academic field of finance. While a gap between theory and practice persists in many areas of management decision-making, it would seem, especially so, for working capital management.

The gap between theory and practice may not be so serious, if working capital is given appropriate decision-making context. Specifically, if the working capital is viewed as an investment, and that changes in working capital policies are included in the capital budgeting process of the firm.

In view of the relative size of working capital changes, and also the finding that many firms do indeed view such changes as investment projects, it is well to consider more closely the relationship of working capital decisions to other financial decisions made by the firm. This relationship is found in financial control. While control is well known to be one of the key functions of management, it would appear to have received considerably less treatment than planning, at least in the financial literature. But just as control without adequate planning will likely be futile, planning without adequate control will prove frustrating.

A first dimension of financial control that has been well documented is to monitor the financial progress of the firm over time. This usually takes the form of tracking selected financial ratios, and thereby assessing both the current status and likely future prospects of the organisation. If attention is limited to single ratios for just profitability and liquidity, then financial control is relatively straight forward. If, instead, management tracks a larger number of financial ratios, then financial control is more complex as tradeoffs must be made. In general, if there are N measures being tracked any investment project or change in policy will result in 2^N possible changes in the status of the firm, Obviously, the number $2^N - 2$ quickly gets large as N is increased. One way to handle the complexity of multiple ratios is with composite measures such as the Dupont System or the Altman Bankruptcy model.

A second dimension of financial control is to consider corrective actions that can be taken when firms progress departs from firms plans. For example, if the liquidity position of the organisation appears to be worsening, management may decide to issue either bonds or equity in order to reduce short-term financial obligations. Alternatively, management may decide to reduce inventory levels and/or expand credit if the probability goal of the firm is not being achieved. Many possible corrective actions pertain to the current assets and current liabilities of the firm, and thus working capital adjustments can be an important part of overall financial control within the organisation.

A logical extension of this idea is to view corrective actions as investments made by

the firm. Just as investments are routinely made by the firm in capital project, so too should the firm routinely consider changes in working capital as investment projects. Viewed in this way, each investment in working capital is an attempt to move the firm closer to its expressed goals. This view, it should be noted, is different than just including working capital implications with each capital project being considered. It is also a view that is consistent, with the theory of the firm, the theory of finance, and apparently the current practices of many large industrial firms.

A list of possible corrective actions having to do with working capital is presented in Exhibit-15.1. The list, which is representative rather than exhaustive, is organised into six groups that correspond to certain current assets and current liabilities normally found on the balance sheet.

Exhibit- 15.1

Possible Corrective Actions Involving Working Capital

Cash

1. Change collection network
2. Change disbursement network
3. Change size of operating cash balance

Marketable Securities

4. Change method of investing surplus cash
5. Change method of transferring funds between cash account and marketable securities portfolio.

Accounts Receivable

6. Change cutoff score for credit applications
7. Change discounts offered to customers
8. Change frequency of follow-up payment notice

Inventory

9. Change inventory valuation methods
10. Change inventory order quantities
11. Change inventory safety stocks
12. Change distribution network

Payables and Accruals

13. Change suppliers used
14. Change response to suppliers discounts
15. Change payroll procedures

Short-term Borrowing

16. Change lenders used
 17. Change payment methods
 18. Change collateral arrangements
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Not all of the corrective actions in Exhibit-15.1 would be feasible, let alone desirable, for a given firm at a particular point in time. For each corrective action that is feasible, financial managers should identify the expected benefits and costs towards

evaluating whether it would help the firm move towards its expressed goals. Corrective action #7, for example, is a change in the cash discounts which the firm offers to its customers. A cash discount tantamounts to a reduction in price. Suppose the discount is increased, to the extent that customers take advantage of the larger discount by paying their bills sooner, the firm's investment in accounts receivable is reduced. The expected benefit of corrective action 7, therefore, should reflect the extent of the discount that is offered to the proportion of credit customers that are expected to take the discount and the resulting decrease in the receivables investment. The expected cost of corrective action # 7 is the reduced profit to the firm as a result of credit customers that avail themselves of the larger discount.

Based on past experiences with customer response to changing credit terms, the credit manager ought to be able to make reasonable estimates of the expected benefits and cost to the firm of offering customers a larger cash discount. Expected benefit and cost can then be combined in order to calculate a "return-on-investment" for the corrective action. If a similar procedure is also followed for each corrective action being considered (such as those in Exhibit-15.1), then each corrective action can be viewed as a proposed investment project by the firm-and evaluated within the context of the capital budgeting process. Again, this would seem to be consistent with both the theory and current management practice.

15.3 MODELS FOR INTEGRATION

There have been many valuable theoretical and operational contributions in managing each component of working capital linking them with one another. Linear programming (LP) models have been used to introduce the dynamic features of the working capital process. Two large scale LP models were designed to link the sources of short term credit to short term uses and to integrate the variables involved in managing short-term cash flow in this chapter. The Goal programming as a tool for the management of working capital has been applied.

Though the need for integrating the working capital processes into the long run financial planning processes has been recognized and a variety of theoretical linkages have been suggested, many of the models have not incorporated the dynamics of uncertainty involved in the short- run investment. None of these models are really integrated into the capital investment and long-run financing processes of the firm. The primary objective of this chapter is to offer an integrated model designed for management decision making and to provide a model for testing "What if" policy questions concerning the impact of working capital variables on the total profitability of capital investment alternative.

The model is divided into two parts, viz the Capital Investment (CI) module and the Working Capital (WC) module.

15.3.1 Capital Invest Module

The financial planning process is composed of many variables and occurs in an uncertain and dynamic environment, therefore, this model will use simulation techniques to represent the interactions among the capital investment and working capital variables. The Hertz model is revised to simulate the capital investment process. The variables are divided into three major categories viz, market, investment and cost. The market analysis variables are market size, growth rate of market size related to the life cycle of the product and market share related to the price of the product. The investment analysis variables are life of the investment, on line time, initial and future investment costs excluding working capital costs. The cost analysis variables are the variable and fixed costs.

