

Advanced Cost and Management Accounting

Lecture 23

Topic: Alternative transfer pricing methods

- There are five different types of transfer pricing methods which can be used by companies.
- **Market-based transfer prices:** these are listed prices of identical or similar products.
- **Marginal cost transfer prices,** mostly variable cost in the short run. Interpreted as direct costs and variable indirect costs.
- **Full cost transfer prices,** include cost of all resources committed to a product in the long run
- **A cost-plus transfer price,** a mark-up is added to enable supplying division to make a profit.
- **Negotiated transfer prices,** by managers of supplying and receiving divisions.

Market based transfer prices

- **Where perfectly competitive market for an intermediate product exists,** it is optimal for both decision making and performance evaluation to set transfer price at the competitive market price.

- **Perfect competition exists where the product is homogeneous and no individual buyer or seller can affect price.**

- When transfers are recorded at market price, divisional performance is likely to represent real economic contribution to the company profits. Profits are likely to be similar as if the divisions were separate companies.

The effect of selling expenses

- In practice company profits will be different when the intermediate product is acquired internally or externally.
- Selling expenses will be incurred when selling intermediate product in the external market.
- Companies modify the market prices to allow a margin to account for selling expenses

Other market imperfections

- Markets are unlikely to be perfectly competitive.
- Also, transferred products may have special characteristics. Market price is appropriate only when quality, delivery and discounts are identical.
- It may be possible to purchase intermediate product in the market at a temporary low price. If supplying division has excess capacity, incorrect decisions may arise from the market price rule.

Example

- A supply division has spare capacity and produces intermediate product at an incremental cost of Rs 1000; transfer price of this product is set at the external market price Rs 1600.
- Suppose a supplier sells in the market at a temporary distress price of Rs 1500, the receiving division will prefer to purchase from the external supplier.
- The relevant cost for the company of making the product is Rs 1000; hence the market price rule can motivate the manager to take decisions not in the best interest of the company.

Market imperfections

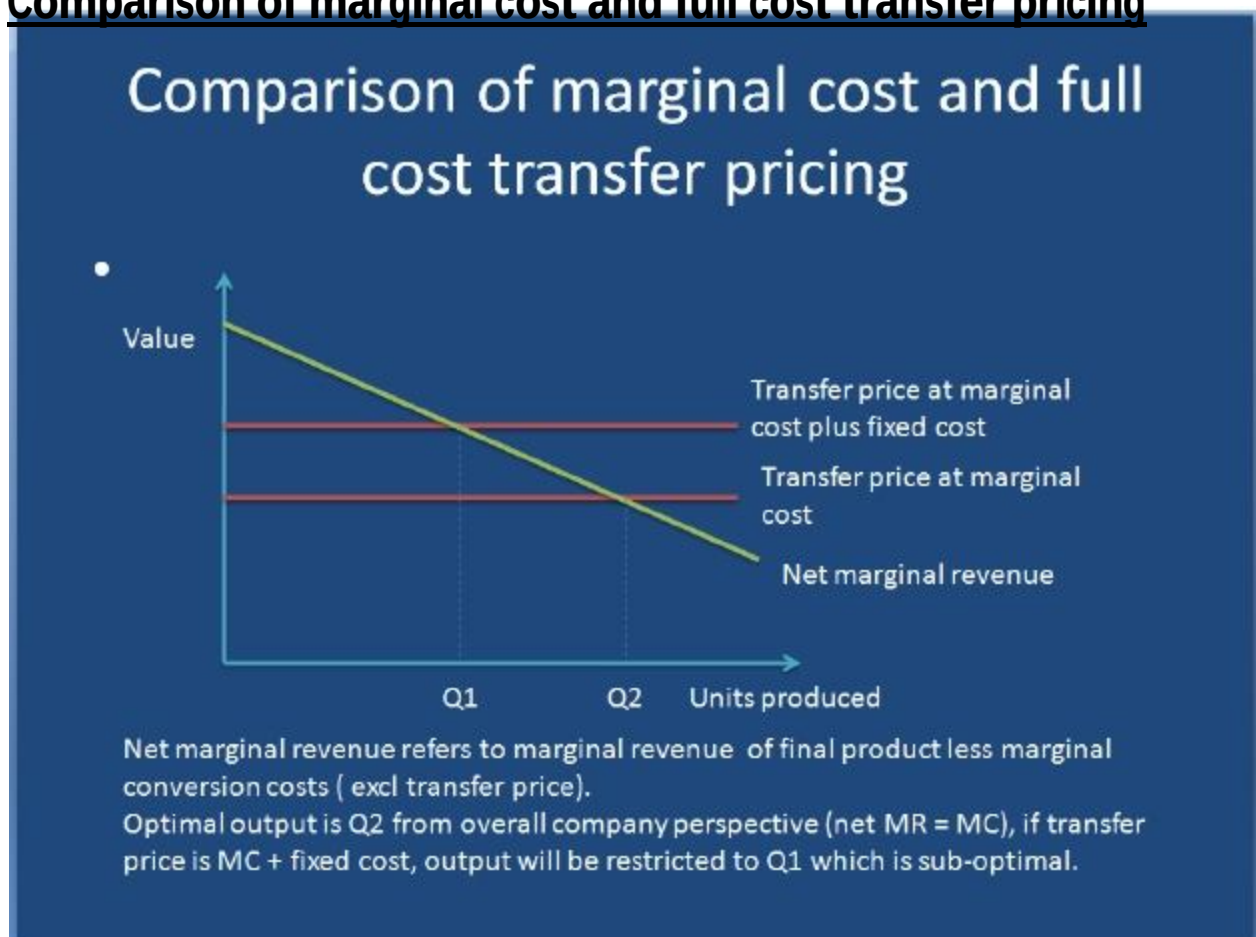
- These complications arise as markets are not perfectly competitive.
- Many companies use adjusted market-based transfer price to reflect temporary imperfection of markets.
- Such transfer prices are perceived as being fair by the divisional managers for performance evaluation.
- Also divisional autonomy is unlikely to be undermined.

Marginal Cost Transfer Prices

- Marginal cost transfer prices can motivate both supplying and receiving managers to operate at output levels that will maximize overall company profits.

- **Marginal cost is constant per unit throughout the relevant output range and equivalent to short-term variable cost.**
- **Variable cost is optimal only when the short-term perspective is adopted.**

Comparison of marginal cost and full cost transfer pricing



Marginal cost transfer pricing

- Surveys have shown that less than 10% of companies transfer goods at marginal cost.
- The major reason is that supplying division does not cover its full cost, and profits are understated, whereas receiving division is not charged with full cost and its profits are over stated.
- This is inaccurate information for evaluating performance.
- A further problem is that marginal costs may not remain constant over the entire range of output.
- Low usage of marginal cost transfer prices suggests that managers do not view product related decisions as short-term, and marginal cost is taken as short-term variable cost. A long run marginal cost is more appropriate.

Full cost transfer prices

- Full cost transfer prices or full cost plus mark-up are widely used in practice.
- Managers view product related decisions as long-run decisions.
- They are preferable for performance evaluation.
- Transfer pricing above variable cost may be consistent with 'economist's marginal cost.
- E.g. the economist would argue that extra wear and tear caused by plant usage is part of marginal cost. The accountant allows for this in depreciation which is taken as fixed cost.

- The major problem with full cost transfer prices is that they are derived from traditional costing systems, which can provide poor estimates of long run marginal costs.
- Ideally full cost transfer prices should be derived from activity based costing systems.
- A further problem with full cost transfer prices is that they do not provide an incentive to the supplying division as they do not include a profit margin.

Cost plus mark-up transfer prices.

- Cost plus transfer prices attempt to meet the performance evaluation purpose of transfer pricing.
- Sometimes variable costs are used as the base cost and a mark-up added to cover fixed cost as well as profit margin. In such cases the full cost will be more inaccurate than traditional systems.
- A further problem arises when we extend our analysis beyond two divisions. If each division transfer product at cost plus 20%, then the mark-up can be enormous by the time mark-up is added by the final division.

Negotiated transfer prices

- Negotiated transfer prices are most suited where some market imperfection exists.
- Managers have the freedom to buy and sell outside the company and engage in a bargaining process.

- It is claimed that the friction and ill-feeling of centrally controlled transfer prices will be eliminated.
- It is important that managers have equal bargaining power. Unequal bargaining power can occur if transfers are a small proportion of business for one division and a larger proportion of the other division.
- The situation may arise where divisional managers cannot agree on a mutually satisfactory transfer price. Central headquarter may then have to resolve the dispute.
- This raises behavioral problem with respect to morale and motivation, it also means at the time of performance evaluation, managers will be held responsible for decisions they did not make.
- Nevertheless the support and involvement of top management must be available to intervene to avoid sub-optimal decisions.

Limitations of negotiated transfer prices

- They depend on negotiating skills and bargaining power of managers, final outcome may not be optimal.
- They can lead to conflict between divisions.
- Managers may have unequal bargaining power.
- They are time-consuming where a large number of transactions are involved.

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An illustration of transfer pricing

- The Thar division and the Makran division are divisions within the Balochistan Group.
- One of the products manufactured by the Thar division is an intermediate product for which there is no external market.
- This intermediate product is transferred to the Makran division where it is converted into a final product for sale in the external market.
- One unit of the intermediate product is used in the production of the final product.

An illustration of transfer pricing:

- The expected units of the final product which the Makran division estimates it can sell at various prices is as follows:

– Selling price	Quantity sold
100	1000
90	2000
80	3000
70	4000
60	5000
50	6000

An illustration of transfer pricing:

- The costs of each division are as follows:

	Thar	Makran
· Variable cost per unit	11	7
· Fixed cost attributable	60,000	90,000

- The transfer price of the intermediate product has been set at Rs 35 based on full-cost plus mark-up.

An illustration of transfer pricing:

- At transfer price of Rs 35, profit computation for each division will be:

Thar division (supplying division):

Output	Revenue	Variable Cost	Fixed cost	Profit
1000	35000	11000	60000	(36000)
2000	70000	22000	60000	(12000)
3000	105000	33000	60000	12000
4000	140000	44000	60000	36000
5000	175000	55000	60000	60000
6000	210000	66000	60000	84000

An illustration of transfer pricing

- Makran Division (receiving):

Output	Revenue	variable	transfer	fixed cost	profit
2000	100000	7000	35000	90000	(32000)
2000	180000	14000	70000	90000	6000
3000	240000	21000	105000	90000	24000
4000	280000	28000	140000	90000	22000
5000	300000	35000	175000	90000	0
6000	300000	42000	210000	90000	(42000)

An illustration of transfer pricing

- The supplying division maximizes profits at an output level of 6000 units whereas the receiving division maximizes profits at an output level of 3000 units.
- Receiving division will therefore purchase 3000 units from the supplying division.
- This is because Makran will expand output as long as net marginal revenue exceeds transfer price.
- Net marginal revenue = marginal revenue from sale less marginal cost of conversion (excl transfer price)

An illustration of transfer pricing

Units	Net marginal revenue
1000	93000 (100000 – 7000)
2000	73000 (80000 – 7000)

3000	53000 (60000 – 7000)
4000	33000 (40000 – 7000)
5000	13000 (20000 – 7000)
6000	-7000 (0 – 7000)

Faced with a transfer price of Rs 35000 per 1000 units, the Makran division will not expand output beyond 3000 units because the transfer price for each batch will exceed the net marginal revenue.

An illustration of transfer pricing

- Profits at different output levels for the company as a whole.
Note these calculations do not incorporate transfer prices as they are inter-company items and will cancel out.

output	Revenues	variable cost	fixed cost	fixed profit
1000	100000	18000	150000	(68000)
2000	180000	36000	150000	(6000)
3000	240000	54000	150000	36000
4000	280000	72000	150000	58000
5000	300000	90000	150000	60000
6000	300000	108000	150000	42000

- The profit maximizing output for the company as a whole is 5000 units. Therefore the current transfer pricing system does not

motivate divisional managers to operate at the optimum level for the company as a whole.

- To induce overall company optimality the transfer price must be set at the marginal cost of the supplying division, which is the unit variable cost of Rs 11 per unit.
- Therefore transfer price for a batch of 1000 units should be Rs 11000.
- Now the receiving division will expand output as long as net marginal revenue exceeds transfer price.
- Net marginal revenue at 5000 units is Rs 13000, the transfer price is Rs 11000, therefore expanding output to this level will increase profits.
- Setting the transfer price at the unit marginal cost of the supplying division will motivate managers to operate at the optimum output level for the company as a whole.
- It is not a suitable measure for divisional performance, as fixed costs are not recovered, and loss is reported.

An illustration of transfer pricing

- **To induce overall company optimality the transfer price must be set at the marginal cost of the supplying division, which is the unit variable cost of Rs 11 per unit.**
- **Therefore transfer price for a batch of 1000 units should be Rs 11000.**
- **Now the receiving division will expand output as long as net marginal revenue exceeds transfer price.**
- **Net marginal revenue at 5000 units is Rs 13000, the transfer price is Rs 11000, therefore expanding output to this level will increase profits.**

- Setting the transfer price at the unit marginal cost of the supplying division will motivate managers to operate at the optimum output level for the company as a whole.
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An illustration of transfer pricing

- Consider a full cost transfer price with mark-up. Unit fixed cost has to be estimated at the planning stage using a pre-determined fixed overhead rate.
- At 5000 units output level for the company, fixed cost per unit for the intermediate product will be Rs 12 per unit (60000 fixed cost / 5000 units), giving a full cost of Rs 23 (Rs 12 plus Rs 11 variable cost).
- If the transfer price is set at Rs 23 per unit (Rs 23000 per 1000 batch) receiving division will expand output as long as net marginal revenue exceeds transfer price.
- This will be 4000 units where the net marginal revenue is Rs 33000. At 5000 units net marginal revenue is Rs 13000 and manager will not choose to expand output to 5000.

