CHAPTER 4

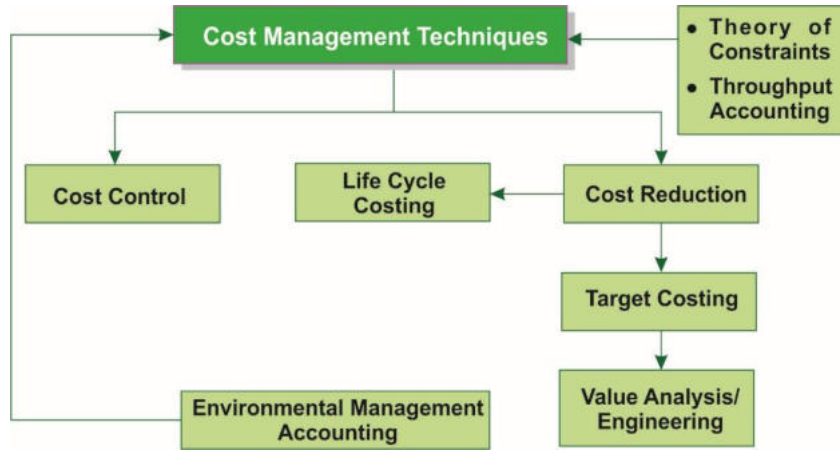
SPECIALIST COST MANAGEMENT TECHNIQUES

LEARNING OUTCOMES

After studying this chapter, you will be able to:

- ❑ IDENTIFY the costs involved at different stages of the life cycle
- ❑ DERIVE and EVALUATE life cycle cost, target cost
- ❑ ADVISE on the issues business face in the management of environmental costs

CHAPTER OVERVIEW



A. COST CONTROL/ WASTE CONTROL AND COST REDUCTION

Profit is a feature of the gap between sales and cost; hence it can be enhanced either by increasing the sales or reducing cost; & can also be maintained by controlling the cost. In the competitive business environment, it is not easy to increase sales; hence cost reduction or cost control, as the case may be, is available.

1. Cost Control

Cost control implies regulation of the cost of operation through the action of executives. It involves setting up the **targets** (yardstick) for managers who are responsible for cost centres and comparing their performance against such targets. Therefore, Cost Control involves continuous comparisons of actual with the standards or budgets to regulate the former.

1.1 Types of Targets

Target used for purpose of cost control can be either external or internal. The type of benchmarking (if applied by an organisation) plays a crucial role in making this decision. The prevailing techniques when target is established in-house include standard costing and budgetary control.

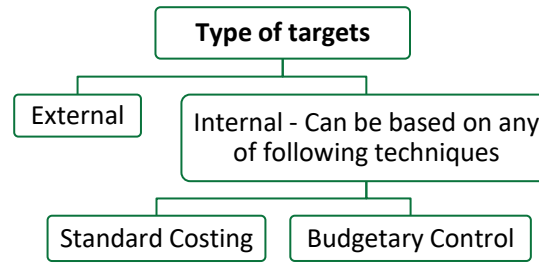


Figure A.1 – Type of Targets

1.2 Prerequisite of Cost Control

Crowningshield and Gorman in their book **Cost Accounting - Principles and Managerial Applications** identified six prerequisites of cost control and these are –

- Effective delegation of authority and assignment of responsibility for costs; simply means cost centre must be designated against the name of the manager responsible for it.
- An agreed plan that sets up objectives and goals to be achieved with celerity; simply means clearly defined targets.
- Motivation (may be finance linked or non-financial) to encourage individuals to reach the goals established and agreed.
- Timely and efficient reporting.
- The recommendations must be followed by action.
- An effective system of follow-up to judge the effective implementation of recommendation.

2. Cost Reduction

Cost reduction is the real and permanent reduction in the unit cost of goods manufactured or service rendered without impairing the utility for the intended use. Therefore, cost reduction is continuous effort to reduce cost through economics (standardization of product or component) and savings in costs of manufacture, administration, selling and distribution. It believes in reducing to cost till the optimal level rather any specified level such as standards or budget.

Concept Insight

- To identify the scope of cost reduction, a **cost reduction team** can be utilized, which shall act in guidance of well-defined programme comprising the details on areas to focus and estimated allocated time for each such area.
- A cost/benefit approach to a cost reduction programme is essential.
- Since the changes suggested by the cost reduction team are permanent in the nature hence application of ***change management*** become essential.

2.1 Scope of Cost Reduction

Some of the important area where maximum efforts of the organization must concentrate to reduce costs are discusses as under:

Product Design

Design of the product has a high possibility for cost reduction, because above 80% of production cost is committed at design phase only. Since designing of the product is the preliminary stage in the manufacturing of a product, hence the impact of any economy or cost reduction will be felt throughout the manufacturing life of the product.