Each variable is assumed to be stochastic and independent. However, it is assumed that the parameters are specified for each variable by the decision makers, reflecting their perception of the interrelationships among the variables. If there are well

Exhibit 15.2

Simulation of the working capital-capital investment process

established relationships among variables, these functional relationships can be easily inserted into the model. The variables involved in the capital investment module are presented in Exhibit-15.2 and the actual operation of the CI module is presented in the exhibit.

The programme randomly selects in a sequential order a value from the specified distribution for each variable. The uncertain and dynamic characteristics of the CI process are reflected in this random interaction of the variables. The selected values are used in the calculation of a net present value (NPV), internal rate of return (IRR), and a benefit/cost ratio (B/C) for each simulation. This process including the working capital module is repeated 100 times and the final outcomes are profitability profiles or cumulative frequency distributions of NPV, IRR, and B/C.

15.3.2 Working Capital Module: An Overview

The module simulates the integration of working capital components into the capital investment (CI) process. Forecasting errors and inflation are introduced into the total investment planning process because they are the primary causes of working capital management problems. The objectives of the module are: (1) to identify and measure the benefits and costs of investments in working capital components; (2) to identify the impact of forecasting errors and inflation on cash, inventory receivables, payables and short-term borrowing; and (3) to measure the sensitivity of net present value (NPV) and internal rate of return (IRR) profiles to changes in WC strategies designed to offset forecasting errors and inflationary conditions.

Historically, working capital (WC) activities are frequently revised, relatively routine and occur in a relatively short time period. Also the WC process is usually considered to be independent of the CI planning process. The management of short-run cash flows is a continuous and dynamic process occurring in an uncertain environment. However, because the CI model operates on an annual basis it is assumed, for convenience, that the strategic planning of the WC cycle also operates on a one year horizon. A shorter time period could be programmed to accommodate the needs of decision makers.

Cash Flow Crises

A cash flow crisis often occurs when unexpected events arise, e.g., actual short-run expenditures being greater than forecasted and/or actual short-run cash inflows being less than forecasted. Surprise outflows can be related to a large price increase for raw materials. An unexpected decline in inflows arises when actual sales are less than forecasted or if there is an extension of the normal trade credit payment pattern. In both cases total cash outflows are frequently greater than total cash inflows plus existing cash items.

The standard approach to investment planning is to assume that the forecasted cash flows actually occur. For example, in solving for the net present value (NPV) or internal rate of return (IRR) of an investment it is assumed the forecasted distributions of revenues and costs actually occurred. By assuming the profitability profiles generated from the forecasted inputs actually happen, the analysis misses the effect a short-run financial crisis has on cash flows. Because cash flow crises often arise when forecasting errors occur, the analysis of investment opportunities

requires an additional step. A dual simulation process is introduced with one assumed to represent the forecasted results and the other the actual outcomes. In simulating these two sets of conditions, the model assumes sales are the key mechanism. It is assumed that actual sales (s) are generated by the CI programme and a supportive forecast of sales (SF) is produced by the WC module. Simulating sales conditions where the actual sales are randomly different from forecasted sales, captures the essences of forecasting errors, which incorporates the major cause of WC problems.

If the forecasted sales exceed actual sales there will be a cash flow shortfall. To offset the short-fall current asset and current liability components are adjusted by management. The cash flow shortfall is the heart of the problem related to a WC crises. The model provides management a variety of short-run policy alternatives to offset the cash flow shortfall.

New Variables

In the WC module two new sets of probabilistic variables are introduced and combined with the variables in the CI module. One set represents three WC variables. These variables inject the uncertainty existing in the WC system into the total financial planning process. These three probabilistic variables are: (1) sales forecast (SF) in year 1, (2) an annual growth rate of forecasted sales (G) related to the life cycle of the product, and (3) trade credit/sales (TC) ratio that is related to the quantity of production.

The second set of probabilistic variables represent the inflation dimension as its impact on the firm. There are four separate rates of inflation. The stochastic inflationary variables serve as an adjustment to the values selected for price (P), interest (ib,iL), total purchases (PUR), total Labour costs (LC), and fixed costs (FC).

Additionally, management determines a single value for each of the following variables.

Cash

- Beginning cash
- Minimum cash
- Maximum cash (minimum cash plus marketable securities)

Receivables

- Beginning receivables
- Bad debt allowance

Inventory

- Beginning inventory
- Required ending inventory
- Maximum inventory cushion
- Cost of excess inventory

Operating

- Gross margin for purchases
- Percent of marginal sales achieved
- Marginal labour cost on marginal sales

Interest

Short term borrowing rate

Short term lending rate

The working capital module is divided into three additional parts beyond the investment information presented in the CI module. The first module comprises the cost and income components. Also, inflation adjustments occur in this module. The second module involves the processes related to production and inventory. Finally, the module that links the total process together is the cash and trade credit system.

Operation of the WC Module

The objectives of each module and an explanation of its operation are presented in the following sections. A numerical example with accompanying comments concerning the operation of the module are found in Table 15.1. The example of the model in Table 15.1 integrates all of the modules in the total working capital-capital investment process (WC-CI). The following presentation is an explanation of the sequential operation of the WC module and is based on the data in Table-15.1.

Investment Information

The first operation of the model is the determination of actual and forecasted sales in both rupees and units. The initial price is provided by the user, which is Rs. 12.50 in our example in Table-15.1. A random market size of 45.4 lakh units is selected for year 1. Also, a market share of 17.92 per cent is selected at random. Sales demand is 8,62,219 units and is determined by multiplying the random market size (1) times the market share. Sales of Rs. 1.077 crore are calculated by multiplying price times sales demanded in units. Sales forecasted in rupees is randomly drawn from a distribution and sales forecast in units is calculated by dividing by price.