An illustration of transfer pricing

- At 4000 units the revenue of the supplying division will be Rs 92000 (4000 x 23) but the cost shown for the Thar division will be Rs 104000 (60000 fixed cost + 44000 variable).
- Thar division will report a loss as fixed costs have not been fully recovered.
- Hence this transfer price is neither suitable for performance evaluation nor optimal output decisions.

- We can conclude from this illustration that to ensure overall company optimality the transfer price must be set at the marginal cost of the supplying division.

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Lecture 25

Domestic transfer pricing recommendations

1:

- Where a competitive market exists for the intermediate product, the market price (less any adjustments to reflect additional selling and distribution expense) should be used as the transfer price.
- If supplying division has spare capacity, receiving division should be instructed to purchase the agreed quantities from the supplying division to ensure overall optimality.
- 2. where no external market exists for the intermediate product, transfers should be made at the long run marginal costs.
- The long run marginal cost should consist of two elements: a short run marginal cost per unit of product and a fixed lump sum fee based on budgeted use of average capacity of the supplying division.
- This is to ensure the receiving division incorporates the full cost of the supplying division's resources.
- 3. Where an imperfect market for the intermediate product exists, and a small number of transactions are involved, a negotiated transfer pricing system is likely to be most suitable.

- Some external benchmarking is likely to be used to enable a meaningful bargaining process to take place.
- 4. where cost based transfer prices are used, standard costs and not actual costs per unit should be used. If actual costs are used, supplying division will be able to pass on the cost of any inefficiencies to the receiving division.

International transfer pricing

- Supplying and receiving divisions may be located in different countries with different taxation rates, and the taxation rates in one country may be much lower than the other.
- It would be in the company's interest that most of the profits are located in the country with low tax rates.
- For example an organization manufactures products in country A which has a marginal tax rate of 25% and sells those products in country B where marginal tax rate is 40%. Company will use highest possible transfer price so that country B will have higher costs and lower profits. The opposite for country A.
- In many multi-national organizations, the taxation issues outweigh other transfer pricing issues and the dominant consideration is the minimization of global taxes.
- Taxation authorities are aware that companies can use the transfer pricing system to manipulate the taxable profits. The arm's length principle is used:
 - Similar transactions involving unrelated parties
 - Deduction of profit from selling price
 - Cost-plus method.

Example

- X Ltd, a manufacturing company has two divisions: Division A and Division B.
- Division A produces one type of product, Xeno, which it transfers to division B and also sells externally. Division B has been approached by another company which has offered to supply 2500 units of Xeno for Rs 35 each.
- The following details are available:

· Sales revenue

_ Sales to division B @ Rs 40	400,000
_ External sales @ Rs 45	270,000

Less:

Variable cost @ Rs 22	352,000
Fixed costs	<u>100,000</u>
Profit	<u>218,000</u>

if division B decides to buy from the other company, what will be impact of the profits of division A and on X Ltd, assuming external sales of Xeno cannot be increased.

Solution

- The loss of contribution in division A from lost sales of 2500 @ Rs 18 (40 – 22) = Rs 45000.
- The impact on the whole company is:

— external purchase cost (2500x35) = 87500

- incremental cost of manufacture $(2500 \times 22) = 55000$
- Additional cost to company = Rs 32,500

Example

Effects of transfer pricing on Division and Company profits

- Division A of a large organization manufactures a single standardized product. Some of the output is sold externally whilst the remainder is sold to Division B. In Division B it is a subassembly in an manufacture of that Division's product. The unit costs of Division A's product are as follows:

– Direct material	4
– Direct labor	2
– Direct expenses	2
– Variable manufacturing expenses	2
– Fixed manufacturing expenses	4
– Selling and packing exp – variable	<u>1</u>
	<u>15</u>

Example...

- Annually 10000 units of the product are sold externally at the standard price of Rs 30.
- In addition to external sales, 5000 units are transferred annually to Division B at an internal transfer charge of Rs 29 per unit.
- This transfer price is obtained by deducting variable selling and packing expense from the external price.

- Division B incorporates the transferred-in goods into a more advanced product.

Example...

- The unit costs of this product are as follows:

– Transferred-in item (from div A)	29
– Direct material and components	23
– Direct labor	3
– Variable overheads	12
– Fixed overheads	12
– Selling and packing exp –var	<u>1</u>
	<u>80</u>

Example...

- Division B's manager disagrees with the basis used to set the transfer price.
- He argues that the transfers should be made at variable cost plus an agreed (minimal) mark-up.
- He claims that his division is taking output that Division A would be unable to sell at the price of Rs 30.
- Partly because of this disagreement, a study of the relationship between selling price and demand has recently been made by the sales director. The resulting report contains:

Example....

- Division A

– Selling price	20	30	40
– Demand	15000	10000	5000
- Division B

– Selling price	80	90	100
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– Demand	7200	5000	2800
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- The manager of division B claims that the study supports his case.
- He suggests that a price of Rs 12 would give Division A a reasonable contribution to its fixed overheads while allowing Division B to earn a reasonable profit.
- He also believes that it would lead to an increase in output and an improvement in the overall company profits.

Example...

- **Required:**
 - **(a) to calculate the effect that the transfer pricing system has had on the company 's profits, and**
 - **(b) to establish the likely effect on profits of a transfer price of Rs 12, as suggested by the manager of Division B.**

Solution...

- The variable cost per unit of output for sales outside the company are Rs 11 for the intermediate product and Rs 49 (10A + 39B) for the final product.
- Selling and packing expense are not incurred for internal transfers.
- Optimal output of intermediate product for sale on external market:

· Selling price	20	30	40
· Unit contribution	9	19	29
· Demand (units)	15000	10000	5000
· Total contribution	135000	190000	145000

- **Optimal output is 10000 units at a selling price of Rs 30**

Solution...

- Optimal output for final product
- Selling price 80 90 100
- Unit contribution 31 41 51
- Demand (units) 7200 5000 2800
- Total contribution 23200 205000 142800
- Optimal output is 7200 units at a selling price of Rs 80.
- Optimal output of Division B based on transfer price of Rs 29.

Solution...

- Division B will regard transfer price as variable cost. Therefore total variable cost will be Rs 68 (29+39) and division B will calculate contribution as follows:

– Selling price (Rs)	80	90	100
– Unit contribution	12	22	32
– Demand units	7200	5000	2800
– Total contribution	86400	110000	89600

The management of Division B will choose output level of 5000 units at a selling price of Rs 90. This is sub-optimal for the company as a whole.

Solution...

- Profits for the company as a whole are reduced from Rs 223000 (7200 units) to Rs 205000 (5000 units).
- The Rs 205000 profits would be allocated as follows:
- Division A Rs 95000 (5000 @ (29-10))
- Division B Rs 110000

Solution...

- (b) at a transfer price of Rs 12, the variable cost per unit produced in Division B will be Rs 51 (12+39).
- Division B will calculate the following contributions:

– Selling price	80	90	100
– Unit contribution	29	39	49
– Demand	7200	5000	2800
– Total contribution	208800	195000	137200

Solution...

- The manager of Division B will choose an output of 7200 units and sell at Rs 80. This is optimum level of output for the company as a whole.
- Division would obtain a contribution of Rs 14400 ($7200 \times (12 - 10)$) from internal transfer of the immediate product, and Division B would get a contribution of Rs 208,800.
- Total contribution for the company as a whole would be Rs 223200. Division A would also earn a contribution of Rs 190,000 from sale of intermediate product in the external market.

Lecture 26

Cost Management

- In some previous lectures features of traditional management accounting and mechanisms used to control costs were described.
- The focus was on comparing actual results with a pre-set standard (usually budget), and taking remedial action.
- The emphasis is on cost containment rather than cost reduction.

- **Cost management focuses on cost reduction and continuous improvement rather than cost containment.**
- **Cost management consists of those actions that are taken by managers to reduce costs.**
- **Some of the actions are taken on the basis of information extracted from the accounting systems.**
- **Other actions are taken without the use of accounting information. They involve process improvements, where such opportunities have been identified.**
- **Ideally, the aim is to take action that will both reduce costs and enhance customer satisfaction.**

Life-cycle costing

- **Life-cycle costing estimates and accumulates costs over a product's entire life-cycle.**
- **This will determine whether profits earned from manufacturing, will cover costs incurred in the pre and post manufacturing stages.**
- **Life-cycle costing helps management to understand the cost consequences of developing a product.**
- **It helps identify areas in which cost reduction efforts are most likely to be effective.**
- **Most accounting systems report on a period by period basis, and product profits are not monitored over their life-cycles.**
- **Product life-cycle reporting involves tracing costs and revenues on a product by product basis over their life cycle.**
- **Three stages of a product life-cycle are**

- Planning and design stage
- Manufacturing stage
- Service and abandonment stage

Target costing

- We have looked at target costing as a mechanism for determining selling prices.
- As a cost management tool, target costing involves the following stages:
 - Stage 1: determine the target price which customers will be prepared to pay for the product.
 - Stage 2: deduct a target profit margin to determine target cost.
 - Stage 3: estimate actual cost of the product.
 - Stage 4: if estimated actual cost exceeds target cost, investigate ways of driving down the actual cost.
- The first stage requires market research to determine customer perceived value. This will be based on its differentiation value compared to competing products, and the price of competing products.
- The target profit margin depends on the planned return on investment.
- A major feature of target costing is that a team approach is adopted to achieve the target cost. Team members include designers, engineers, purchasing, manufacturing, marketing and management accounting personnel.

- The aim during the product design process is to eliminate product functions that add cost, but which do not increase market price.
- The major advantage of target costing is that it is deployed during the design and planning stage. This way it can have maximum effect in determining the level of locked-in costs.
- If the target cost cannot be attained, the product should not be launched.
- Design teams should not be allowed to achieve target costs by eliminating desirable product functionality.

Tear-down analysis

- Tear-down analysis (also known as reverse engineering) involves examining a competitor's product to identify opportunities for improvement and /or cost reduction.
- The competitor's product is dismantled to identify its functionality and design. This provides insight about the processes and the cost.
- The aim is to benchmark provisional product design with the design of competitors.

Value engineering

- Value engineering (known as value analysis) is a systematic examination of cost of a product.
- Aim is to devise means of achieving standard quality and reliability, at the target cost.
- This is achieved by:
 - Identifying improved product design with reduced cost,

- Eliminating unnecessary functions that increase product cost for which customers are not prepared to pay.
- Value engineering requires the use of functional analysis. This involves decomposing the product into its elements or attributes.
- E.g in automobiles functions might consist of : style, comfort, reliability, attractiveness etc.
- Surveys are conducted to determine the price customers are willing to pay for the various attributes.
- Where cost of a function exceeds the value to the customer, either the function should be eliminated or modified.
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The need for accurate cost measurement systems

- Target costing should be supported by an accurate cost system.
- Cost drivers should be established that determine cost of the activities consumed.
- Arbitrary cost allocations should be avoided.
- Target costing exercise should result in reduction of cost to the organization and not only the product.

An illustration of Target Costing

- The Micro Electronics Company manufactures cameras and video equipment. It is in the process of introducing a new state of the art combined digital video and still camera.
- The company has undertaken market research to ascertain customer perception and compare with competitors products.

- As a result, target selling price has been established and a life-time projected volume.
- Cost estimates have been prepared based on proposed product specifications.

An illustration of Target Costing

- The company has set a target profit margin of 30% of selling price.
- This has been deducted from the proposed selling price to determine the target cost.
- Following summary information has been presented to management

– Projected lifetime sales volume	300,000 units
– Target selling price	Rs 800
– Target profit margin (30%)	Rs 240
– Target cost (800 – 240)	Rs 560
– Projected cost	Rs 700

An illustration of Target Costing

- The excess of the projected cost over the target cost results in an intensive target costing exercise.
- After completion of the target costing exercise, the projected cost is Rs 555, i.e. below target cost of Rs560.
- the analysis of the projected cost before and after the target costing exercise is as follows:

An illustration of Target Costing

	Before	after
Manufacturing cost		
direct materials (bought in)	390	325

direct labor	100		80	
direct machining costs	20		20	
ordering and receiving	8		2	
quality assurance	60		50	
rework	15		6	
engineering and design	<u>10</u>	603	<u>8</u>	491
Non-manufacturing costs				
marketing	40		25	
distribution	30		20	
After-sales services and warranty	<u>27</u>	<u>97</u>	<u>19</u>	<u>64</u>
Total cost	700		555	

An illustration of Target Costing

- To achieve the target cost the company establishes a project team to undertake the intense target costing exercise.
- In response to the need to reduce projected cost, the team starts with purchasing a video camera from its main competitors and undertake a tear-down analysis.
- This process involves dismantling the cameras to provide insights into potential design improvements.
- Value engineering is also undertaken to identify new designs that will accomplish the same functions at a lower cost.

An illustration of Target Costing

- The outcome is a significant reduction in projected direct materials, labor and rework costs.

- Next the team engages in functional analysis.
- This process indicated several functions included in the prototype are not valued by customers.
- The functional analysis results in further cost reductions.
- The team now turn their attention to redesigning the production and support processes.
- They redesign the ordering and receiving process by reducing the number of suppliers and working closely with smaller suppliers.
- When projected cost is below the target cost, the exercise is concluded.