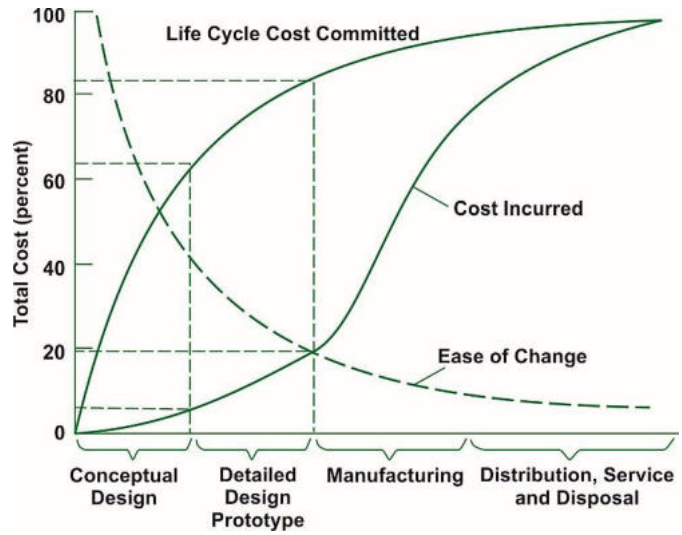


Figure A.2 – Life Cycle Committed Cost

Efficient designing for a new product or improving the design for an existing product can reduce the cost in the following manners:

- Cheaper substitute, higher yield and less quantity and varieties of materials, cause a reduction in cost.
- Reduced time of operation and increased productivity reduce cost.
- Standardization and simplification in variety increases productivity and reduces costs.

Organisation

It is not possible to measure the extent of the cost reduction resulting from an improvement in organisation nevertheless, economies are bound to be achieved if the following considerations are looked into:

- Definition of each function and responsibility.
- Proper assignment of task and delegation of responsibility to avoid overlapping.
- A suitable channel of communication between various management levels.
- Co-operation and close relationship between the various executives.
- Removal of doubts and fiction.
- Encouragement to employees for cost reduction suggestion.

Factory Lay Out Equipment

A cost reduction programme should study the factory layout and the utilisation of the existing equipment to determine whether there is any scope of cost reduction by elimination of wastage of men, materials and maximum utilisation of the facilities available.

The necessity for replacement of plants, introduction of new techniques or expansion of facilities should be considered, and various alternatives explored with a view to reducing costs.

Production Plan Programme and Method

Production control ensures proper planning of work by installing an efficient procedure and programme ordering correct machine and proper utilisation of materials, manpower and resources so that there is no waste of time and money due to waiting for components, men, material etc. An efficient cost reduction programme should examine the following points relating to production control.

- Whether wastage of manpower and material is kept to the minimum.
- Whether there is any scope for reducing idle capacity.
- Whether the procedures for the control of stores and maintenance services are efficient.
- Whether labour wastage may be reduced, and productivity increased by eliminating faulty production methods, plant layout and designs or introducing incentive schemes.
- Whether there is scope for reduction of overhead, whether a budgetary control system is in operation to ensure the control over overhead costs.

It may be extended to administrative, selling and distribution methods, personnel management, purchase and material control, financial management and other services.

2.2 Tools and Techniques

For Cost Reduction the following tools and techniques can be applied

- Value Analysis
- Inventory Management (e.g., Just in Time, Backflush)
- Business Process Reengineering
- Target Costing
- Kaizen Costing
- Standarisation of product, components etc.

Test Your Understanding

State what standardization of the components and the manners in which it will work out to reduce the cost?

Hint

Standardisation of component means using the same type of component for more than one product or all the products which any manufacturer is producing.

For example, if an automobile company manufactures cars of different models, it is possible to use only one type of door handle and wiper in all the models. Standardisation of the component can be benefits which may lead to cost reduction, major among them are-

- Economies of scale.
- Ease in inventory control.
- Ease for an operator who use this component for various purposes.

3. Difference between Cost Control and Cost Reduction

Cost Reduction	Cost Control
Cost Reduction is the achievement of a real and permanent reduction in the unit cost of products manufactured.	Cost Control involves a comparison of actual with the standards or budgets, to regulate the actual costs.
Realistic savings in cost, which are permanent too.	There could be temporary savings in cost.
Product's Utility, Quality and Characteristics are retained.	Quality Maintenance is not a guarantee.
Not observing standard cost or budget allocation as a yardstick	The process involves setting up a target, investing variances and taking remedial measures to correct them.
Continuous process of critical examination includes analysis and challenge of standards.	Control is achieved through compliance with standards. Standards by themselves are not examined.
A Fully dynamic approach.	Relatively less dynamic than Cost Reduction.
Universally applicable to all areas of business. Does not depend upon standards, though target amounts may be set.	Limited applicability to those items of cost for which standards can be set.
Emphasis here is partly on present costs and largely on future costs.	Emphasis on present and past behaviour of costs.
The function of Cost Reduction is to find out substitute ways and new means like waste reduction, expense reduction and increased production.	Cost Control does competitive analysis of actual results with established standards.