The difference between sales demand (s) and sales forecast (SF) reflect the forecasting error and is a critical value in the working capital management process. If forecasted sales are greater than the actual sales ($SF_t > S_t$), the firm did not achieve its sales forecast. Therefore, the sales demanded (Q) become the actual sales (AS). However, if sales demand is greater than forecasted sales ($S_t > SF_t$), unforecasted or potential sales arise and it is assumed management will try to produce as much as possible to close this gap and meet these potential marginal sales. In example in Table 15.1 management assumed 40 per cent of potential marginal sales would be produced. Whenever $S_t > SF_t$, the marginal sales achieved are added to the sales demand to give actual sales (AS). The final operation of this module is the calculation of forecasted production (FPQ). Table 15.1 shows FPQ is calculated by adding the change in the amount of required ending inventory (units) to the sales forecast in units.

Each of the variables in this module make an important contribution to the total module. It is apparent the gap between S_t and SF_t is the primary reason for financial planning. The gap between S and SF introduces uncertainty into the investment planning process.

Previously capital investment theory has assumed that $S_t = SF_t$. The contribution of the (WC-CI) model is to include a sales forecast variable and build in the assumptions that (1) $S_t \neq SF_t$, for $t = 1, \dots, n$, (2) if $S_t > SF_t$ all marginal sales may not be achievable and there might be a cost premium for marginal sales that should be added to total costs of the investment, (3) also, when marginal sales are achieved, they generate cash in-flows that were not anticipated when it was assumed $S_t = SF_t$, (4) if $SF_t > S_t$, there can be a cost of carrying additional inventory that should be added to the total cost of the investment, and cash inflows will be smaller than planned under conditions when $S_t = SF_t$.

Cost and Income Module

There are several key operations involved in the costs and income module. The three primary operating costs are : purchases (PUR), labour (LC) and fixed (FC). It is assumed that these variables are closely related to the forecasted production, i.e. quantity of goods produced. When $S_t > SF_t$, it is possible to have marginal production above the original forecasted level. When this condition occurs, the marginal cost of purchases and labour are calculated separately and added to their respective forecasted costs for purchase and labour.

Increases in cost as a result of inflationary conditions are introduced in this module. The programme randomly selects an inflation rate for purchases and this rate is applied to total purchases. The model also randomly selects and applies an adjustment to labour and fixed costs. Additionally, a random inflationary rate is injected into the price of the product. Thus, as shown in Table 15.1, actual sales are computed by multiplying the production quantity with the price which has been adjusted for inflationary pressures. When actual sales and costs are calculated, the model calculates the remaining components of the income statements.

The major cost items are calculated in this module and Table 15.1 provides an example of these calculations. First, for period 1, labour cost per unit of 2.52 was randomly chosen, and multiplied with forecasted production. The labour costs are increased for inflation, which was 5.35 per cent in year 1. In this model inflation is assumed to be a random variable. When marginal sales are achieved, marginal labour costs are calculated in units of marginal sales. In Table 15.1, the marginal labour costs (MLCX) are 10 per cent. Thus on the additional marginal sales achieved, the cost of labour was 10 per cent higher than under normal operating conditions.

Fixed costs are assumed to be a random variable that is related to the sales demanded. The fixed costs are also increased by a separate inflation rate, 4.45 per cent, that was selected randomly.

Purchase costs are calculated by multiplying the gross margin (.5) times the value of forecasted production. The gross margin is a key input variable determined by the user. When $S_t > SF_t$, there are marginal purchases made to accommodate the marginal sales determined earlier. Normally, the gross margin for marginal sales (GMMP) should be greater than the gross margin. It is .6 in Table 15.1. Additionally all purchase costs are adjusted by a randomly selected inflation value of 5.35 per cent.

In year 1 the initial investment cost of Rs. 7.72 million is randomly selected, and an annual straight line depreciation schedule of Rs. 857,778 is determined for nine year horizon with all receipts and costs determined, earnings before interest and taxes (EBIT) of Rs. 758,065 are calculated. Next it is assumed that the interest cost on short-term debt is paid the following year. Thus, in year 1, there is no interest cost, and earnings before taxes (EBT) is equal to EBIT. The assumed tax rate is 40 percent. Table 15.1 shows the calculation of Rs. 303,226 in taxes, and net income equals Rs. 454,839.

Production – Inventory System

The module focuses on the production-inventory process. Management has at its discretion a set of variables that may be used for controlling inventory limits. In this module management establishes single point estimates for each of the following production –inventory decision variables. (1) An estimate of the beginning inventory quantity (BIQ); (2) A required ending inventory (REI) value which is an estimate of management's desired ratio of ending inventory(units)/ sales forecast (units). The

level of REI is related to the units of production in period t. (3) A maximum inventory cushion (MIC) that management expresses as a percent, above the required ending inventory quantity (REI). If the actual ending inventory (AEIOT) is greater than the maximum ending inventory MEIOt), there will be excess inventory (EXINV). (4) The cost of carrying excess inventory is cost that arises when $SF > S$, thereby causing a cash cost for holding inventory in excess of the forecasted inventory needs. The cost of carrying excess inventory is assumed to be the cost of capital. As shown in Table 15.1, it is multiplied with the cost of excess inventory to determine the cost of holding excess inventory.

Cash-trade Credit System

This module ties together receivables and the cash operation including short-term borrowing or investing in marketable securities. The module collects which serve as inputs for calculating the net present value of the investment.