Lecture 27

Kaizen costing

- Widely used by Japanese organizations as a mechanism for reducing and managing costs.
- Kaizen is the Japanese word for making small improvements to a process rather than through large innovations.

- Target costing is applied during the design stage whereas Kaizen costing is applied during the manufacturing stage.
- Kaizen costing focuses on the production process and cost reductions are derived primarily through increased efficiency of the production process.
- Kaizen costing relies heavily on employee empowerment. Workers are given responsibility to improve process and reduce costs.

Activity based management

- The terms activity based management (ABM) or activity based cost management (ABCM) are used to describe cost management applications of ABC.
- **Three stages are required:**
 - Identifying major activities that take place
 - Assigning costs to cost pools / centers for each activity
 - Determining the cost driver for each major activity.

- ABM focuses on managing a business on the basis of activities performed.
- ABM is based on the fact the activities consume costs, hence managing activities will manage costs.
- ABM provides information on what activities are performed, what they cost, why undertaken and how well performed.

Traditional vs ABM analysis

• Salaries	320
• Stationery	40
• Travel	140
• Telephone	40
• Depreciation	<u>40</u>
•	<u>580</u>

- ABM analysis
- Preparing quotations 120
- Receiving cust orders 190
- Assessing credit 100
- Expediting 80
- Resolving cust probs 90
- 580

Traditional budget and control reports analyze costs by type of expense. In contrast ABM analyzes costs by activities and thus provides management with information on why costs are incurred, and the output from the activity.

- To identify and prioritize the potential for cost reduction, organizations classify activities as either value-added or non value-added.
- Value-added is what customers perceive as useful and are prepared to pay for. E.g painting a car.

- Non value added activities include inspecting, storing and moving raw material. Actions taken to carry these out efficiently will reduce costs.
- Care is needed as cost driver rates can encourage dysfunctional behavior. Rate can be improved by splitting the purchase orders, thus increasing number of orders. Ultimately this may increase costs.

Business process re-engineering

- Involves examining business processes and making substantial changes to how the organization currently operates.
- A business process is a collection activities linked together in a co-ordinated manner.
- E.g material handling is a business process consisting of scheduling production, storing materials, processing purchase orders, inspecting materials and paying suppliers.

- The aim is to improve key business processes by focusing on simplification, cost reduction, improve quality and enhance customer satisfaction.
- The process might be re-engineered by sending production schedule direct to nominated suppliers, and entering into contractual agreements to deliver materials according to production schedule.
- Quality guarantees and inspection prior to delivery can also be included.
- End result might be the elimination or reduction of storing, purchasing and inspecting activities.
- In BPR focus is on major changes rather than marginal improvements.

Cost of quality

- Quality has become one of the key competitive variables.

- TQM is a customer oriented process of continuous improvement that focuses on delivery of consistent high quality, on time.
- Companies discovered it was cheaper to produce items correctly the first time. It is a waste of resources to make sub-standard items, then detect and rework, or scrap them.
- Emphasis of TQM is to design and build in quality.
- Managers need to know the costs of quality and how they are changing over time.
- **A cost of quality report should be prepared showing:**
 - Prevention costs; i.e preventive maintenance, quality planning, training, extra cost of high quality material.
 - Appraisal costs; cost of inspection at each stage, quality audits, and field tests.
 - Internal failure costs; such as scrap, downtime, repair

- External failure costs; customer complaints, warranty replacements, damaged reputation.

Cost management and the value chain

- Value chain analysis is increasingly being used to manage costs more efficiently.
- Value chain is the linked set of value creating activities all the way from basic raw materials to the end-use product.
- A firm which performs value chain activities more efficiently and at a lower cost than its competitors, will gain an advantage.
- It is a system of inter-dependent activities in which performance of one activity affects the performance and cost of another.
- Each link is seen as the customer of the previous link. If each link satisfies the needs of its

customer, then end-customer satisfaction should follow.

Benchmarking

- In order to identify the best way of performing activities and business processes, organizations are turning to benchmarking.
- This involves comparing key activities to world-class best practices.
- Benchmarking identifies an activity, such as customer order processing, that needs to be improved.
- It finds a non-rival organization, considered to represent world class best practice for this activity, and studies how it performs the activity.
- The objective is to find out how the activity can be improved, and implement the improvements.
- Benchmarking is cost beneficial since an organization can save time and money avoiding mistakes that other companies have made.

- The overall aim is find and implement best practices.

Just-in-time Systems (JIT)

- JIT seeks to achieve the following goals:
 - Elimination of non-value added activities
 - Zero inventory
 - Zero defects
 - Batch size of one
 - Zero breakdowns
 - 100% on time delivery

Whether achieved or not, they set targets and create a climate for continuous improvement.

Elimination of non value-added activities

- JIT is a philosophy of management dedicated to elimination of waste. Waste is anything that does not add value to the product.
- The lead time involved in manufacturing and selling a product consists of process time,

inspection time, move time, and storage time. Of these, only process time actually adds value to the product.

- Research has shown that process time is less than 10% of total lead time in many organizations. Therefore 90% of lead time adds no value, and in JIT philosophy, related cost can be significantly reduced.
- JIT system is a mechanism for reducing non value-added costs and long run costs.
- The implementation of JIT production methods was considered to be one of the major factors of the success of the Japanese firms in international markets.
- The JIT approach involves a continuous commitment to the pursuit of excellence in all phases manufacturing operations.
- The aims of JIT are to produce at the required quality, in the required quantity , and at the required time.

Lecture 28 –

Business process re-engineering*

- Involves examining business processes and making substantial changes to how the organization currently operates.
- A business process is a collection of activities linked together in a co-ordinated manner.
- E.g material handling is a business process consisting of scheduling production, storing materials, processing purchase orders, inspecting materials and paying suppliers.
- The aim is to improve key business processes by focusing on simplification , cost reduction, improve quality and enhance customer satisfaction.
- The process might be re-engineered by sending production schedule direct to nominated suppliers, and entering into contractual

agreements to deliver materials according to production schedule.

- Quality guarantees and inspection prior to delivery can also be included.
- End result might be the elimination or reduction of storing, purchasing and inspecting activities.
- In BPR focus is on major changes rather than marginal improvements.

Cost of quality*

- Quality has become one of the key competitive variables.
- TQM is a customer oriented process of continuous improvement that focuses on delivery of consistent high quality, on time.
- Companies discovered it was cheaper to produce items correctly the first time. It is a waste of resources to make sub-standard items, then detect and rework, or scrap them.
- Emphasis of TQM is to design and build in quality.

- Managers need to know the costs of quality and how they are changing over time.
- **A cost of quality report should be prepared showing:**
 - **Prevention costs;** i.e preventive maintenance, quality planning, training, extra cost of high quality material.
 - **Appraisal costs;** cost of inspection at each stage, quality audits, and field tests.
 - **Internal failure costs;** such as scrap, downtime, repair
 - **External failure costs;** customer complaints, warranty replacements, damaged reputation.

Cost management and the value chain



- Value chain analysis is increasingly being used to manage costs more efficiently.

- Value chain is the linked set of value creating activities all the way from basic raw materials to the end-use product.
- A firm which performs value chain activities more efficiently and at a lower cost than its competitors, will gain an advantage.
- It is a system of inter-dependent activities in which performance of one activity affects the performance and cost of another.
- Each link is seen as the customer of the previous link. If each link satisfies the needs of its customer, then end-customer satisfaction should follow.

Example - Traditional vs activity based budgets, and life-cycle costing

- The budget for the production, planning and development dept of Okara plc is currently prepared on traditional system.

- The analysis of costs by expense type for period ended 30 November 20X0 is as follows:

– Expense	budget %	Actual %
– Salaries	60	63
– Supplies	6	5
– Travel cost	12	12
– Technology cost	10	7
– Occupancy cost	12	13
– Total budget and actual costs for the dept for period ended November 30 are Rs 1,000,000 and Rs 1,060,000 respectively.		

Traditional and activity based budget, and life-cycle costing

- The company now feels an Activity Based Budgeting approach should be used.
- A number of activities have been identified, and budget and actual cost should be attributed as follows:

Budget % Actual %

– Scheduling new products	20	16
– Scheduling existing products	40	34
– Remedial scheduling	5	12
– Special studies –specific orders	10	8
– Training	10	15
– Management and administration	15	15

Traditional and activity based budget statements, and life-cycle costing

- Required:
- (a) prepare two budget control statements for department and compare with actual, showing variances, using
 - traditional expense based analysis, and
 - Activity based analysis

Solution

- (a) Performance report – traditional:
- Expense Budget Actual variance

– Salaries	600000	667800	67800A
– Supplies	60000	53000	7000 F
– Travel cost	120000	127200	7200A
– Technology	100000	74200	25800F
Occupancy	120000	137800	17800A
	1000000	1060000	60000A

· Performance report – activity based

Activity	Budget	Actual	Variance
Scheduling new	200000	169600	30400F
Scheduling existing	400000	360400	39600F
Remedial	50000	127200	77200A
Special studies	100000	84800	15200F
Training	100000	159000	59000A
Mgt and admin	150000	159000	9000F
	1000000	1060000	60000

Lecture 29

Traditional and activity based budget statements, and life-cycle costing

- (b) Other activities have been identified and the budget quantified for the three months ended March 31, 20X1 is as follows:

Activity	cost driver	units	Cost(000)
Product design	hours	8000	2000
— Purchasing	P.Orders	4000	200
— Production	mach hours	12000	1500*
— Packing	volume(cu.m)	20000	400
— Distribution	weight (kg)	120000	600

*this includes depreciation provision of Rs 300k of which Rs 8000 applies to 3 mths for a new product (NPD)

Example cont...

- New product NPD is included in the above budget.
The following additional information applies to NPD:
 - Estimated output over life-cycle: 5000 (4 yrs)
 - Product design requirement: 400 design hours
 - Output in qtr ended march 31, 20X1: 250 units
 - Equivalent batch size per purchase order: 50 units
 - Production time .75 mach hr; vol 4cu.m; wt 3kg.
 - Prepare unit overhead cost for NPD using activity based approach which includes a share of life-cycle costs.

Solution

- (b) The cost driver rates are as follows:
 - Product design (Rs 2m/8000 hrs) = Rs 250 per hr

- Purchasing $(200,000/400) = \text{Rs } 50 \text{ per P.O}$
- Production (excl depn) $(1500,000 - 300,000) / 12000\text{hrs} = \text{Rs } 100 \text{ per mach hr}$
- Packing $(400,000/20000) = \text{Rs } 20 \text{ per cu.m}$
- Distribution $(600,000 / 120,000) = \text{Rs } 5 \text{ per kg}$

Solution

- The activity-based overhead cost per unit is as follows:
 - Product design (400hrs at Rs 250 = 100,000 divided by life-cycle output of 5000 units)

= 20
 - Purchasing (5 Pos at 50 units per order costing Rs 250 for output of 250 units)

= 1
 - Production (.75 mach hr at Rs 100)

= 75
 - Depreciation (Rs 8000 / qtr for 4 years divided by life-cycle output of 5000 units)

= 25.6

– Packing (.4 cu m at Rs 20)	=8
– Distribution (3 kg at Rs 5)	= 15
– Total cost	144.6

Benchmarking*

- In order to identify the best way of performing activities and business processes, organizations are turning to benchmarking.
- This involves comparing key activities to world-class best practices.
- Benchmarking identifies an activity, such as customer order processing, that needs to be improved.
- It finds a non-rival organization, considered to represent world class best practice for this activity, and studies how it performs the activity.
- The objective is to find out how the activity can be improved, and implement the improvements.

- Benchmarking is cost beneficial since an organization can save time and money avoiding mistakes that other companies have made.
- The overall aim is find and implement best practices.

Just-in-time Systems (JIT)*

- JIT seeks to achieve the following goals:
 - Elimination of non-value added activities
 - Zero inventory
 - Zero defects
 - Batch size of one
 - Zero breakdowns
 - 100% on time delivery

Whether achieved or not, they set targets and create a climate for continuous improvement.

Elimination of non value-added activities

- JIT is a philosophy of management dedicated to elimination of waste. Waste is anything that does not add value to the product.
- The lead time involved in manufacturing and selling a product consists of process time, inspection time, move time, and storage time. Of these, only process time actually adds value to the product.
- Research has shown that process time is less than 10% of total lead time in many organizations. Therefore 90% of lead time adds no value, and in JIT philosophy, related cost can be significantly reduced.
- JIT system is a mechanism for reducing non value-added costs and long run costs.
- The implementation of JIT production methods was considered to be one of the major factors of the success of the Japanese firms in international markets.

- The JIT approach involves a continuous commitment to the pursuit of excellence in all phases of manufacturing operations.
- The aims of JIT are to produce at the required quality, in the required quantity , and at the required time.

Batch sizes of one

- Set up time is the time required to adjust equipment and retool for a different product.
- Long set up time makes production of small batches uneconomic.
- However, production in large batches leads to substantial throughput delays and creation of high inventory levels.
- JIT philosophy is to reduce set up time to zero. By investing in advanced manufacturing technologies, some machine settings can be adjusted automatically.

- If setup time approaches zero, there is no advantage in producing in batches, and optimal batch size can be one.