B. TARGET COSTING

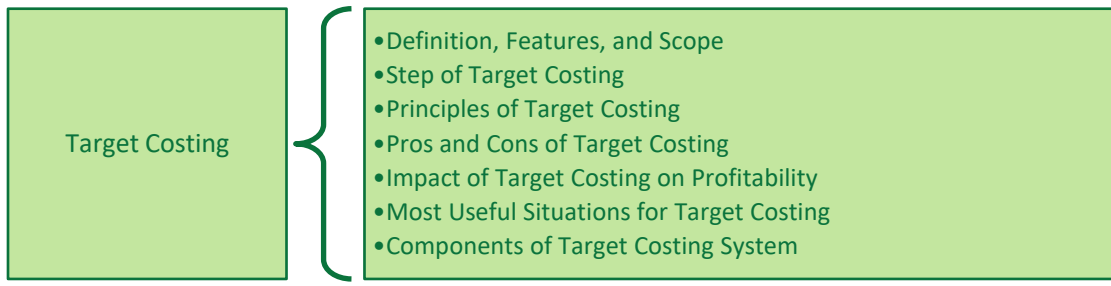


Figure B.1 – Overview of Target Costing

1. Definition, Features, and Scope

Target costing can be described as a process that occurs in a competitive environment, in which cost reduction is an important component of profitability. It is in practice since the 1970s in Japan.

Target costing can be defined as ***"a structured approach to determining the cost at which a proposed product with specified functionality and quality must be produced, to generate a desired level of profitability at its anticipated selling price"***.

Target costing is an important part of a comprehensive and strategic profit management system that helps an organization to survive, even in an increasingly competitive environment. Hence it is not only a product costing system, but rather a management technique that aims at reducing the overall cost of a product (over the entire life cycle) with the help of productivity, value engineering, and effectiveness at the research and design phase. So, target costing is *capable to take into account initial design and engineering costs, as well as cost of manufacturing, distribution, sales, and services.*

Note- *Target costing initiates cost management at the earliest stages of product development and applies it throughout the product life cycle by actively involving the entire value chain.*

Target costing is almost the exact opposite of cost-plus margin modeling where a company produces a product with no cost structure in mind. Once the product is built, they add a profit margin on top to arrive at the final price.

In Target costing, we first determine what price we think the consumer will pay for our product. We then determine how much of a profit margin we expect and subtract that from the final price. The remaining amount left is what is available as a budget to be used to create the product.

Test Your Understanding

Can you list a few limitations of the traditional cost-plus pricing model, which can be overcome by target costing?

Hint

It is really important to recognise the limitation of the traditional cost-plus pricing model to understand the scope and relevance of target costing.

The limitation includes-

- The ignorance of the price charged by competitor.
- The ignorance to the price which customer ready to pay and
- Cost control.

Illustration 1

Kowloon Toy Company (KTC) expects to successfully launch Toy "H" based on a Disney character. KTC must pay a 15% royalty on the selling price to Disneyland.

KTC targets a selling price of ₹100 per toy and profit of 25% on the selling price.

The following are the cost data forecast:

	₹/ toy
Component H_1	*8.50*
Component H_2	*7.00*
Labour: 0.40 hr. @ ₹60 per hr.	*24.00*
Product Specific Overheads	*13.50*

In addition to the above, each toy requires 0.6 kg of other materials, which are supplied at a cost of ₹16 per kg with a normal 4% substandard quality, which is not usable in the manufacture.

Required

DETERMINE if the above cost structure is within the target cost. If not, what should be the extent of cost reduction?

Solution

Target Cost "H"

	₹ / Toy
Target Selling Price	100.00
Less: Royalty @15%	15.00
Less: Profit @ 25%	25.00
Target Cost	60.00

Cost Structure "H"

	₹ / Toy
Component H_1	8.50
Component H_2	7.00
Labour (0.40 hr. × ₹60 per hr.)	24.00
Product Specific Overheads	13.50
Other Material (0.6 kg / 96% × ₹16)	10.00
Total Cost of Manufacturing	63.00

Currently, the expected cost is ₹63 against the target cost of ₹60. Company KTC should make efforts to **reduce the cost of H by ₹ 3** to achieve a target selling price of ₹100.