The primary decision variables available to management in controlling levels of cash and accounts receivable are: (1) The beginning value of cash (BC) and accounts receivables (AR); (2) A minimum cash level (CLOW) is determined as a ratio of cash/sales forecast (CMIN), which depends on the levels of production; (3) A maximum cash level (MAXCASH) that is expressed as a per cent above the minimum cash balance(CLOW) . MAXCASH is a discretionary variable that can range from zero to a large whole number. If ending cash (EC) falls between CLOWt and, the difference between Ect and CLOWt is invested in marketable securities (MAXCASHt); (4) The sum of minimum cash balances (CLOWt) and invested in marketable securites (MSt) equals the maximum cash position in a specific time period (CMAX). There are three interest rate variables in the model; (5) Interest rate on short term borrowed funds (ib); (6) Interest rate on lending (iL) (7) Cost of capital (k) . The cost of capital is the discount rate in the present value equation.

The model assumes that there is a controlled stochastic relationship between receivables and sales and between payables and sales. The ratios of receivables/sales (ARS) and payables/sales (AP/S) serve as proxies for these two relationships.

Table 15.1. Integration of Working Capital and Capital Investment Modules: An Example

Variables	Year	Comments
Price (P)	(Rs.) 12.50	Pt is an initial input; Pt = P1 = Rs. 13.44
Market Size (MSIZE)	(u) 48,11,491	MSIZE0 is a randomly selected variable = 4,40,000
Market share (MSHR)	(%) 179200	220267 Randomly selected.
Sales Demand* (Q)	(u) 8,62,219	11,24,671 Qt = MSIZEt (MSHRt)
Sales Demand (S)	(Rs.) 1,07,77,737	1,51,15,577 St = Pt × Qt
Sales Forecast* (SFQ)	(u) 8,23,750	9,21,711 SFQ1 is a randomly selected Value. SFQ2 = Q1 (1+g2) Where g2 = .0690; g2,....., gn are randomly selected Variables.
Sales Forecast (SF)	(Rs.) 1,02,96,875	1,23,87,798 SFt = SFQt (Pt)
Pot Marg Sales (PS)	(Rs.) 4,80,860	37,27,779 PSt = (St - SFt); if SFt > St: PSt = 0.

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Marg Sales Achieve	(Rs.)	1,93,344	10,91,111	If SF > S: MSA = 0; If S > SF: MSA = PSt (PSAt); PSA2 = .4 PSA = Potential Sales Achieved.
Marg Sales Achieve (MSAQ)	(Rs.)	15,388	81,184	MSAQ _t = MSA _t /Pt
Actual Sales (AS)	(Rs.)	1,04,89,218	1,34,78,909	If SF > S: ASt = St; If St > SFt; ASt = (SFQ _t + MSAQ _t) Pt
Actual Sales* (ASQ)	(u)	8,39,137	10,02,985	ASQ _t = ASt/Pt
Forecast Prod (FPQ)	(u)	9,22,600	8,22,861	FPQ _t = SFQ _t + (REIQ _t - AEIQ _t - 1); Where REIQ is required ending Inventory and AEIQ _t - 1 Is actual required ending Inventory given below. These concepts are presented in the inventory module.
COST AND INCOME MODULE				
Labour Cost (LC)	(Rs.)	23,24,951	18,76,123	LC ₁ = LC ₁ Per Unit (FPQ 1); Where LC ₁ = 2.52; where LC ₂ = 2.2799 AND BIQ = beginning inventory = 98,850 (u); LC _t for future years follows the second equation.
Infl Adj Lab Cost (PALC)	(Rs.)	24,49,334	19,90,566	PALC _t = LC _t (1 + PAL _t); where PAL is inflation rate for labour costs; PAL 1 = .0535; PAL2 = .061
Marg Labour Cost (MLC)	(Rs.)	42,654	2,03,609	If St > SFt: MLC _t = MSAQ _t (LC _t Per unit x 1 + MLCX) = Marginal labour cost per unit Above LC per Unit. MLCX = .10. If St > SFt: MLC = 0.
Infl Adjust (PAMLC)	(Rs.)	44,936	2,16,029	If St < SFt: PAMLC _t = 0; If St > SFt: PAMLC = MLC _t (1 + PAL _t)
Fixed Cost (FC)	(Rs.)	1,75,000	2,15,000	FC _t = related to SFt.
Infl Adjust (PAFC)	(Rs.)	1,82,787	2,16,029	PAFC _t = FC _t (1 + PAF _t); Where PAF _t is inflation rate for fixed cost. PAF1 = .0445; PAF2 = .064.
Purchase Cost (PUR)	(Rs.)	57,66,248	55,76,087	PUR _t = GM (FPQ _t × Pt) where GM is gross margin. GM = .5.
Infl Adjust (PAPUR)	(Rs.)	60,74,737	60,19,381	PAPUR _t = PUR _t (1 + PAP _t); Where PAP _t is inflation rate for purchases. PAP1 = .0535; PAP2 = .0795.
Marg Purch Cost (MPUR)	(Rs.)	1,15,406	6,54,667	If St > SFt: MPUR = (MSAQ _t × Pt) GMMP; GMMP = .6, Gross Margin for marginal purchases. If SFt > St: MPUR = 0.
Infl Adj (PAMPUR)	(Rs.)	1,21,580	70,76,712	PAMPUR _t = MPUR _t × (1 + PAP _t).
Operating Income (OI)	(Rs.)	16,15,843	43,17,355	Iot = ASt - PALC _t - PAMLC _t - PAF _t - PAPUR _t - PAMPUR _t .
Investment Cost (IC)	(Rs.)	77,20,000	0	IC ₀ is a randomly selected variable.