JIT Purchasing Arrangements

- Delivery of materials immediately precedes their use.
- Frequent deliveries so stocks can be cut to a minimum.
- Suppliers to inspect material before delivery, and guarantee quality.
- More business to fewer suppliers and placing longer-term purchase orders.
- Reduction in paper-work arising from blanket long-term orders to a few suppliers

Lecture 30 –

JIT and Management Accounting*

- Management accounting must support just-in-time manufacturing by monitoring, identifying and

communicating to decision makers, any delay, error and waste in the system.

- Emphasis on providing information on supplier reliability, set up times, throughput cycle times, percentage of deliveries that are on time, and defect rates.

Savings from JIT and determination of optimal selling price

- A Ltd manufactures and distributes three types of cars (the T1, T2, and T3). Each type of car has its own production line. The company forecast loss

Current operations – budgeted details for the next year:

Direct materials	2520	2924	3960
Direct labor	1120	1292	1980
Total direct cost	<u>3640</u>	<u>4216</u>	<u>5940</u>
Budgeted production (cars)	75000	75000	75000
Number of production runs	1000	1000	1500
Number of orders executed	4000	5000	5600
Machine hours	1080k	1800k	1680k

Savings from JIT and determination of optimal selling price

Annual Overheads	Fixed	Variable
Set ups	42660	13000 per prod run
Materials handling	52890	4000 per order
Inspection	59880	18000 per prod run
Machining	144540	40 per machine hour
Distribution and warehousing	42900	3000 per order

Impact of Proposed JIT system:

direct labor	increase by 20%
set ups	decrease by 30%
materials handling	decrease by 30%
inspection	decrease by 30%
machining	decrease by 15%
distribution and warehouse	eliminated

Required (a)

Based on the budgeted production levels, calculate the total annual savings that would be achieved by introducing the JIT system.

Savings from JIT

Solution:

The annual cost savings are as follows:	(Rs 000s)
Direct labor $0.2(1120+1292+1980) \times 75000$	+65880
Variable set ups $(30\% \times 13000) \times 3500$	- 13650
Materials handling $(30\% \times 4000 \times 14600)$	-17520
Variable inspection $(30\% \times 18000 \times 3500)$	-18900
Machining $(15\% \times 40 \times 4560k)$	-27360
Distribution and warehousing (3000×14600)	- 43800
Fixed $[30\%(42660+52890+59880) + (15\% \times 144540)$	
+42900]	<u>-111210</u>
Total savings	<u>166560</u>

Determination of optimal selling price

- The following table shows the price/demand relationship for each type of car per annum:

T1 Price	demand	T2 price	demand	T3 price	demand
5000	75000	5750	75000	6500	75000
5750	65000	6250	60000	6750	60000
6000	50000	6500	45000	7750	45000
6500	35000	7500	35000	8000	30000

Determination of optimal selling price

- Required (b)

- Assuming that A Ltd adopts the JIT system and that the revised variable overhead cost per car remains constant (as per the proposed JIT system budget), calculate the profit-maximizing price and output level for each type of car.

The total variable overhead costs allocated to each product is as follows:

(all 000s)	T1	T2	T3
Set up (9100 per prod run)	9100	9100	13650
Materials hand (2800/order)	11200	14000	15680
Inspection (12600/prod run)	12600	12600	18900
Machining (34 per mach hr)	36720	61200	57120
Total output	75	75	75
Variable overheads per car	928.26	1292	1404.67
Direct materials	2520	2924	3960
Direct labor	1344	1550.4	2376
Total variable cost per car	4792.26	5766.4	7740.67

Determination of optimal selling price

The above variable costs are now used to derive the contributions for the various price

levels: T1 car

Price	demand	unit contr	total
5000	75000	207.74	15581
5750	65000	957.74	62253
6000	50000	1207.74	60387
6500	35000	1707.74	59771

Similarly the total contributions for the other cars can be calculated.

The profit maximizing price and output level for T1 is Rs 5750 and 65000 respectively.

Lecture 31 –

Strategic Management Accounting*

- Strategy – to accomplish a task, win against an opponent.
- Information for formulation and implementation of organization strategy.
- To develop an integrated framework of performance measurement that can be used to clarify, communicate and manage strategy.
- Strategic decisions usually involve the longer term and have a significant effect on the organization.

External information about competitors

- To protect organization's strategic position, and determine future strategies.
- Help evaluate its competitive position relative to rest of industry.
- Collecting data on costs and prices, sales volumes and market shares, cash flows and resource availability for main competitors.
- Information available from public source i.e. annual reports, press, official institutions and informal sources. (sales personnel, consultants, industry specialist)

Strategic positioning*

- A firm has a choice of three generic strategies in order to achieve sustainable competitive advantage:
 - Cost leadership – compete on the basis of lower selling prices. Advantage may be due to

economies of scale, access to favorable raw material prices, superior technology.

– Differentiation – superior and unique products. E.g. dependability of product, after-sale service, wide availability.

– Focus – on a narrow segment of the market that has special needs.

Accounting in relation to strategic positioning

- There will be more emphasis on particular accounting techniques depending on the strategic position adopted.
- Tight cost controls are more appropriate where cost leadership strategy is followed.
- Manufacturing cost standards are likely to be less important for a firm following product differentiation strategy.

Target costing and strategic management accounting

- Target costing falls within the domain of strategic management accounting.
- Justification for this is the external focus and the market-driven approach to product pricing and cost management.
- The aim is to achieve target cost, which involves examining cost reduction opportunities throughout the entire value chain.

The Balanced Scorecard

- Attention is being given to encourage behavior that is consistent with organization's strategy.
- Development of an integrated framework of performance measurement that can be used to clarify, communicate and manage strategy implementation.
- The approach will attempt to integrate both financial and non-financial measures, and

incorporate performance measurement within the strategic management process

The Balanced Scorecard

- Product quality, delivery, reliability, after-sale service and customer satisfaction have become key competitive variables.
- None of these were given much importance measured by traditional management accounting performance measurement systems.
- The need to integrate financial and non-financial measures of performance and identify key performance indicators that link to strategy, led to the emergence of the balanced scorecard.

Lecture 32 — The Balanced Scorecard philosophy*

- The balanced scorecard philosophy assumes that an organization's vision and strategy is best

achieved when the organization is viewed from the following four perspectives:

- Customer perspective (how do customers see us)
- Internal business process perspective (what must we excel at)
- Learning and growth perspective (can we continue to improve and create value)
- Financial perspective (how do we look to shareholders)

The Balanced Scorecard

- The balanced scorecard is a strategic management technique for communicating and evaluating the achievement of the mission and strategy of the organization.
- (Insert fig 23 page 1002)
-

The Balanced Scorecard

	Objective s	Measure s	Targets	Initiativ es	
FINANCIA L					
CUSTOME R					
INTERNAL BUSINESS PROCESS					
LEARNING AND GROWTH					

Implementation

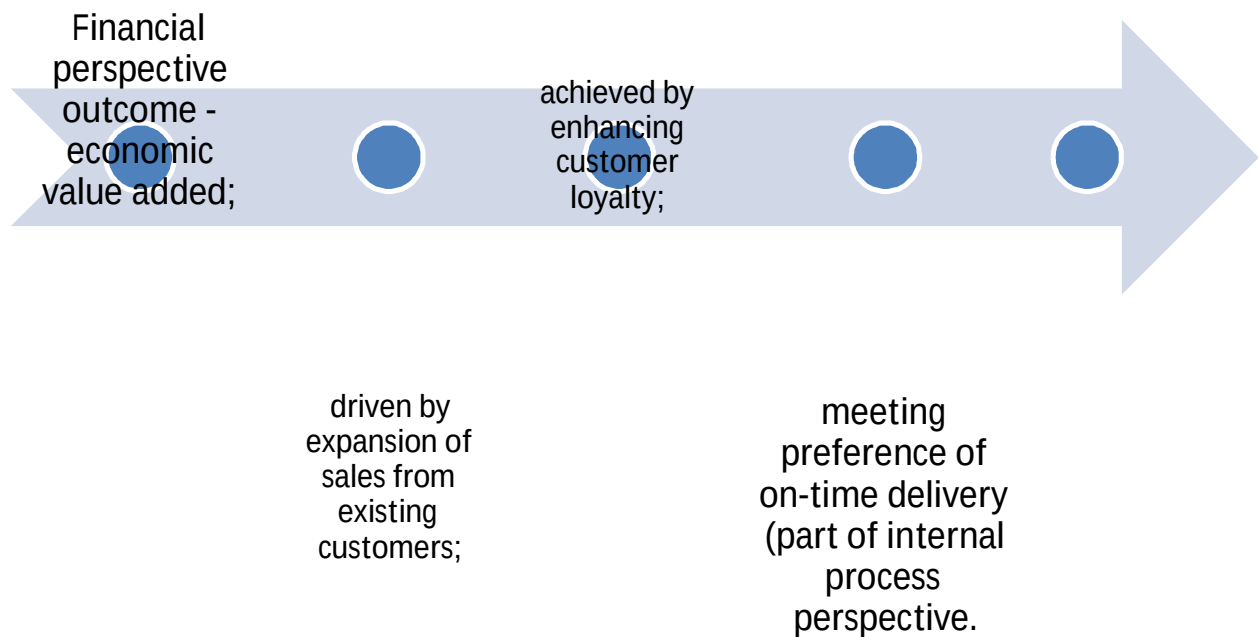
- To implement the balanced scorecard, the major objectives of each of the four perspectives should be stated.
- The chart shows that these objectives should then be translated into specific performance measures.
- There may be one or more objectives to each perspective, and one or more performance measure linked to each.
- In the scorecard, firms should identify major initiatives for achieving each objective and also establish targets for each performance measure.

The aim of balanced scorecard

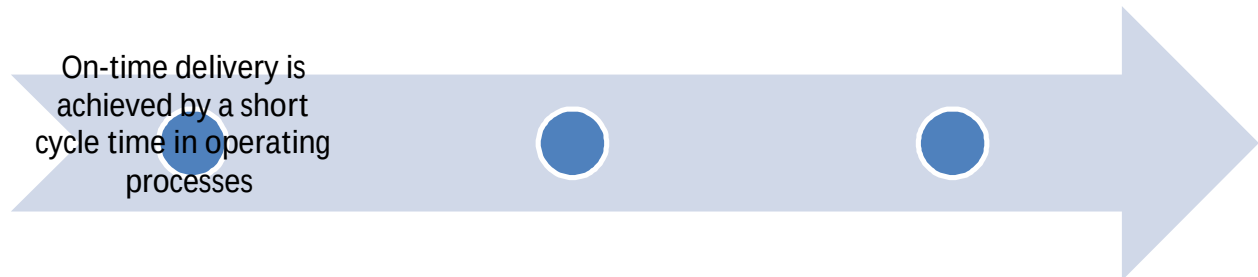
- The aim of the scorecard is to provide a comprehensive framework for translating a company's strategic objectives into a coherent set of performance measures.

- Only critical measures are incorporated in the scorecard.
- Cause and effect relationship encompasses all four perspectives of the balanced scorecard.

Cause and Effect



Cause and Effect



Short cycle time can be achieved by training the employees – this is part of learning and growth perspective.

Non-financial measures

- So financial performance measures show financial impact of decisions, as their impact materializes. This can be long after the decisions were made.
- Drivers of future performance are the non-financial measures relating to the customer, internal business process and learning and growth perspectives.

Organization's strategy

- Most companies do not align performance measures to their strategy.
- Instead they try to improve performance of existing processes. (lower cost, improved quality, shorter customer response time).
- They do not identify the processes that are truly strategic. (i.e. those that require exceptional performance)
- The objectives and accompanying performance measures relating to each of the four perspectives, should reflect and operationalize an organization's mission and strategy.

Linkage between strategy and performance measurement

- A company following a low cost strategy will have different objectives and key performance

measures than another which follows a product differentiation strategy.

- Experience shows where companies implement the balanced scorecard, they not only clarify and communicate strategy, but also manage strategy.
- The distinguishing features of a balanced scorecard approach are the linkages between strategy and performance measurement, and financial and non-financial performance measures, (cause and effect).

Southwest **Lecture 33** – balanced scorecard analysis.

- Strategic theme: operating efficiency
 - Financial: what will drive operating efficiency?
Answer: more customers on fewer planes.
 - Customer: how will we get more customers on fewer planes? Answer: attract segment of

customers who value price and on-time arrivals.

– Internal: what must our internal focus be?

Answer: fast aircraft turnaround time.

– Learning: how will our people accomplish fast turnaround time? Answer: educate and compensate ground crew, use employer

Southwest airlines. – balanced stockholder programme. – scorecard analysis.

· Strategic theme: operating efficiency

– Financial: what will drive operating efficiency?

Answer: more customers on fewer planes.

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– Internal: what must our internal focus be?

Answer: fast aircraft turnaround time.

- Learning: how will our people accomplish fast turnaround time? Answer: educate and compensate ground crew, use employer stockholder programme.

Southwest Airlines' Balanced Scorecard Framework.

	Objectives	Measurement	Target	Initiative
Financial	Profitability More customers Fewer planes	Market value Seat revenue Plane lease cost	30% CAGR 20% CAGR 5% CAGR	
Customer	Flight is on time Lowest prices	On-time arrival rating Market survey	#1 #1	Quality management. Customer loyalty program
Internal	Fast ground turnaround	On ground time On time depart	30 minutes 90%	Cycle time optimization
Learning	Ground crew	% ground crew trained	Yr 1 – 70%	ESOP. Ground crew

	alignment	% ground Yr 3 – training	
		crew	90%
		stockholders	Yr 5 –
			100%

Balanced scorecard as a strategic management system*

- The scorecard is being used to accomplish the following critical management processes:
 - Clarifying and translating vision and strategy into specific strategic objectives, and identifying the critical drivers of the strategic objectives.
 - Communicating and linking strategic objectives and measures. Establish local objectives that support global strategy.