2. Step of Target Costing

The following are the steps to be performed while target costing applied. These steps will give insight into the features of the target costing too.

Step 1– **Re-orient culture of thinking and attitude**, so that importance must be given to market driven prices and the needs of customer can be prioritized rather than just technical requirements whenever the product will be developed.

Step 2– **Identify** the **market requirements** as regards design, utility, and need for a new product or improvements in the existing products. (Be customer-oriented while determining the requirements)

Note – *If dealing the multiple products, perform this exercise for all products.*

Step 3– **Establish** the **market-driven target price** based upon market share, the competition, the price charged by competitors, the elasticity of demand, and strategy.

Step 3A– **Determine** the **volume of product** to be produced that will be produced at the established market-driven target price.

Step 3B– **Establish** the **target profit margin** (for each product), based on the long-term objectives and considering the financing aspects.

Step 4– **Determine** the **target cost** by reducing the desired/required margin from market-driven target price. At this step, a work sheet needs to be prepared through which target cost needs to be allocated to different assemblies of the subsystem, which will be the responsibility of either team of or individual designer/s.

Step 4A– **Establish** a **balance between target cost and requirement**; target cost must be seen in conjunction with requirements of customers which was identified at step two to lock the target cost.

Step 5– **Establish** the **target costing process** (comprises the persons, their role & responsibilities and tool & techniques to be involved in the process of target costing)

Step 6– **Brainstorm and analyses the alternatives** to identify the opportunity to reduce the cost through consideration of the multiple concepts and design alternate for both the product and its manufacturing process at each stage of the development cycle.

Step 6A– **Establish product cost models** (along with cost table) for each concept and design alternate to support decision making. At early development stage model may be based upon analogy technique and as product and process become a more defined model used must be based upon industrial engineering or bottom-up estimating.

Step 7– Use the tools to **closing down the gap** between cost as determined by product cost model in step 6A and target cost locked in step 4A. Analysis of cost reduction target can be performed to identify cost reduction opportunities (both in design and layout of product and processes) using Value Engineering/ Value Analysis.

Test Your Understanding

Can you list the questions that a manufacturer must answer in order to close the gap?

Hint

The major questions which a manufacturer must answer to explore the opportunity for improvement are-

- Can the use of any materials be eliminated, or a cheaper material be substituted without affecting quality?
- Can labour savings be made without compromising quality or can productivity be improved by motivating them?
- Can production volume be increased to achieve economies of scale?
- Can a part or assembly components be bought in to save on assembly time?
- Can the incidence of the cost drivers be reduced, or cost savings be made by reviewing the supply chain?

Step 7A – **Reduce the indirect cost applications** – Re-engineer the indirect process by eliminating the non-value-added function to minimize the cost. Use Activity Based Costing (along-with knowledge of cost drivers) to understand how design decision impact these indirect costs (to explore the scope of avoidance).

Step 8 – **Measure the results and maintain management focus** on further possibilities of cost reduction as a continuous improvement program.

Note- *Step 6 and 6A has importance in the case of newly developed product rather than in case of existing products.*

Practical Insight

The deductive approach discussed in step 4 above is not the only approach, there is another approach of target costing which can be applied as an inside-out approach '**Additive Approach'**

A University Management Accounting Research Group found another approach that is additive instead of being deductive. It suggests that target cost can be calculated by adding up the costs function in a product for every product function. The starting point under this approach is the supplier or suppliers' supplier.

3. Principles of Target Costing

S Ansari, J Bell & Dan Swenson in the year 2006 in **A Template for Implementing Target Costing** developed a model in which target costing depends on achieving appropriate profit through planning, analyzing and studying both profitability and cost at the same time. It includes six main principles (as premise or dimension of target cost), which are enlisted below-

- Leadership of Target Selling Price.
- Focusing on Customer.
- Using and Developing Teamwork.
- Reduce the Cost of the Product Life Cycle.
- Focus on the Stage of Product Design.
- Attention to all Stages of the Value Chain.

4. Pros and Cons of Target Costing

4.1 Pros

- It reinforces top-to-bottom commitment to process and product **innovation**, and is aimed at identifying issues to be resolved, in order to achieve some competitive advantage.
- It uses management control systems to support and reinforce manufacturing strategies, and to identify market opportunities that can be converted into **real savings** to achieve the best value rather than simply the lowest cost.
- **A proactive approach** to cost management ensures proper planning well ahead of actual production and marketing.
- Implementation of target costing enhances employee awareness and empowerment. It also fosters partnership with suppliers.
- Encourages the adoption of **value- added activities** with higher pay-off and elimination of non-value- added activities to residual level.
- It **enhances product life** by reducing the time to market.
- Target Costing takes a **market-driven approach towards cost**, in which value is defined not only by what customers demand but also by what they are willing to pay for. This strategy introduces a discipline in which planning focus shifts to those costs that create value and meet the needs of the customer. By involving and educating customers, target costing provides a process that allows teams to make intelligent trade-offs between features, functionality, and cost, resulting in designs that are better suited to customer's quality and price expectations.