Working Capital Management: An Integrated View

Deprec (DEP)	(Rs.)	8,57,77	8,57,778	DEP1 is straight line depreciation; $DEPt = IVt / N$; Where $N = 9$ Years.
Book Value (BV)	(Rs.)	68,62,222	60,04,444	$BV1 = ICO - DEP1$; $BV2 = BV1 + DEP2$.
EBIT	(Rs.)	7,58,065	34,59,477	$EBITt = OIt - DEPt$.
Interest (ZNT)	(Rs)	0	2,41,050	$INTt = ib$ (cumulative S/T borrowingt-1); ib is borrowing rate of interest, $T1b1 = .08$; for $t2, \dots, tn$, $T1bt = ibt-1$ (Pat); cumulative S/T borrowing - 1 given on last page.
EBT	(Rs.)	7,58,065	32,18,526	$EBTt = EBITt - INTt$
Taxes (T)	(Rs.)	3,03,226	12,87,410	Tt TR (EBT); where TR Ts tax rate. $TR = .4$.
Net Income (NI)	(Rs.)	4,54,839	15,31,116	$NIIt = EBTt - Tt$
Production-Inventory Module				
Required Ending Inventory (REIQ)	(u)	98,850	92,171	$REIQt = REIt$ (SRF); $REI1 = .12$; $REI2 = .10$.
Begin Inventory (BIQ)	(u)	0	98,850	$BIQ1 = O$; $BIQt = AEIQt - 1$ For $tt2, \dots, tn$
Actual Production (ORIDQ)	(u)	9,37,987	9,96,266	$PRODQt = SFQt - BIOt + MSAQt + REIQt$
Actual Ending Inv (AEIQ)	(u)	98,850	92,171	If $St > SFt$; $AEIQt = REIQt$; If $SFt > St$; $AEIQt = PRODQt - ASQt + BIt$
MAX Ending Inv (MEIQ)	(u)	1,18,620	1,10,605	$MEIQt = REIQt (1 + MIC)$; $MIC = .2$
Excess Inv (ExINVQ)	(u)	0	0	If $MEIQt > AEIQt$: $ExINVQt = 0$; If $AEIQt > MEIQt$: $ExINVQt = AEIQt - MEIQt$
Carrying Cost (CEXINV)	(Rs.)	0	0	$CEXNVt = ExINVQt$ (GM) $GM = \text{Gross Margin} = .5$; $K = \text{Cost of carrying Inventory} = .1$
Cash-Trade Credit System				
Trade Credit/Sales (TC)	(%)	.3535	.331	TCt is a random variation and proxies for $(AR/S - AP/St)$.
Net Act. Rec. Bal. (AR)	(Rs.)	37,07,937	44,61,517	$ARt = St$ (BDA); $BDA = BDA$
Bad Debt Allowance	(Rs.)	3,70,794	4,46,152	$BADt = ARt$ (ADA); $BDA = (BDA)$
Cash Receipts (CR)	(Rs.)	67,81,281	1,23,54,531	$CRt = ASt + ARt-1 - BADt$
Begin Cash + MS Bal	(Rs.)	0	6,17,812	$BC1 = 0$; $BCt = Ect-1, (BC)$ For $T2, \dots, tn$
Cash Available (CBAL)	(Rs.)	67,81,281	1,29,72,343	$CBALt = CRt + BCt + BEXC - FUTCOSTt$, $BECX$ is est from S/T investment Is Zero in years 1 and $FUTCOST = 0$ future investment Cost.
Total Cash Pay (CPAY)	(Rs.)	91,76,000	1,12,24,972	$CPAYt = PALCt + PAMLCt + PAFcT + PAPURt + PAMPt + Tt + CEXINvt + INTt - 1$
End Cash + MS Bal (EC)	(Rs.)	6,17,812	6,19,390	$ECt = SEt$ (CMINt) + $MSSt$; $CMIN1 = .06$; $CMIN2 = .0$ *****
Cash Lower Bound (CLOW)	(Rs.)	6,17,812	6,19,390	$CLOWt = SFt$ (CMINt)
Max Cash + MS Level (CMAX)	(Rs.)	7,41,374	7,43,268	$CMAXt = CLOWt (1 + MAXCA)$ $MAXCASH = .2$

					Integrating Working Capital and Capital Investment Processes
Short Term Debt (STD)	(Rs.)	30,131,31	0	If $(CBAL_t - CPAY_t) >$ CLOW _t ; STD _t = 0; If $(CBAL_t - CPAY_t)$ < CLOW: STD _t = $CPAY_t - CBAL_t$ + CLOW. See Appendix 1 for additional conditions.	
Payment S/T/debt (PAY)	(Rs.)	0	11,27,981	If $(CBAL_t - CPAY_t) >$ CLOW _t ; PAY _t = $(CBAL_t - CPAY_t) -$ If $(CBAL_t - CPAY_t) <$ CLOW _t ; PAY _t = 0. See Appendix 1.	
Cum S/T/ Debt (SUMCX)	(Rs.)	30,13,131	18,85,150	SUMCX _t = $SUMCX_{t-1} - PAY_t + STD_t$	
Interest Cost (INT)	(Rs.)	2,41,050	1,61,180	INT _t = $SUMCX_t (T_b)$; $T_b =$ borrowing rate = .08	
S/T LEND (Mkt Sec) (MS)	(Rs.)	0	0	If $SUMCX_t > 1$, MS = 0. See Appendix 1.	
Interest Benefits (BEXC)	(Rs.)	0	0	BEXC _t = $MS_t (i_L)$; $i_L =$ lending rate = .07	
Cash CT MAX Cash + MS (CEX)	(Rs.)	0	0	CEX _t = $CBAL_t - CPAY_t - SUMCX_t - CMAX_t$	
Cash Flow (CF)	(Rs.)	23,95,320	12,74,186	CF _t = $CR_t - PALC_t - PAMLC_t - PAPUR_t - PAMPUR_t - PAFCT - T^*t$	
Revised Cash Flow (RCF)	(Rs.)	0	0	RCF _t = $CF_t - T^*t - T_t + BEXC_t - 1 - INT_{t-1} - (Ect - Ect - 1) + (SUMCX_t - SUMCX_{t-1}) - CEXINV_t$	
cost of Capital (k)	(%)	.10	.1055	$kt = kt-1 + PAt - PAt-1$	

In Table 15.1 cash equals zero at the beginning of year 1. For subsequent years beginning cash equals ending cash (-1), which includes cash plus marketable securities. The total cash available for meeting cash payments equals cash receipts (CR_t) plus beginning cash (BC_t) plus interest earned on marketable securities (INT) minus any capital investment costs (FUTCOST).