- Plan, set targets and align initiatives. Include and monitor the longer term (3 – 5 years) targets.
- Enhance feedback and learning, strategy implementation can be monitored and adjusted.
- Measuring scale; tractor ploughing land, sowing of seeds, adding fertilizer, crops have grown.

Benefits

- Benefits:
 - A single report shows four perspectives on company performance.
 - Developing major goals for four perspectives and translating these into specific performance.
 - It helps managers to see whether improvements in one area may have been at the expense of another.

- The approach improves communication within the organization and promotes active formulation and implementation of organizational strategy

Limitations

- Criticism mostly questions the assumption of cause and effect relationship on the grounds that they are too ambiguous, and lack empirical support.
- Others relate to omission of employee and environment perspectives. The response is that there is nothing to prevent additional perspectives. However too many perspectives should be avoided as a major benefit of the balanced scorecard is its conciseness and clarity of presentation.

Lecture 34

Establishing objectives and performance measures – Financial

- Objectives

- operating profit, return on investment, net profit, economic value added. In addition, revenue growth, cost reduction and asset utilization.
- typical financial objectives are to increase return on investment by 20%, and/or to increase sales and operating income by 100% over the next five years.
- Financial measures provide feedback on whether improvements in operational performance measures are being translated into improved financial performance.

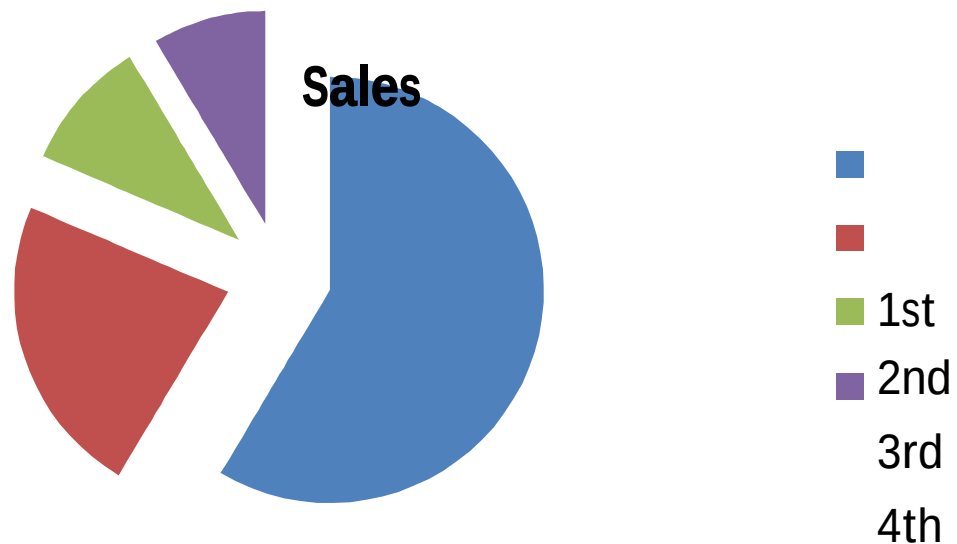
The Customer Perspective

- Objectives:

- Market share

- Customer retention
- New customer acquisition
- Customer satisfaction
- Customer profitability

Measuring Market Share



Measuring market share

- proportion of sales in a particular market.
- Measured as sales revenue, sales volume or number of customers.
- Estimates of total market size obtained from trade associations and industry groupings.
- Indicates whether strategy adopted is achieving expected results in the target markets.

Customer retention

- Ensuring existing customers are retained, this will maintain or increase market share.
- Measured in terms of average duration of customer relationship.

- Surveying defecting customers and their reasons can provide valuable feedback.
- Customer loyalty can be measured by number of new customers referred by existing customers.

Customer acquisition / satisfaction

- Measured by either number of new customers or total sales to new customers in the desired segment.
- Other measures include the number of new customers expressed as a percentage of prospective inquiries, or the ratio of new customers per sales call.
- Customer satisfaction
 - Involves use of questionnaire surveys and customer response cards.
 - Also measured by letters of complaint, and other means of feedback.

Customer profitability

- Profitability should be analysed by different customer segments.
- Unprofitable segments identified.
- Newly acquired customers may initially be unprofitable, life-cycle profitability analysis should be used.
- Actions to make customers profitable may include altering their buying behavior so they consume less resources, or price increases.

The internal business perspective*

- Creating satisfied and loyal customers only translates into achieving financial objectives by ensuring that the key internal business processes are effective and efficient.

- The internal business process measures should focus on the internal processes that are required to achieve the organizations customer and financial objectives.
- **Three principal internal processes are:**
 - Innovation processes
 - Operation processes
 - Post-sales service processes
- In innovation processes managers research the needs of customers and then create the products or services that will meet those needs.
- Objectives of innovation process include:
 - Increasing the number of new products
 - Decreasing the time to develop new products
 - Identifying new markets and customers

Innovation processes

- Companies are becoming increasingly aware that success in developing a continuous stream of innovative products services can provide a competitive advantage.
- Research and development has become a more important element in the value chain of most businesses.
- Measures observed in organizations include:
 - Percentage sales from new products
 - New product introduction vs competition / plan
 - Number of key items in which Co is 1st or 2nd .

Operation processes

- The operation process starts with the receipt of the customer order, and finishes with the delivery of the product to the customer.
- Objectives of operation process include:
 - Decreasing process time
 - Increasing process efficiency
 - Improving product quality
 - Decreasing processing cost
- Performance and control measures have traditionally relied on financial measures such as standard costs, budgets and variance analysis.
- This over-emphasis sometimes motivated dysfunctional actions. E.g.
 - Pursuit of efficiency encouraged maximum utilization of labor and machines, resulting in excessive inventories, not related to current customer orders.

Cos have added measures of quality, reliability, delivery, that provide value to customers as a result of global competitive environment.

Cycle time measures

- Many customers place a high value on short and reliable lead time.
- This is measured by the time taken from placing an order until the time the desired product is received.
- Traditionally companies met this requirement by holding large inventories of many different products. This is not consistent with being low cost producer.
- Companies are adopting JIT systems to achieve both low cost and short lead-time objectives.
- Reducing cycle time is hence critical for JIT companies.

Post sales service processes

- The final category relating to internal business process perspective includes warranty and repairs, treatment of defects and returns, and the process and administration of customer payments.
- Post sale service performance can be measured by applying some of the time, quality and cost measures that have been suggested for the operating processes.
- E.g cycle time to measure speed of response to failures; activity cost to measure cost of resources being used for the post sale service.

The learning and growth perspective

- Identifies the infrastructure that the business must build to create long-term growth and improvement.

- Investing in the future other than in assets and R&D (which is included in innovation in the internal processes perspective).
- People, systems and organization procedures to provide capabilities that enable accomplishment of other three perspectives.
- **Three principal categories:**
 - Employee capabilities
 - Information system capabilities
 - motivation, empowerment and alignment

Virtually no effort has been devoted to measuring the outcomes relating to the above three categories.

Employee capabilities*

- Three common core measurement outcomes:
 - Employee satisfaction: measured using surveys, typically they are requested to

specify on a scale from dissatisfied to highly satisfied, for a list of questions that measure employee satisfaction. Examples of questions relate to: involvement in decisions, encouragement to be creative and use initiative.

- Employee retention: can be measured by annual percentage of key staff that leave.
- Employee productivity: many methods can be used, a generic method is sales revenue per employee.

Information system capabilities*

- Excellent information is needed on customers, internal processes and financial consequences of decisions.
- Measures of strategic information availability include: percentage of processes with real time: quality, cycle-time and cost feedback. And

percentage of on-line information about
customers.

Motivation, empowerment and alignment

- Proposed measure for motivated and empowered employees is the number of suggested improvements per employee.
- Performance drivers focus on whether departments and individuals have their goals aligned with company objectives, and articulated in the balanced scorecard.

Lecture 36 – Quantitative models for the planning and control of stocks*

- Investment in stocks represents a major asset in most organizations.
- To determine optimum level of investment in stocks, two conflicting requirements must be met.

- First, stocks must be sufficient to meet requirement.
- Second, it must avoid holding surplus stock that are unnecessary and increase the risk of obsolescence.

The optimal stock level

- The optimal stock level lies somewhere between these two extremes.
- We will examine the application of quantitative models for determining the optimum investment in stocks.
- We shall consider the economic order quantity and the level at which stocks should be replenished.

Reasons for holding stocks

There are three general reasons for holding stocks:

- Transaction motive – to meet production and sales requirements.
- Precautionary motive – where supply of raw materials is unreliable.
- Speculative motive – where future input prices are expected to change.
- The quantitative models incorporate only the transactions motive for holding stock

Relevant costs for the quantitative model

- Relevant costs for determining optimum stock level are holding costs and ordering costs.
- Holding costs consist of:
 - Opportunity cost of investment in stocks
 - Variable insurance cost:
 - Variable warehouse and storage cost;
 - Variable material handling cost

- Cost of obsolescence and deterioration in stocks
 - Holding costs not affected by changes in stock levels are not relevant costs.
- Relevant holding costs
- Warehousing and storage: salary of storekeeper, depreciation of equipment, fixed rental of buildings and equipment are irrelevant.
 - If space can be rented out, it should be included as opportunity cost.
 - Insurance cost should be included only when premiums are charged on fluctuating levels of stocks. Fixed annual insurance cost is not a relevant holding cost.
 - The opportunity cost of holding stocks is reflected in the required return from investment.
- Relevant ordering costs*

- Ordering costs consist of preparing a purchase order, receiving deliveries and paying invoices.
- To estimate variable cost of ordering, the number of orders placed is used.
- The cost of acquiring stock is not relevant as it remains unchanged irrespective of the order size or stock level. (except where quantity discounts are available – discussed later).
- Ordering and holding costs will change in relation to the order size, these will be relevant for decision making models.

Economic order quantity (EOQ)

- If more units are ordered at one time, fewer orders will be required per year. This will mean reduction in ordering cost.
- However, when fewer orders are placed, larger average stocks must be maintained, this leads to an increase in holding stocks.

- The optimum order size is one where the total amount of ordering and holding costs are minimized. This is known as the Economic Order Quantity (EOQ)

Example - EOQ

- A company purchases a raw material from an outside supplier at a cost of Rs 9 per unit. The total annual demand for this product is 40,000 units, and the following additional information is available.
- Required annual return on investment in stocks
(10% x Rs9) 0.9
- Other holding cost per unit 0.1
- Holding cost per unit 1.00
- Cost per purchase order 2.00

Determine optimal order quantity.

Example - EOQ

Order quantity	200 400 600 800
Average units in stock	100 200 300 400
Number of Purchase orders	200 100 67 50
Annual holding cost (Rs)	100 200 300 400
Annual ordering cost (Rs)	400 200 134 100
Total relevant cost(Rs)	500 400 434 500

The Economic Order Quantity (EOQ) is 400 units.
At this point the total annual relevant costs are at a minimum.

Note

No of Pos D/ order qty; Holding cost=avg stock*
Rs1 per unit

EOQ Graph

- Fig 25.1
- Please insert from Colin Drury book, 6th edition.

EOQ – formula method

- Economic order quantity can be found by applying a formula.
- The formula incorporates basic relationship between holding and ordering costs, and order quantities.
- Number of orders for a period is the total demand for the period (D) divided by the quantity in each order (Q).
- The ordering cost is obtained by multiplying the number of orders for a period by the cost per order (O).

EOQ – formula method

- Hence ordering cost is given by:

- $\frac{\text{Demand for the period}}{\text{quantity in each order}} \times \text{cost per order} = \frac{DO}{Q}$
- Holding costs will be the average stock ($Q/2$) multiplied by the holding cost per unit (H).
- $\frac{\text{quantity of order}}{2} \times \text{holding cost per unit} = \frac{QH}{2}$

image slide

- Hence ordering cost is given by:
- $\frac{\text{Demand for the period}}{\text{quantity in each order}} \times \text{cost per order} = \frac{DO}{Q}$
- Holding costs will be the average stock ($Q/2$) multiplied by the holding cost per unit (H).
- $\frac{\text{quantity of order}}{2} \times \text{holding cost per unit} = \frac{QH}{2}$

EOQ – formula method

- Total cost for any order qty (TC) = $\frac{DO}{Q} + \frac{QH}{2}$
- We can determine the minimum with respect to Q as $Q = \frac{2 DO}{H}$
 - Q: quantity ordered; D: demand for the period
 - O: cost per order; H: holding cost per unit

Assumptions of EOQ formula

- Holding cost per unit will be constant – additional storekeepers might be hired as the stocks increase beyond a certain level.
- Average stock balance is equal to one half of the order quantity i.e. constant amount of stock is consumed per day.
- Despite the approximations in the data, the calculation of EOQ is still likely to be useful.

Example - EOQ

- In the example discussed earlier, if we apply the formula method, the result is: _____

$$\text{Total cost TC for EOQ of 400 units} = \frac{DO}{Q} + QH$$

$$= \frac{40000 \times 2}{400} + 400 \times 1$$

$$= \text{Rs } 400.$$

Lecture 37 – Relevant holding costs*

- Warehousing and storage: salary of storekeeper, depreciation of equipment, fixed rental of buildings and equipment are irrelevant.
- If space can be rented out, it should be included as opportunity cost.