4.2 Cons

Although the result of target costing is clear and substantial in most cases, it still has a few shortcomings that one should be aware of and guard against. These are –

- ***The development process can be lengthened to a considerable extent only*** - since the design team may require a number of design iterations before it can devise an acceptable low-cost product that meets the target cost, margin criteria, and customers' specifications. This occurrence is most common when the project manager is unwilling to "pull the plug" on a design project that cannot meet its costing goals within a reasonable time frame. Usually, if there is no evidence of rapid progress toward a specific target cost within a relatively short period of time, it is better to either ditch a project or at least shelve it for a short time and then try again, on the assumption that new cost reduction methods or less expensive materials will be available in the near future that will make the target cost an achievable one.
- A large amount of mandatory cost-cutting **can *result in finger-pointing in various parts of the company***; especially if employees in one area feel they are being called on to provide a disproportionately large part of the savings.
- For example, industrial engineering staff will not be happy if it is required to completely alter the production layout in order to generate cost savings, while the purchase staff is not required to make any cost reductions through supplier negotiations. Avoiding this problem requires strong interpersonal and negotiation skills on the part of the project manager.
- Representatives from a number of departments on the design team can sometimes make it more ***difficult to reach a consensus on the proper design*** because there are too many opinions regarding design issues.
- This is a major problem when there are particularly stubborn people on the design team who are holding out for specific product features. Resolving out is difficult and requires a strong team manager, as well as a long-term commitment on the part of a company to weed out those who are not willing to act in the best interests of the team.
- Effective implementation ***requires the development of detailed cost data***. This can be really costly and may not be profitable for the company when a detailed cost-benefit analysis is done.
- Use of target costing ***may reduce the quality of products*** due to the use of cheap components which may be of inferior quality.
- Based upon innovation, also involves a great amount of ***forecasting*** *and* ***estimation***. A substantial portion of information is market-led, hence highly ***dynamic*** in nature.

Note- *For every problem area outlined above, there is one dominant solution and that is 'retaining the strong control over the design teams, which calls for a* ***good team leader****. The team must be in the form of a matrix of cross-functional experts. This person must have exceptional knowledge of the design process, good interpersonal skills, and a commitment to staying within both time and cost budgets for a design project.*

Case Scenario

Kaveri Ltd. (KL) is a manufacturer of bikes in India, and it sells them in India and outside India. KL has just launched the World's smallest and most affordable bike called 'Zingaroo'. The bike is mounted with all-aluminum, single cylinder, air cooled, and 99.2 cc engine. The engine makes just over 8 bhp power and 8 Nm of torque, but it stakes claim to be the fuel-efficient bike, with a claimed figure of 88 kmpl. It has been creating competition for two wheelers as none of the Indian companies as well as foreign companies, offer a bike for such a competitive price within the reach of middle-class families.

KL has adopted the target costing technique in manufacturing this bike. For KL, maintaining the target price was difficult. During the designing and production process of bikes, input costs increased frequently. However, KL designed various components especially for bikes to maintain the target price. Though, one curiosity about how this can be done in the future when input costs are bound to increase further.

Many environmentalists have opposed the manufacture of this bike, because they believe that mass production of the small bike (about 2.5 lakh bike every year) will create heavy pollution. Many people believe that this small bike is not up to the safety standards due to its lightweight and use of aluminum and plastic frames. The design of this bike is entirely different from that of other bikes. This also causes doubt that the existing bike mechanics would be able to repair it or not. The durability of the bike is another issue in the Indian environment. Further, the performance of 'Zingaroo' more or less depends upon the condition of roads and traffic systems.

After the launch of 'Zingaroo', many other national and international automobile companies are also planning to manufacture small bikes which will create tough competition in near future.

Required

Now you being a strategic performance analyst of KL, answer the following questions:

(i) IDENTIFY strategy which KL has adopted for 'Zingaroo' bike?

(ii) After adopting target costing, IDENTIFY issues and challenges faced by KL and suggest remedial action to be taken to solve these issues?

Solution

(i) KL has adopted *Low-Cost Strategy* for "Zingaroo" bike since it is the most affordable bike.