Total cash payments equals the sum of all cash outflows which are shown in Table 15.1. All outflows occur in the year. If cash payments are greater than cash available, the company will have to borrow (short-term) to meet the total cash payment. Under these conditions, ending cash equals lower boundary (CLOW) prescribed by management. Table 15.1 shows this was the case in year 1. Ending cash is a complex variable that is explored further in the next few paragraphs.

If cash payments were greater than cash available (CBAL₁), it is necessary to borrow enough short-term funds to cover the cash shortfall plus maintaining the

minimum levels of cash. In the case where $CPAL_t > CPAY_t$, and there is short term (S/T) debt outstanding the difference between $CBAL_t - CPAY_t$, is used to retire debt and also maintain the minimum cash balance. The model will continue to retire debt in future years when $ABAL > CPAY$. Once the ST debt is retired the model will invest, the idle cash balances that exist above the cash lower boundary. Thus, the model assumes the investment is either borrowing or lending in any given period. Of course, it is possible that neither could occur, but it is highly unlikely. The model will invest up to CMAX in any year. Any cash above CMAX is included in cash receipts and is assumed to be earning the cost of capital.

When there is cumulative ST debt outstanding, an interest cost is incurred at the short term rate (ib). The interest costs become a cash outflow the following period. If there are investments in marketable securities, they earn at the lending rate (iL). Any cash earned on marketable securities becomes cash available in the following period. Traditional analysis assumes investment is financed by long term sources and, furthermore, it assumes the debt/equity mix is relatively stable in the long-run. It does not explicitly allow for a cash flow shortfall which results in an increase in short term debt. If a prolonged working capital crisis was financed by short run financing, one serious outcome could be a radical change in a company's debt/equity mix. The chances of short-term debt surge is quite plausible in an inflationary environment or a period of high interest rates. Finally, the traditional approach does not consider a cash overflow, where liquid assets would earn less than the cost of capital. Thus explicitly introducing interest cost of short term borrowing and interest earned on marketable securities is an addition to traditional investment analysis.

15.3.3 Present Value Module

Traditional Analysis:: In traditional analysis cash receipts were equal to the inflow of funds from actual sales, and cash payments included initial and future investment costs, price adjusted labour cost, total purchases and fixed costs, plus taxes. In equation form, the net present value (NPV) of an investment proposal is:

$$NPV(A) = -IC_0 + \frac{AS_1 - TC_1}{(1+K)} + \frac{AS_2 - TC_2}{(1+K)^2} + \dots + \frac{AS_n - TC_n + SV_n}{(1+K)^n}$$

Where

ICO = Investment cost at the beginning of the period

AS_t = total cash Inflow from actual sales or cash inflow

In each period

TCO_t = total cash outflows in each period which

included

The following:

TLC_t = total price adjusted labour costs, or PALC_t

TPC_t = total price adjusted purchases, or PART + PAM

PAFC_t = Price adjusted fixed costs;

T_t = taxes;

FUTCOST_t = future investment costs;

Other variables included are:

SVN = salvage value of the investment

k = cost of capital

Revised Analysis : An objective of this model is to provide a more comprehensive investment analysis framework by explicitly integrating the working capital operations into the capital investment process. Forecasting errors and inflation may cause cash flows from the revised model to vary markedly from flows generated by the

traditional model. Short-term borrowing and/or the sale of marketable securities are used to offset a cash flow shortfall or the retirement of debt. Marketable securities absorb an overflow of cash above the minimum level but below the maximum level. Also changing inventory levels, minimum cash levels or payment patterns of receivables and payables can alter shortfalls or overflows. Thus an objective of the revised model is to measure the size and sign of the cash flows and thereby make it possible to highlight the cost and benefits related to the working capital strategies. The significance of these working capital strategies on the net present value of an investment are explained in the following paragraphs.

First, declining business conditions or a prolonged inflationary environment can change payment behaviour and dramatically alter the inflow of funds from receivables. Thus a lengthening of payments on receivables that was not forecast can result in a significant cumulative shortfall in the actual cash inflows from an investment. During this period if the delays in receivables payments are not offset by a stretching of payable, the net cash flows will be further reduced. If cash flows are negative short-term borrowing will occur after cash and marketable securities are reduced to their minimums. The borrowing costs are determined in the revised model and are reflected as a cash outflow. Alternatively an acceleration of receivable inflows without a change in the payment of payables can expand the net cash flow during that period. Excess idle cash balances are invested and generate cash benefits for the investment.

Second, an adjustment in taxes is required because in the traditional models, short-term interests cost or benefits were not permitted. Thus, EBIT is increased when interest income is received, which makes EBT higher than in the traditional case. Also, in the revised model, interest costs cause EBT to be lower than in the traditional model. Thus, tax outflows in the revised model differ from taxes in the traditional model. Third, carrying excess inventory produces a holding cost. This cost enters the revised NPV equation as a cash outflow. This cost only occurs when inventory exceeds the upper control limit. Fourth, another big factor in the revised model relates to cash management policies and operations. The change in the ending cash account (EC_t) between period t and $t-1$, can produce a substantive change in cash inflow or outflow. When $EC_t > EC_{t-1}$, it indicates an increase in the level of cash held and a reduction in cash available for meeting cash payments, which results in a lower net cash flow. The opposite effect occurs if $EC_t < EC_{t-1}$. There are several refinements related to ending cash and they are presented in Table 15.2.