- Insurance cost should be included only when premiums are charged on fluctuating levels of stocks. Fixed annual insurance cost is not a relevant holding cost.
- The opportunity cost of holding stocks is reflected in the required return from investment.
- `<iframe width="425" height="349" src="http://www.youtube.com/embed/jHZTIEPpOCA" frameborder="0" allowfullscreen></iframe>`

Note: EOQ – vehicles at a petrol station filling petrol; people at ATM machines drawing cash; scene of warehouse operation

Relevant ordering costs*

- Ordering costs consist of preparing a purchase order, receiving deliveries and paying invoices.
- To estimate variable cost of ordering, the number of orders placed is used.

- The cost of acquiring stock is not relevant as it remains unchanged irrespective of the order size or stock level. (except where quantity discounts are available – discussed later).
- Ordering and holding costs will change in relation to the order size, these will be relevant for decision making models.

Economic order quantity (EOQ)

- If more units are ordered at one time, fewer orders will be required per year. This will mean reduction in ordering cost.
- However, when fewer orders are placed, larger average stocks must be maintained, this leads to an increase in holding cost.
- The optimum order size is one where the total amount of ordering and holding costs are minimized. This is known as the Economic Order Quantity (EOQ).

Example - EOQ

- A company purchases a raw material from an outside supplier at a cost of Rs 9 per unit. The total annual demand for this product is 40,000 units, and the following additional information is available.
- Required annual return on investment in stocks
(10% x Rs9) 0.9
- Other holding cost per unit 0.1
- Holding cost per unit 1.00
- Cost per purchase order 2.00
- Determine optimal order quantity.

Example - EOQ

Order quantity	200	400	600	800
Average units in stock	100	200	300	400
Number of Purchase orders	200	100	67	50
Annual holding cost(Rs)	100	200	300	400

Annual ordering cost (Rs)	400	200	134	100
Total relevant cost(Rs)	500	400	434	500

The Economic Order Quantity (EOQ) is 400 units. At this point the total annual relevant costs are at a minimum.

EOQ Graph

- P 1079
- Fig 25.1
- Please insert from Colin Drury book, 6th edition.

EOQ – formula method

- Economic order quantity can be found by applying a formula.
- The formula incorporates basic relationship between holding and ordering costs, and order quantities.

- Number of orders for a period is the total demand for the period (D) divided by the quantity in each order (Q).
- The ordering cost is obtained by multiplying the number of orders for a period by the cost per order (O).
- Hence ordering cost is given by:
- $\frac{\text{Demand for the period}}{\text{quantity in each order}} \times \text{cost per order} = \frac{DO}{Q}$
- Holding costs will be the average stock (Q/2) multiplied by the holding cost per unit (H).
- $\frac{\text{quantity of order}}{2} \times \text{holding cost per unit} = \frac{QH}{2}$
- Total cost for any order qty (TC) = $\frac{DO}{Q} + \frac{QH}{2}$
- We can determine the minimum with respect to Q as $Q = \sqrt{\frac{2DO}{H}}$

- Q: quantity ordered; D: demand for the period

O: cost per order; H: holding cost per unit

Assumptions of EOQ formula

- Holding cost per unit will be constant – additional storekeepers might be hired as the stocks increase beyond a certain level.
- Average stock balance is equal to one half of the order quantity i.e. constant amount of stock is consumed per day.
- Despite the approximations in the data, the calculation of EOQ is still likely to be useful.

Example of eoq

- In the example discussed earlier, if we apply the formula method, the result is: _____

$$\text{Total cost TC for EOQ of 400 units} = \frac{DO}{Q} + \frac{QH}{2}$$

$$= 40000 \times 2/400 + 400 \times 1/2$$

$$= \text{Rs } 400.$$

Lecture 38

Optimum lot size for a production run

- The EOQ formula can be adapted to determine the optimum length of the production run when set-up cost is incurred only once for each production run.
- Set-up costs include: labor, material, machine-down time and other related costs.
- Optimum number of units to be manufactured in each run involves balancing set-up costs with holding costs.
- To apply EOQ formula, simply substitute set-up costs for ordering costs.

- $Q = \frac{2DS}{H}$
- Assume annual demand D for a product is 9000 units. Labour and other expenses for production run require set-up cost of Rs 90. Holding cost is Rs 2 per unit per year. The EOQ model can be used to determine how many units should be scheduled for each run:
 $Q = \frac{2 \times 9000 \times 90}{2} = 900$
- With a demand of 9000, and production run of 900 units per run, there will be 10 production runs.
- If working days are 300 hundred each year, there should be a production run every 30 days.
- If demand is 9000 then 30 units are required each day, (divided by 300 days) and if setup takes three days, production run should be started when stock level reaches 90 units.

Quantity discounts*

- Where firms are able to obtain quantity discounts for large purchase orders, the price per unit will differ, and this must be taken into account in the EOQ.
- The differences will arise as follows:
 - Saving in purchase price
 - Reduction in ordering cost,
 - Increase in holding cost from higher stock levels.

Example – discounts

- A company purchases raw materials at a cost of Rs 7 per unit. The total annual demand for this product is 9000 units. The holding cost is Rs 4 per unit and the ordering cost is Rs 5 per order.
- A quantity discount of 3% of purchase price is available for orders in excess of 1000 units.
- Should the company order in batches of 1000 units and take advantage of quantity discounts?

- Starting point is to calculate the EOQ, and then decide whether the benefits exceed the cost.
- $EOQ = \frac{2 \times 9000 \times 5}{4} = 150$ units
- Savings made if purchase is in batches of 1000 instead of 150 units:

– price: $3\% \times 63000$	1890
– ordering cost: $\frac{9000 \times 5}{1000} - \frac{9000 \times 5}{150}$	255
– Holding cost: $\frac{(1000 - 150) \times 4}{2}$	-1700

The re-order point*

- To determine the re-order point, we must ascertain the lead time (the time taken between placing the order and delivery of stocks).
- The re-order point will be the number days in lead time multiplied by the daily usage during that period.
- For a manufacturer the re-order point is the level of finished goods stock at which production order should be issued.

- For materials and components, it is the time when the purchase requisition is initiated

Example – reorder point

- Assume annual usage of raw material is 6000 units, and weekly usage is constant.
- In 50 working weeks in a year, the weekly usage will be 120 units.
- If the lead time is 2 weeks, order should be placed when stocks fall to 240 units.
- EOQ can indicate how frequently the stock should be purchased.
- If $EOQ = 600$, and annual demand = 6000, ten orders will be placed every five weeks.
- However, with a lead time of two weeks, the firm will place an order three weeks after the first delivery, when the stock will have fallen to 240 units. (600 units EOQ less three weeks usage at

120 units per week). The order will then be repeated with five weekly intervals.

- The EOQ model can therefore be used to indicate when to replenish stock and the amount to replenish.
- ## Safety stocks*

- Safety stocks are the amount of stocks that are carried in excess of the expected use during the lead time.
- This provides a cushion against running out of stocks because of fluctuations in demand.
- E.g lead time = 2 weeks, weekly usage = 120 units; re-order point will be 240 units.
- However, if weekly usage increases to 140 units during lead time, or lead time goes up to three weeks, the firm will fall short of stock.

Safety stocks

- Response of a firm may be to re-order at 420 units to allow 140 units usage for three weeks.
- This will consist of re-order point based on normal usage and lead time of 240 units, plus 180 units of safety stock. This covers the possibility that lead time and expected usage will be greater than projected.
- Thus re-order point is computed by adding safety stock to average usage during average lead time.
- Maintaining high safety stock will not be appropriate where the cost of holding the excessive stock is higher than the cost of stock-out.
- Stock-out costs are the opportunity cost of running out of stock. For finished goods, this will be the loss of contribution.
- The level should be set where the cost of stock-out plus the cost of holding the safety stocks are minimized.

Lecture 39

Control of stocks through classification*

- Large firms may have thousands of items to be stored. It is not possible to apply EOQ to all.
- Stocks should be classified and elaborate techniques applied to important categories.
- A common procedure is the ABC classification.
- An estimate is made of the total purchase cost of each item of stock for the period. Sales forecast is the basis for estimating quantities.
- A school with children in classrooms, different classes; a supermarket with different sections for different types of goods e.g. toiletries, household, confectionery...

Control of stocks through
classification*

- Each item is then grouped in decreasing order of annual purchase cost.
- Top 10% of items in terms of annual purchase cost are included in category A.
- Next 20% is B and the final 70% is C.
- If there are 10000 items, the top 1000 in terms of annual purchase cost are A.
- In practice it will be unnecessary to have elaborate controls on the 7000 C items.
- First division, second div and third div in college results. Show college, students receiving results, convocation ceremony.

Illustration – ABC categories*

- Stage 1: estimate annual purchase cost

Item	usage	price	purchase cost
1	60000	1.00	60,000
2	20000	0.05	1000
3	1000	0.10	100
4	10000	0.02	200
5	100000	0.01	1000
6	80000	2.00	160000

The list continues for all items

The analysis may look like:	items	%	Cost	%
Class A	1000	10	200000	77
Class B	2000	20	190000	19
Class C	7000	70	80000	8
	10000	100	1000000	100

Stage 2: group items, A top 10%, B 20%, C 70%

Other factors influencing order quantity
Top 30% account for approx 90% of value; 80-20 rule

- Shortage of future supplies:
 - Future supplies may be restricted due to import problems or transport difficulties etc.
 - In anticipation a firm may over order stocks to meet production needs.
- Future price increases:

- Supplier announces price increase at future date
- Firm may buy in excess of requirement
- Obsolescence
 - Stocks may be subject to obsolescence due to changes in technology, fashion, perishable goods.
 - purchases of small quantities and low stock may be appropriate

Steps to reduce safety stocks

- When demand is uncertain, safety stocks are likely to be high.
- Safety stocks may be reduced as follows:
 - New suppliers are identified who promise quicker and more reliable deliveries.
 - Existing suppliers pressurized for faster deliveries.

- The lower the average delivery time, the lower will be the safety stock, and the firm's investment in stocks.

Performance reporting

- Managers are likely to concentrate only on those variables that are measured.
- They will take action that will improve their performance rating, even if not always in the best interest of the company.
- If annual holding costs are not allocated to managers, they may be induced to obtain larger order sizes. Consequently less frequent production runs will occur.
- This will reduce annual cost charged to the manager.
- This situation can be avoided by charging holding costs to the relevant manager.

Materials Requirement Planning (MRP)

- In complex manufacturing environments, the demand for materials purchases is dependent on the volume of planned output of components and sub-components.
- They include raw materials which have to be purchased.
- Materials requirement planning (MRP) is a computerized approach for coordinating the planning of materials acquisition and production.

MRP

- The major feature of MRP is that it involves an estimation of the quantity and timing of finished goods; and then uses this to determine the requirements for components / sub-components at each stage of production.

- The aim of MRP is to generate a planned coordinated schedule of materials requirement for a specified time period.
- It takes into account scheduled receipts, projected target stock levels, and items allocated to production, but not yet drawn.

MRP and EOQ

- The EOQ model can be used within the MRP systems to determine economic quantity sizes to be purchased.
- Care should be taken to ensure that assumption of EOQ model of constant demand applies broadly.
- MRP has later been extended to management of all manufacturing resources, including machine capacity planning and labor scheduling.

Lecture 40
JIT purchasing arrangements

- The goals of JIT include:
 - Eliminating non value added activities
 - A batch size of one, and
 - Zero inventories
- JIT philosophy has been extended to the purchasing function.
- JIT techniques seek to ensure delivery of material immediately precedes their use.

JIT

- Improved service is obtained by giving more business to fewer suppliers, and placing long-term purchase orders.
- Major feature of JIT purchasing is that suppliers are not selected on the basis of price alone.
- Performance on quality, delivery as needed and commitment to JIT are vital

Other advantages of JIT

- Include:
 - significant quantity discounts
 - Savings in time from negotiating with fewer suppliers.
 - Reduction in clerical work from issuing long-term orders.
- By seeking to ensure that production and purchases are timed to coincide with demand, the determination of EOQ and re-order point are no longer required.

Example – Relevant Costs and Optimum Batch-size

- Ferozee Ltd manufactures an item called badam, the annual demand is 4000 units spread evenly throughout the year.
- Production takes place 4 times a year in batches of 1000 units.
- One raw material input for badam is the unnab, also manufactured by Ferozee.

- Unnab is produced in large quantities and there is sufficient production capacity.

The standard costs of producing badams and unnabs are:

	Badam	Unnab
Raw materials	13	8
Unnab standard cost	22	
Labor – unskilled	7	4
- skilled	9	5
Variable overheads	5	3
Fixed overheads	<u>4</u>	<u>2</u>
Standard Cost	<u>60</u>	<u>22</u>

Included in fixed costs for badam are the set up costs for each production run.

Cost per set up are:

Labor costs – skilled labor	66
machine parts	<u>70</u>
total	<u>136</u>

There are no set up costs of unnab.

Example – Relevant Costs and Optimum Batch-size

- The cost of financing stocks of badams is 15%.