(ii) The issues and challenges faced by KL and their remedial action are as follows:

Maintaining of Target Price

'Zingaroo' bike is one of the world's cheapest and smallest bike. Maintaining target-price proved to be a big challenge for the KL since input cost of the bike is bound to increase further in the future. The initial value engineering may not uncover all possible cost savings. Thus, Kaizen Costing may be designed to repeat many of the value engineering steps for as long as a bike is produced, constantly refining the process and thereby stripping out extra costs.

Environmental Issues

Many environmentalists have opposed the manufacture of bike as they believe that mass production of small bikes will create heavy pollution since automobile pollution is already a big problem for a country like India. For this issue, 'Zingaroo' bike can be prepared based on BS emission norms. These norms restrict the pollution created by any motor vehicle.

Safety Issues

Since 'Zingaroo' bike is made of aluminium and plastic frames so this may also create safety issues for the customers. For such issues, KL should meet safety standards. Further, KL should make people aware that 'Safety is Primary'/ 'Drive Safely'.

Servicing/ Repairing Facilities

The design of 'Zingaroo' bike is entirely different from that of other bikes. This causes doubt that the existing bike mechanics would be able to repair or not. For such a problem, the creation of a good network of service centers can be a solution i.e. repair center should be established on the required places.

Durability

Durability of 'Zingaroo' bike is another issue in the Indian environment. The performance of a bike more or less depends upon the condition of roads and traffic systems. For such issues, tyre quality and hydraulic brake system should be compatible with the roads and traffic system.

Global Competition

After the launch of 'Zingaroo', many other national and international automobile companies are also planning to manufacture a small bike, which will be a big challenge for the KL in the near future. To face such competition, it may adopt the Kaizen Costing technique. The cost reductions resulting from Kaizen Costing are much smaller than those achieved with Value Engineering but are still worth the effort since competitive pressures are likely to force down the price of 'Zingaroo' over time, and any possible cost savings allow KL to still attain its targeted profit margins while continuing to reduce cost.

5. Impact of Target Costing on Profitability

Target costing can have a startlingly large positive impact on profitability, depending on the commitment of management to its use, the constant involvement of management accountants in all stages of a product's life cycle, and the type of strategy a company follows. Target costing improves profitability in two ways.

- It places ***continuous emphasis on product costs throughout the life cycle*** of every product, and the management is completely aware of costing issues since it receives regular reports from the management accounting members of all design teams.
- It improves profitability through ***precise targeting of the correct prices*** at which the company feels it can field a profitable product in the marketplace that will sell in a robust manner. This is opposed to the more common cost-plus approach under which a company builds a product, determines its cost, tacks on a profit and then does not understand why its resoundingly high price does not attract buyers. Thus, target costing results not only in better cost control but also in better price control.

Note- If any organisation constantly issues a stream of new products, or if its existing product lines is subject to severe pricing pressure, it ***must make target costing a central part of its strategy.***

If the shortcomings (highlighted in the previous heading) of target costing are dealt with by a management team, it will find that target costing is one of the best management accounting methods available for improving profitability.

6. Most Useful Situations for Target Costing

Target costing is most useful in those situations where a substantial amount of product costs is locked (committed) during the product design phase. This is a common feature of a product to be manufactured, but rare in the case of services. In the services area, such as consulting, the bulk of all activities can be reconfigured for cost reduction when services are being provided directly to the customer. In the services environment, the "design team" is still present but is more commonly concerned with streamlining the activities conducted by the employees providing the service, which can continue to be enhanced at any time, not just when the initial services process is being laid out.

Target costing may not be for everyone, the two cases illustrated below where the utility of target is not at the maximum level.

Target Costing & Fast-Food Restaurant
The design team can lay out the floor plan of a fast-food restaurant, with the objective of creating an arrangement that allows employees to cover the shortest possible distances while preparing food and serving customers; this is similar to the design of a new product. However, unlike a product design, this layout can be readily altered at any time if the design team can arrive at a better layout, so that the restaurant staff can continue to experience high levels of productivity improvement even after the initial design and layout of the facility. In this situation, costs are not locked in during the design phase, so there is less need for target costing.
Target Costing & Chemical Production Industry
Another situation where target costing results in less value is the production of raw materials, such as chemicals. In this case, there are no design features; instead, the industrial engineering staff tries to create the most efficient possible production process, which has little to do with cost reduction through the improvement of customer value.

Companies, with following features expected to gain maximum from target costing –

- Assembly-oriented industries.
- Involved heavily with the diversification of the product lines.
- Use technologies of factory automation, including computer-aided design, flexible manufacturing systems, office automation, and computer-aided manufacturing.
- Have experienced shorter product life cycles where the pay-back for factory automation typically must be achieved in less than eight years.
- Must develop systems for reducing costs during the planning, design, and development phases.
- Are in the process of implementing management methods such as just-in-time, value engineering.