Finally, positive cash flows are used to retire accumulated short-term borrowing ($SUMCX_t$) thereby reducing cash flows available for reinvestment, as shown in table 15.2. When negative cash flows happen, short-term borrowing will occur after liquid assets are reduced to a minimum. The result is that accumulated short term borrowing. Table 15.2 presents the logic of these two cases.

In comparing the revised cash flow (RCF) model to the traditional cash flow (CF) approach, it is necessary to refer to the equation for each one of Table 15.1. The RCFs differ from the CFs for the following reasons. First, the contribution of trade credit policies and bad debts are reflected in cash receipts. Additionally, forecasting errors and inflation cause change in the level of cash ($EC_t = EC_{t-1}$) and short-term borrowing ($SUMCX_t - SUMCX_{t-1}$). These two terms are algebraically added to the revised cash flows. Also the cost of carrying excess inventory because of forecasting errors enter the NPV equation as an outflow. The interest return from marketable securities and the interest cost of short-run borrowing are appropriately included in the revised cash flows.

If the sum of the costs are greater than the receipts, and liquid assets are at a minimum, short term borrowing is employed to offset the amount of the negative

cash flow. The rationale for this modeling assumption is that after the initial investment costs (IC) are incurred, any additional costs are related to an investment in working capital components or delayed capital expenditures (FUTCOST_t). Increases in the level of short-term borrowing (SUMCX_t=SUMCX_{t-1}) to offset a shortfall are included in the RCF equation as an inflow, therefore when outflow > inflow additions to STD_t equal the shortfall and the RCF is recorded as a zero. Table 15.1 illustrates this concept. In the traditional model a cash flow (CF) shortfall is recorded as a negative value, e.g., year 1 in Table 15.1.

By making the working capital components explicit and introducing forecasting errors, the revised model can identify and measure the cost of the shortfall, which was not previously accomplished. When a positive cash flow exists, short-term borrowing is paid off before any positive cash flows are available for discounting. Thus, when borrowing occurs, the RCFs are limited on the down side to zero and when positive flows occur the RCFs are limited on the top side by the retirement of debt. In conclusion, the RCFs will operate in a more narrow band than the CF from the traditional model.

For comparative purposes the model calculates the traditional (CF_t) and revised cash flow (RCF_t) for each period in the life of the investment. This provides management an invaluable source of information to compare the CF to the RCF_t. Because of the large number of possible combinations and permutations, interpretation of these data should be done with care. The size of the gap between CF_t and RCF_t profiles reflects the effect working capital components and strategies have on the profitability of an investment. For example, when the CF profile is positive and greater than the RCF profile, a narrow gap shows working capital components have a limited affect on the value of the investment. However, a large gap indicates the importance of working capital components and strategies in determining the value of the investment. An analysis of these wide differences can aid management in re-evaluating the forecasted inputs, the forecasting errors and the working capital strategy that is creating the gap. There are many possible combinations of inputs that cause a gap. The model produces the necessary data to identify the variable(s) causing the problem.

Table 15.2 : Determining Net Cash Flow From Investment after adjusting for ending Cash and S/T Debt Retirement or Addition

Legend

CBAL	=	Total cash inflow
CPAY	=	Total cash outflow
CEX	=	Net Cash flow in excess of cash minimums
UNDISX=		Net cash flow from investment after adjusting for ending cash and S/T/ debt retirement or addition
EC	=	Ending cash plus m.s. balance
BEXC	=	Interest benefit from S/T/ investment
INT	=	Interest cost on S/T debt
CMAX =		CMINX * (1.0 MAXCASH)
Cr	=	Cash receipts
FUTCOST	=	Any future investment cost
CEINV =		Cost of excess inventory
CLOW =		Minimum cash balance
SUMCX=		Cumulative S/T/ debt
CBAL _t =		CR _t - FUTCOST _t + EC _{t-1} + BEXCT -1

$$CPAY_t = \text{fixed cost} + \text{labour cost} + \text{purchase cost} + \text{Taxest}_t + \text{CEINV}_t + \text{INT}_{t-1}$$

$$CEX_t = CBAL_t - CPAY_t - CPAT_t - CMAX_t$$

$$\text{If } CBAL_t - CPAY_t < CMAX_t, CEX = 0$$

$$\text{When } CBAL_t = CPAY_t < CMAX_t, UNDISX_t = 0$$

$$UNDISX_t = CBAL_t - CPAY_t - EC_t + \text{SUMCX}_{t-1} - \text{SUMCX}_t$$

Case 1.

$$\text{When } CBAL_t - CPAY_t < CLOW_t$$

$$EC_t = CLOW_t$$

$$\text{SUMCX}_t = \text{SUMCX}_{t-1} + CLOW_t - (CBAL_t - CPAY_t)$$

$$EC_t + \text{SUMCX}_{t-1} - \text{SUMCX}_t = CBAL_t - CPAY_t$$

$$\text{Therefore } UNDISX_t = 0$$

Case 2.

$$\text{When } CLOW_t < (CBAL_t - CPAY_t) < CMAX_t$$

$$\text{and } CBAL_t - (CBAL_t < \text{SUMCX}_{t-1})$$

$$EC = CLOW_t$$

$$\text{SUMCX}_t = \text{SUMCX}_{t-1} - (CBAL_t - CPAY_t - CLOW_t)$$

$$\text{SUMCX}_{t-1} - \text{SUMCX}_t = CBAL_t - CPAY_t - CLOW_t$$

$$EC_t + \text{SUMCX}_{t-1} - \text{SUMCX}_t = CBAL_t - CPAY_t$$

$$\text{Therefore } UNDISX_t = 0$$

Case 3.

$$\text{When } CLOW_t < (CBAL_t - CPAY_t) < CMAX_t$$

$$\text{and } \text{SUMCX}_{t-1} < CBAL_t < -CPAY_t$$

$$\text{SUMCX}_t = 0$$

$$EC_t = CBAL_t - CPAY_t - \text{SUMCX}_{t-1}$$

$$EC_t + \text{SUMCX}_{t-1} - \text{SUMCX}_t = CBAL_t - CPAY_t$$

$$\text{Therefore } UNDISX_t = 0$$

Case 4.