- Each unit requires 0.40 square meters of storage space. Warehouse rent is Rs 20 p.a. per sq m. Ferozee only pays for storage space actually used.
- Idle payment is made to all except unskilled labor, these are paid only for work carried out.
- *Required (a) Show optimum batch size for badam. Calculate savings if different from current policy.*

Solution Optimum batch size $Q = \frac{2DS}{H}$

- Relevant cost of production of badam is:

– Raw materials	13	
– Unnab std cost – raw mat	8	
– unskilled lab	4	
– variable overheads	<u>3</u>	15
– Unskilled labor	7	
– Variable overheads	<u>5</u>	
Incremental cost of production		40

- Annual demand of badams is 4000 units
- Set up cost = Rs 70 (skilled labor Rs 66 is fixed)

- Annual holding cost is Rs 14 (storage Rs 8 + capital tied up in stock Rs 6).
- Storage: .4 sq m x Rs 20 = Rs 8
- Capital cost: 15% x Rs 40 = 6
- Applying the formula:

$$Q = \text{square root of } \frac{2 \times 4000 \times 70}{14}$$

$$= 200 \text{ units}$$

Cost savings

· Current policy:

– Set up cost (4 x 70)	280	
– Holding cost (1000/2 x 14)	<u>7000</u>	7280

Optimum policy:

Set up cost (4000/200 x 70)	1400	
Holding cost (200/2 x 14)	<u>1400</u>	<u>2800</u>

Example (cont) Quantity discount

Annual savings

4480

- The second stock item is the product jamun, this is purchased for resale and annual demand of 10000 units is spread evenly throughout the year.
 - Incremental ordering costs are Rs 100 per order and normal unit cost is Rs 20.
 - Suppliers of jamun are offering quantity discounts as follows:
- | | |
|--------------------------|------|
| · Qty ordered – upto 999 | 20 |
| · 1000 – 1999 | 19.8 |
| · 2000 and above | 19.6 |
- Holding costs for jamun are Rs 8 per unit per year.
 - Required (b) What is the correct order size for jamun

Solution

$$O = 2DO / H$$

$$= \frac{2 \times 10000 \times 100}{8} = 500 \text{ units}$$

Comparison with savings from discounts at 19.80

– Savings in price: $(10000 \times .2)$ 2000

– Savings in ordering cost:
 $(10000/1000 \times 100) - (10000/500 \times 100)$ 1000

total savings 3000

Additional holding cost: $1000 - 500/2 \times 8 = 2000$

Savings from order size of 1000 at 19.8 = 1000

Quantity discount

· Discount for 2000 units at 19.60

– Savings in price $(10000 \times .4)$ 4000

– Savings in order cost
 $(10000/2000 \times 100) - (10000/500 \times 100)$
1500

– Total savings 5500

– Additional holding cost:

$$(2000 - 500)/2 \times 8 = 6000$$

Additional cost is higher than savings.

Ferozee should purchase batches of 1000 at a price of Rs 19.80

Lecture 41

Application of Linear programming*

- We established that where a scarce resource exists, the contribution per unit of the scarce resource should be calculated.
- The resource should then be allocated to different products on the basis of this contribution per unit. This will maximize profits.
- Where more than one scarce resource exists, the optimum production program cannot be easily established by the above process.

Example – 2 scarce resources

The ZB company produces 2 products. The standards per unit of product are as follows:

	Product BB	Product MB
Standard selling price	110	118
Less variable standard costs:		
- Materials (BB - 8@4; MB 4@4)	32	16
- Labor (BB 6hrs@10; MB 8hrs@10)	60	80
- Variable overhead (BB 4hr@1; MB 6hr@1)	4	6
Variable cost	<u>96</u>	<u>102</u>
Contribution	<u>14</u>	<u>16</u>

During the next period, labor hrs will be restricted to 2880 hrs. Marketing estimates maximum potential for BB sales is 420 units.

Example ...

- Product BB yields a contribution of Rs 14 and uses 6 scarce labor hrs. Hence contribution is Rs 2.33 per labor hr. Similarly, contribution per labor hr of MB is 2.
- Company should therefore allocate scarce labor hrs to manufacture of BB. Since BB sales are limited to 420 units, 2520 labors hrs will be used. (420 x 6).
- Remaining 360 hrs will be allocated to MB, as one unit requires 8 hours, 45 units of MB will be produced
- Profits will be maximized when firm produces 420 BB and 45 MB.
- Total contribution will Rs 6600 as follows:

420 units of BB at contribution of Rs 14	5880
45 units of MB at contribution of 16	<u>720</u>
Total contribution	<u>6600</u>

Two resource constraints

- Let us assume that both BB and MB use a common item of material, and supply of this material is restricted to 3440 units in the next period.
- There are now two scarce resources, labor and materials. Contribution per unit of scarce resource will be as follows:

	Product BB	Product MB
– Labor	2.33(14 / 6hr)	2.00(16 / 8hr)
– Materials	1.75 (14 / 8)	4.00(16 / 4)

BB has higher contribution per labor hr, and MB has higher contribution per unit of material.

Linear programming

- Linear programming is a mathematical technique that can be applied to the problem of rationing limited resources among alternative uses in such a way that optimum benefits can be derived.

- It seeks to find a feasible combination of output that will maximize or minimize the objective function.
- The objective function usually takes the form of maximizing profits or minimizing costs.
- Assumptions of linearity:
- Contribution per unit for each product, utilization of resources per unit are the same whatever quantity of output is produced. This applies within the range being considered.
- Units produced and resources are divisible. We may see an optimal plan for production of 194.38 units, this will be interpreted as 194 units.

Example – linear programming

- The procedure to follow is:
- First formulate the problem algebraically, with Y denoting the number of units of product BB, and Z denoting the number of units of product MB.

- Secondly we must specify the objective function, which in this example is to maximize contribution (C).
- This is followed by the input constraints.
- We can now formulate the linear programming model as:
- Maximize $C = 14Y + 16Z$, subject to:
- $8Y + 4Z \leq 3440$ (material constraint)
- $6Y + 8Z \leq 2880$ (labor constraint)
- $4Y + 6Z \leq 2760$ (machine capacity constraint)
- $0 \leq Y \leq 420$ (maximum sales)
- $Z \geq 0$ (no maximum limitation)

Graphical method

- When no more than 2 products are manufactured, the graphical method can be used, but it becomes impractical where more than 2 products are involved.

- *Materials constraint*: when $Y=0$; $Z=860$
when $Z=0$; $Y=430$
- A straight line is plotted with Y the vertical axis and Z the horizontal axis, at $Z=0$, $y=430$ to $Y=0$, $Z=860$.
- The area to the left of the line $8Y + 4Z \leq 3440$ contains all possible solutions for Y and Z regarding materials

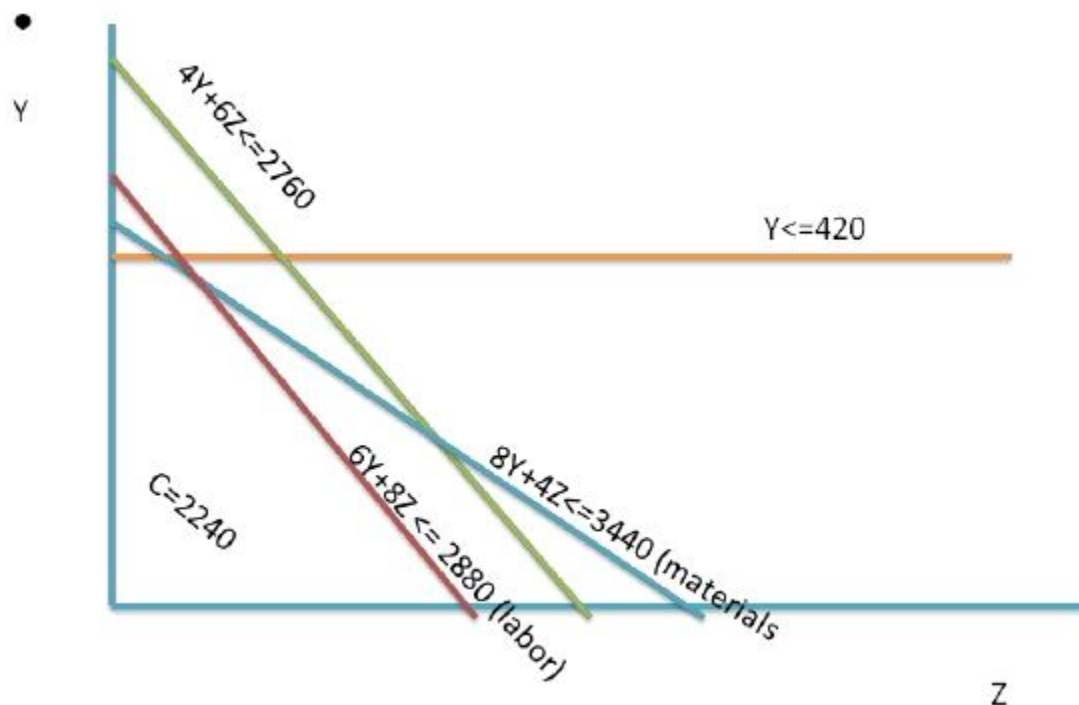
The Labor Constraint

- The labor constraint $6Y+8Z\leq 2880$ indicates when production of $Z=0$, production of Y will be 480 ($2880/6$), and if the output of $Y=0$ then production of Z will be 360 ($2880/8$).
- We can now draw a second line $Y=480$, $Z=0$ to $Y=0$, $Z=360$
- Area to the left of the line $6Y+8Z\leq 2880$ represent all possible solutions for labor.

The Machine Input Constraint

- This constraint is represented by $Z=0$, $Y=690$ and $Y=0$, $Z=490$.
- The line indicating the constraint is $4Y+6Z \leq 2760$. Area to the left of this line represents all possible solutions for machine capacity.
- The final constraint is the sales output constraint represented by the line $Y \leq 420$.

Graphical Illustration



Lecture 42 – The solution

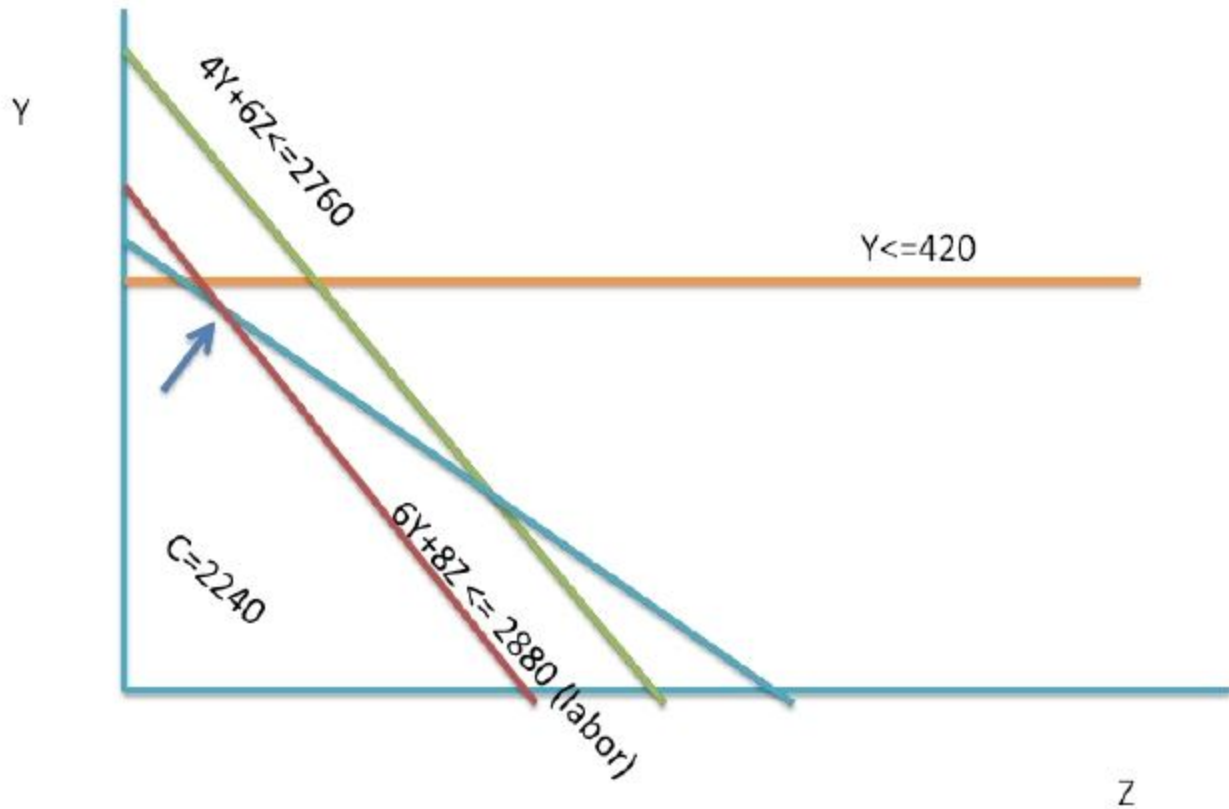
- The feasible area which fits all constraints can thus be identified.
- The point must now be found within the feasible area where contribution C is the greatest.
- The maximum will occur at one of the corner points of this area.

- The objective function $C=14Y+16Z$ line is drawn by using a random value for C, say 2240

The Objective Function

- Using the random contribution value 2240 (16×14), $14Y+16Z=2240$.
- If $Y=0$, $Z=140$ and $Z=0$, $Y=160$, we can now draw this as a dashed line.
- Each point on this line give the values of Y and Z that give a contribution of 2240.
- This objective function is moved to the right until it touches the last corner of the feasible area..

Graphical Illustration



Optimal solution

- At this point contribution C is maximum and this is the solution.