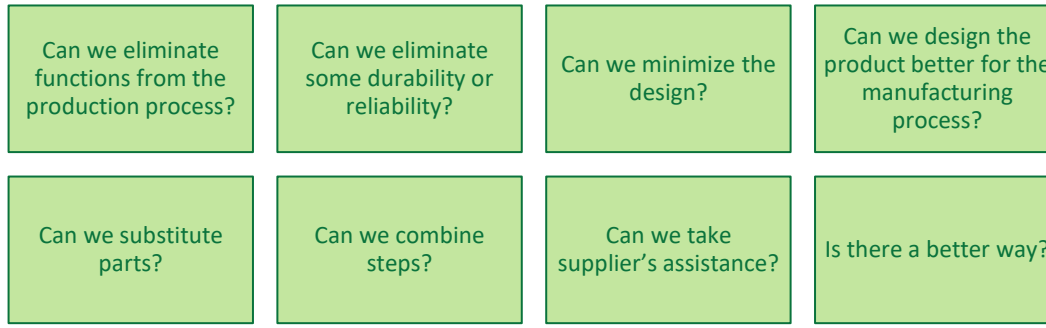
Note- *The above listing is not completely exhaustive as a variety of factors are at work to promote the utility of target costing.*

7. Components of Target Costing System

Typically, the total target is broken down into its various components, each component is studied and opportunities for cost reductions are identified. These activities are often referred to as Value Analysis (VA) and Value Engineering (VE).

Value Analysis[1] *is a planned, scientific approach to cost reduction which reviews the material composition of a product and production design so that modifications and improvements can be made which do not reduce the value of the product to the customer or to the user.* ***Value Engineering*** *is the application of value analysis to new products. Value engineering relates closely to target costing as it is cost avoidance or cost reduction* ***before production****. Value analysis is cost avoidance or cost reduction of a product already in production; both adopt the same approach i.e. a complete audit of the product.*

Here are some of the issues that are dealt with during a Value Analysis/ Value Engineering review:



- **Can we eliminate functions from the production process?**

  This involves a detailed review of the entire manufacturing process and ***determines the non-value-added activities***. By eliminating them, one can take their associated direct or overhead costs out of the product cost. However, these functions were originally put in for a reason, so the team must be careful to develop work-around steps that eliminate one or more activities from the original set of functions and be sure enough that eliminating these activities will not hamper the value- added activities in any manner.

- **Can we eliminate some durability or reliability?**

  It is possible to design an excessive degree of sturdiness into a product. For example, a vacuum cleaner can be designed to withstand a 1-ton impact, although there is only the most vanishing chance that such an impact will ever occur; designing it to withstand an impact of 100 pounds may account for 99.999% of all probable impacts, while also eliminating a great deal of structural material from the design. However, this concept can be taken too far, resulting in a visible reduction in durability or reliability, so any designs that have had their structural integrity reduced must be thoroughly tested to ensure that they meet all design standards.

[1] Value Analysis, Functional Analysis, Value Engineering and Target Costing by Norwood Whittle

- **Can we minimize the design?**

  This involves the creation of a design that ***uses fewer parts or has fewer features***. This approach is based on the assumption that a minimal design is easier to manufacture and assemble. Also, with fewer parts to purchase, less procurement overhead is associated with the product. However, reducing a product to extremes, perhaps from dozens of components to just a few molded or prefabricated parts, can result in excessively high costs for these few remaining parts, since they may be so complex, or custom made in nature that it would be less expensive to settle for a few extra standard parts that are more easily and cheaply obtained. Also, a proper trade-off between price and quality is necessary in this context.

- **Can we design the product better for the manufacturing process?**

  Also, known as design for manufacture and assembly, this involves the ***creation of a product design*** that can be created in ***only a specific manner***. For example, a toner cartridge for a laser printer is designed so that it can be successfully inserted into the printer only when the sides of the cartridge are correctly aligned with the printer opening; all other attempts to insert the cartridge will fail. When used for the assembly of an entire product, this approach ensures that a product is not incorrectly manufactured or assembled, which would call for a costly disassembly or (even worse) product recalls from customers who have already received defective goods.

- **Can we substitute parts?**

  This approach encourages the ***search for less expensive components or materials*** that can replace more expensive parts currently used in a product design. It is becoming an increasingly valid approach since new materials are being developed every year. However, sometimes the use of a different material impacts the types of materials that can be used elsewhere in the product, which may result in cost increases in these other areas, for a net increase in costs. Thus, any parts substitution must be accompanied by a review of related changes elsewhere in the design. This step is also known as component parts analysis and involves one extra activity—tracking the intentions of suppliers to continue producing parts in the future; if parts will not be available, they must be eliminated from the product design.