$$\text{When } CMAX_t < CBAL_t - CPAY_t,$$

$$UNDISX_t = CBAL_t - CPAY_t - CMAX_t = CEX_t, \text{ AND}$$

$$\text{When } CMAX_t < CBAL_t - CPAY_t \text{ and } \text{SUMCX}_{t-1} < CBAL_t - CPAY_t:$$

$$EC_t = CMAX_t \quad \text{SUMCX}_t = 0 \quad \text{SUMCX}_{t-1} = 0$$

$$CT_t + \text{SUMCX}_{t-1} - \text{SUMCX}_t = CT_t$$

$$\text{There } UNDISX_t + CBAL_t = CPAY_t - CMAX_t + CEX_t$$

15.3.4 Cost of Capital

In this model, it is assumed that the management prefers to use a single value for the initial cost of capital (K_0). However, the impact of inflation must be included in the cost of capital, k_t . The cash inflows and outflows in the numerator of the NPV equation are adjusted for inflation. The price of the goods sold in period 2 (P_2) is calculated in the following manner as shown in Table 15.1: $P_2 = P_1 (1 + PA_2)$, where PA is a randomly selected value for inflation drawn from a distribution perceived for inflation between the current and most recent time periods, $PA_t - PA_{t-1}$. This adjustment for inflation is presented below in equation form, which reflects the real cost of capital(t):

$$(1+k_t) = (1+K_t)(1+IF)$$

$$\text{Where } IF = PA_t - PA_{t-1}$$

Using the change in the perceived rate of inflation between periods, more closely

approximates the behaviour of financial markets, than an expected rate of inflation for a long time horizon. The essence of the adjustment assumes, a positive change in the rate of inflation will increase the cost of capital from the preceding period; however, if the rate of inflation decreases, the cost of capital will subsequently decrease. This would not occur if the adjustment process assumed a constant rising mean perceived rate of inflation.

By allowing the cost of capital to change each year, the inflation adjusted net cash flows in the numerator are discounted with a different k in each period. In this simulation model, the cost of capital is a probability distribution, and a cost of capital profile is created. The task of evaluating the profile of NPVs of an investment is complicated by not having a common cost of capital. Management must interpret the statistical properties of the NPVs, especially the mean, standard deviation, skewness and kurtosis when comparing separate simulation of the same alternatives or different alternatives. Furthermore, there is no longer a single cost of capital to serve as a benchmark for which the internal rates of return (IRR) can be compared. Previously if $IRR > k$ the investment was acceptable or rejected if $IRR < k$. In this simulation model, the profile of 100 IRR's are compared to the profile of the 100 k 's and the judgement of the user is needed to determine if the investment is acceptable.

The WC-CI model extends the traditional capital investment model and provides management a tool to test the sensitivity of an investment's profitability to changes in working capital strategies. Forecasting errors and inflationary conditions are shown to be the primary causes of working capital problems. These Working Capital Strategies are designed to offset forecasting errors and inflation. The model aids management in finding the best possible mix of strategies to generate the highest possible values of an investment.

15.4 SUMMARY

A firm is run with both fixed capital and working capital. These capitals change their rates due to swift transformation taking place in each of them. Working capital gets converted into fixed capital and vice-versa. Thus, there is a need to integrate working capital and capital investment processes. This is based on the realisation that changes in the policies of working capital bring about changes on the capital budgeting process of the firm. An attempt is made in this unit to highlight the significance of this integration process and the models to do it. Discussion in this unit is confined mainly to the what if techniques. It focuses on both the capital investment module and working capital module. The capital investment module takes into consideration the variables such as market, investment and cost. Each variable is assumed to be stochastic and independent. The uncertain and dynamic characteristics of the capital investment module are reflected in the random interaction of the variables.

Whereas the working capital module attempts to simulate the integration of working capital components into the capital investment process. More specifically, it attempts to measure the sensitivity of the NPV and IRR to changes in working capital strategies designed to offset the forecasting error and inflationary conditions. The models have highlighted the fact that forecasting errors and inflationary conditions are shown to be the primary causes of working capital problems.

15.5 KEY WORDS

Simulation : A technique to study the interrelationships among the variables of a set, with the help of probabilities.

Investment Information : Information that is crucial for deciding investment in a project.

Cost Project Module : A combination of purchase cost, labour cost and fixed cost.

Cash flow crisis : An unexpected happening resulting in the shortage of cash.

15.6 SELF ASSESSMENT QUESTIONS

- 1) How can computer simulation be used as a tool for improving business decisions? In view of the many techniques now available to the financial theorists, what judicial advantages are to be derived from simulation? Illustrate your decisions with specific examples.
- 2) “In simulating financial decision, the strategy that produces the best simulated result is not necessarily the optimal financing strategy”. Do you agree with this statement? Why or Why not?
- 3) “If one is in possession of a basic single Sequence or independent observations of some random variable with known intrivation function, then one can construct a sequence of such observations of any other random variable whose distribution is known”. Explain
- 4) Define Working Capital. What are the two critical decisions in Working Capital management? In what important ways do these decisions differ from those concerned with the management of the fixed capital of a business? Explain why these difference exists.
- 5) Explain the sequential process of :
 - a) Capital Investment Module
 - b) Working Capital Module.

15.7 FURTHER READINGS

- 1) Bhalla, V. K., 2002, *Working Capital Management- Test and Cases* New Delhi.
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- 3) Orgler Y.E, 1970, *Cash Management*, Wadworth Publishing, Belmont.
- 4) Berenek, William, 1963, *Analysis for Financial Decisions*, Homewood, Richard D. Irwin.