The optimal solution in the example indicates an output of 400 units of Y (contribution 5600) and 60

units of Z (contribution 960), giving total contribution of 6560

Optimal solution - algebraic

- The optimum output can be determined exactly by solving the simultaneous equations for the constraints that intersect at point C:
- $8Y + 4Z = 3440$
- $6Y + 8Z = 2880$, multiply the first equation by 2
- $16Y + 8Z = 6880$, subtract from the second
- $10Y = 4000$, $Y = 400$, substitute Y in the above
- $16 \times 400 + 8Z = 6880$, $Z = 60$

Uses of Linear Programming

- Calculation of relevant cost is essential for decision making.

- When a resource is scarce, alternative uses exist that provide a contribution.
- An opportunity cost is therefore incurred whenever the resource is used.
- The relevant cost for the scarce resource is calculated as:

Acquisition cost of resource + opportunity cost

Calculating relevant cost

- When more than one scarce resource exists, opportunity cost should be established using linear programming techniques.
- In the example of ZB company, the relevant costs of resources used are:
 - Materials 4.40 (4 acquisition + .4 opportunity)
 - Labour 11.80 (10 acqn + 1.80 opportunity)
 - Variable ohds 1.00 (1 acqn + 0 opportunity)
 - Fixed ohds nil (do not vary in the short run)

Variable overheads are assumed to vary with machine hours, which are not scarce, hence zero opportunity cost.

Selling different products

- Assume the company is contemplating selling a modified version of product Y (called product L) in a new market.
- The market price of L is Rs 160 and the product requires 10 units of each resource, labor, materials and overheads.
- Should the product L be manufactured?
- Product L can only be made by restricting output of Y and Z, because of input constraints.
- We need to know the opportunity cost of releasing the scarce resources.

Relevant information is:

Selling price

160

Materials (10x4.4)	44	
Labor (10x11.80)	118	
Variable overhead (10x1)	10	172
Contribution		-12

Total contribution is reduced by 12 for each unit of L.
Maximum payment for additional scarce resource

- Opportunity cost provides important information where a company can obtain additional resource but only at a premium.
- How much should the company be prepared to pay?
- For example the company may be able to remove the labor constraint by paying overtime.

Maximum payment

- Opportunity cost margin indicates that the company can pay upto an additional Rs 1.80 above the standard wage rate and still obtain a contribution from the use of labor.
- The total contribution will be improved by any additional payment below Rs 1.80 per hour.
- similarly ZB company will improve total contribution by paying upto Rs 0.40 in excess of the standard material cost for units obtained in excess of 3440 units.
- Hence the company will increase short-term profits by paying upto Rs 11.80 for each additional labor hr in excess of 2880 hrs and upto 4.40 for each unit of material in excess of 3440 units.

Control

- Opportunity costs are important for cost control.
- For example, material wastage is reflected in adverse material usage variance.

- The responsibility center should be identified not only with the acquisition cost of Rs 4 per unit, but also with the opportunity cost of Rs0.40 for the loss of one scarce unit of material.
- The process highlights the true cost of inefficient usage of scarce resources, and encourages responsibility heads to focus special attention on the control of scarce resources.

Lecture 43 – Capital Investment Decisions*

- Those decisions that involve current outlays in return for a stream of benefits in future years.
- Capital investment decisions are those decisions where a significant period of time elapses between the outlay and recoupment of the investment.

Capital investment decisions normally represent the most important decisions made by an organization, as

they commit a substantial proportion of available resources.

Point:

Investment in New plant, machinery; new products; new process, improvements/modernization of existing processes; vehicles, fork-lifters in warehouse

Capital Investment Decisions*

- A business firm's investment decisions include plant and machinery, research and development, advertising and warehousing facilities.
- Investment decisions in the public sector include new roads, schools and airports.

We will assume that all cash inflows and outflows are known with certainty, and sufficient funds are available to undertake all profitable investments.

Objectives of capital budgeting

- Determining :
 - which specific projects a firm should accept;
 - the total amount of capital expenditure which the firm should undertake;
 - Determining how the total amount of capital expenditure should be financed. However financing decisions will form part of the corporate finance course.
- Decisions should be evaluated on the basis of their expected contribution towards the goals of the organization.
- Theory of capital budgeting specifies that shareholder value is maximized where marginal cost is equal to marginal revenue.

- Marginal cost is represented by the marginal cost of capital, and marginal revenue is represented by the percentage return on investment.
 - Cost of capital means the cost of funds to finance the project.
- ## Opportunity cost of investment*

- The rates of return that are available from investment in the financial markets such as ordinary shares and government treasury bonds, represent opportunity cost of investment in capital projects.
- A firm should invest in capital projects if they yield a return in excess of the opportunity cost.
- The opportunity cost of investment is also known as the minimum required rate of return.

Concept of Net Present Value (NPV)

- By using discounted cash flow techniques and calculating present values, we can compare the return on an investment in capital projects with an alternative investment in the capital markets.
- NPV is the present value of the net cash inflows less the projects initial investment outlay.
- If the rate of return from the project is greater than the return on investment in the capital markets, the NPV will be positive. If it is lower, the NPV will be negative.
- Projects with positive NPVs may be accepted, whereas the negative NPV projects should be rejected.

Example - NPV

- The Bannu Company is evaluating two projects with an expected life of three years and an investment outlay of Rs 1million.
- The estimated net cash flows for each project are as follows:

	Project A	Project B
year 1	300,000	600,000
year 2	1,000,000	600,000
year 3	400,000	600,000
- The opportunity cost of capital for both projects is 10%. Calculate NPV for both.

NPV- project A

Year	Amount	discount factor	Present Value
1	300000	.91 $[1/1.10]$	272,730
2	1000000	.83 $[1/(1.10)_2]$	826,400
3	400000	.75 $[1/(1.10)_3]$	<u>300,520</u>
			1,399,650
	less initial outlay		1,000,000
	Net present value		399,650

NPV – project B

- When the cash flows are the same each year, that is an annuity, and the annuity factor is used instead of the discount factor.

Annual cash flow	annuity factor	PV
600,000	2.487	1,492,200
less investment cost		<u>1,000,000</u>
Net present value		492,200

The Internal Rate of Return (IRR)

- The internal rate of return is an alternative technique used in making investment decisions.
- The IRR represents the true rate earned on an investment over its economic life.
- IRR is that rate which gives the NPV = 0 for all cash inflows and out flows, when discounted.

- IRR can be found by trial and error, using different discount rates.

Calculation of IRR

- If we use a 25% discount rate for project A of The Bannu Company, we get a positive NPV of Rs 84,800.
- We apply a higher rate of 35% this gives a negative NPV of Rs 66530
- Hence NPV will be zero somewhere between 25% and 35%.
- In fact it is around 30%, where NPV = 4,540

Relevant Cash Flows

- Like other decisions, investment decisions should be based on cash flows that are directly attributable.
- These will be the incremental cash flows that occur if the project is accepted.
- They will include cash savings in current outflows.

- Depreciation is a non-cash expense and not included in the cash flows. The capital investment is included in the cash outflows, usually at the start of the project.

Timing of cash flows

- The calculation of NPV and IRR is based on the assumption that any cashflow in the future years will occur in one lump sum at the year end. Obviously this is unrealistic.
- More accurate method is to assume monthly cash flows and monthly discount rates.
- However annual cash flows are easier to handle and do provide a good estimate for most decisions.

Lecture 44 – Comparison of NPV and IRR

- In many situations of conventional projects, the IRR method and the NPV method will result in the same decision.
- Conventional projects are those where an initial cash outflow is followed by a series of cash inflows.
- This applies where the projects are independent of each other.
- However, there are situations where the IRR method may lead to a different decision from those given by the NPV method.

Mutually Exclusive Projects

- Mutually exclusive projects are those where acceptance of one project would mean exclusion of another. E.g the choice of a factory location, or one of many different machines.

Example

- The Bannu company is evaluating two mutually exclusive methods of improving marketing of its products, project X and project Y.

The estimated incremental cash flows are:

	Initial outlay	net inflow at end of yrs 1-3 yr 1	yr 2	yr3
Project X	700,000	343000	343000	343000
Project Y	1,200,000	552,000	552,000	552,000

The company's estimated cost of capital is 10%. Which project should the Company accept.

NPV and IRR calculations

	IRR (%)	NPV (Rs)
· Project X	22	153,041
· Project Y	18	172,824

- As can be seen, the IRR is higher for X, but the NPV is higher for Y.

- If the projects were independent, both would be accepted.
- Here the ranking is crucial since only one project can be accepted.

NPV vs IRR – incremental cash flows

One method must be indicating the incorrect ranking. In fact the IRR gives the incorrect ranking. This is proved as follows:

(all 000s)	0	1	2	3
Project Y	1200	552	552	552
Project X	700	343	343	343
Incremental	500	209	209	209

NPV vs IRR – incremental cash flows

- If the firm adopts IRR and chooses project X, we can consider whether it is worthwhile to add the hypothetical incremental investment (Y-X).
- This is the equivalent of accepting project Y.

- The IRR of the incremental investment (Y-X) is 12%. As the cost of capital is 10%, the incremental project should be accepted.
- IRR indicates we should move from project X to Y, hence NPV is a superior method.

Percentage returns

- Another problem with IRR is that the result is expressed as a percentage and not in monetary terms.
- Consider an investment of Rs 10,000 that yields a return of 50% compared to an investment of Rs 100,000 with a yield of 25%. One has a return of Rs 5000 and the other has a return of Rs 25000.

If the balance 90,000 from the first investment is invested at the cost of capital of 10%, the return would be 9000, and total return is 14000. Compare with a return of 25000 from the second investment.

Payback method

- This method ignores the time value of money, but it is frequently used in practice.
- It is defined as the length of time that is required for a stream of cash flow from an investment to recover the original amount invested.
- If the cash flow is not constant from year to year, payback period is determined by adding up the net cash flows in successive years until the total is equal the original investment.

Example – Payback period

- Cash flows and NPVs for 2 projects are:

	Project A	Project B
Initial cost	50000	50000
Net cash in flows:		
Year 1	10000	10000
Year 2	20000	10000
Year 3	20000	10000
Year 4	20000	20000
Year 5	10000	30000
Year 6	-	30000
Year 7	-	30000
	80000	140000
NPV @ 10%	10500	39460

Example – Payback period

- Project A pays back its initial investment cost in three years, whereas project B pays back its initial cost in four years, so project A would be preferred.
- Two obvious deficiencies:
 - Payback method does not take into account cash flows that are earned after the payback period.
 - Does not take into account the time value of money i.e. present values.

Payback period - advantages

- This method is easily understood and widely used in practice.
- It is a useful approach for ranking projects where a firm faces liquidity constraints.
- It is also appropriate in situations where risky investments are made in uncertain market.
- The payback method assumes that risk is time-related, and uses data in which managers have greater confidence.

Thus the payback period can be used as a rough measure of risk.

Accounting Rate of Return

- Also known as return on capital employed, is calculated by dividing the average annual profits from a project by the average investment cost.

- Profits rather than cash flows are used.
- Assuming depreciation represents the only non-cash expense, profit is equal to cash flow less depreciation.

Accounting Rate of Return

- When the average annual profits are calculated, only additional revenues and costs that follow from the investment are included in the calculation.
- The average investment figure that is used in the calculation depends upon the method of depreciation adopted.
- If straight line method is used, the average investment is half of the initial investment minus half the scrap value at the end of the project.

Lecture 45 –

Business ethics is an important part of any business activity. Students or managers, unfamiliar with many ethical challenges, or behaviors, will find themselves struggling in business areas that include finance, accounting or human resource management, marketing and retail.

Unethical behavior

- Today's managers must necessarily concern themselves with ethical issues, because unethical behavior creates legal risks and damage to businesses as well as employees and consumers.
- Business ethics have become an integral part of business education in general

Unethical behavior*

- A student or manager who is well-versed in ethical behavior in practices, not only in the domestic market but internationally, will find him or herself better prepared to deal with issues or situations that may arise that don't always involve easy answers or decisions.

Concept of values

Each one of us, from the individual consumer to the CEO of an international corporation, is affected in some way by business ethics during the course of his or her life. Therefore, everyone has a stake in the ramifications resulting from unethical business decisions.

Business ethics offers an introduction into the concept of values, morality, as well as culture, beliefs and upbringing in all areas of business, from consumer rights to corporate social responsibility.

Consumer's demand integrity

Decisions made by shift managers or corporate presidents may affect thousands of individuals or entire communities.

Consumers today expect and demand integrity, honesty, and transparency in all levels of their environment. Understanding those expectations is the key to communicating core values and behavior not only to employees, but society in general.

1: Introduction to Business Ethics

a. Definition

b. Role in various types of business structures

2: Why are Ethics in Business Important?

a. Define responsibilities and obligations

b. Good ethics means good business

3: Ethics in the Workplace

a. Small Business Ethics

b. Codes of Conduct

c. Code of Ethics

4: Corporate Responsibility

a. Definition – scope: shareholders, customers, suppliers, lenders, govt depts

b. Example

5: Corporate Compliance

a. Responsibility

b. Business accountability

6: Social Responsibility

a. Laws and regulations

b. Ethical Values

c. Environment

7: Consumer Rights

a. Expectations vs. Reality

b. A Bridge between Business and Society

8: Business Ethics and the Financial World

a. Various examples of Insider Trading,

- b. the financial crisis in the world
- c. Collapse and bankruptcy of major corporations.

9: Final Thoughts on Business Ethics

- a. Where would we be with (out) it?
- b. What If's?
- c. Conclusion

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