- **Can we combine steps?**

  A detailed review of all the processes associated with a product sometimes reveals that some steps can be consolidated, which may mean that one can be eliminated (as noted earlier) or that several can be accomplished by one person, rather than having people in widely disparate parts of the production process perform them. This is also known as ***process centering***. By combining steps in this manner, we can eliminate some of the transfer and queue time from the production process, which in turn reduces the chance that parts will be damaged during these transfers.

- **Can we take supplier's assistance?**

  Another approach to value engineering is to call on the services of a company's suppliers to assist in the cost reduction effort. These organizations are particularly suited to contribute information concerning enhanced types of technology of materials, since they may specialize in areas that a company has no information about. They may have also conducted extensive value engineering for the components they manufacture, resulting in advanced designs that a company may be able to incorporate into its new products. Suppliers may have also redesigned their production processes or can be assisted by a company's engineers in doing so, producing cost reductions or decreased production waste that can be translated into lower component costs for the company.

- **Is there a better way?**

  Though this step sounds rather vague, it really strikes at the core of the cost reduction issue—the other value engineering steps previously mentioned focus on incremental improvements to the existing design or production process, whereas this one is a more general attempt to start from scratch and build a new product or process that is not based in any way on preexisting ideas. Improvements resulting from this step tend to have the largest favourable impact on cost reductions but can also be the most difficult for the organization to adopt, especially if it has used other designs or systems for the production of earlier models.

A mix of all the value engineering steps noted above must be applied to each product design to ensure that the maximum permissible cost is safely reached. Also, even if a minimal amount of value engineering is needed to reach a cost goal, one should conduct the full range of value engineering analysis anyway, since this can result in further cost reductions that improve the margin of the product or allow management the option of reducing the product's price, thereby creating a problem for competitors who sell higher-priced products.

The initial value engineering may not uncover all possible cost savings. Thus, ***Kaizen Costing*** is designed to repeat many of the value engineering steps for as long as a product is produced, constantly refining the process and thereby stripping out extra costs (already discussed in Chapter-3). The cost reductions resulting from kaizen costing are much smaller than those achieved with value engineering but are still worth the effort since competitive pressures are likely to force down the price of a product over time, and any possible cost savings allow a company to still attain its targeted profit margins while continuing to reduce cost.

The type of cost reduction program used for target costing has an impact on the extent of cost reduction, as well as on the nature of the components used in a product. When a design team elects to set cost reduction goals by allocating specific cost reduction amounts to major components of an existing product, it tends to focus on finding ways to make incremental cost reductions rather than focusing on entirely new product configurations that might both radically alter the product's design and lower its cost. This approach is most commonly used during the redesign of products already in the market. Another cost reduction approach is to allocate cost reductions based on the presence of certain product features in a product design. This method focuses the attention of the design team away from using the same components that were used in the past, which tends to produce more radical design changes that yield greater cost savings. However, the latter approach is also a riskier

one, since the resulting product concepts may not work, and also requires so much extra design work that the new design may not be completed for a long time. Therefore, the second method is generally reserved for situations where a company is trying to create products at a radically lower cost than previously.

Further, *Target Costing System is based on involving representatives of all the* ***Value Chain*** *such as suppliers, agents, distributors and existing after-sales service in the target costing system. This aim to spread concepts and efforts to reduce the cost over all the value chain through the development of the spirit co-operation and understanding among all members of organizations associated with the product from suppliers, producers, customers, agents and service providers. The target costing system is based on the concept of long-term relations and mutual benefits in the long term between suppliers and all members of representatives of all the value chain*[2].

All the changes noted in this section that are necessary for the implementation and use of the target costing methodology represent a massive change in mind-set for the product design personnel of any company because they require the constant cooperation of many departments and rapid, voluminous communications between them. All these concepts run counter to the traditional approach.

Illustration 2

Great Eastern Appliances Ltd. (GEAL) manufactures consumer durable products in a ***very highly competitive market****. GEAL is considering launching a new product 'Kitchen Care' into the market and gathered the following data:*

Expected Market Price……..₹ 5,000 per unit

Direct Material Cost……₹ 1,850 per unit

Direct Labour Cost……..₹ 80 per hour

Variable Overhead Cost……₹ 1,000 per unit

Packing Machine Cost (specially to be purchased for this product)…₹ 5,00,000

GEAL expects the selling price for the new product will continue throughout the product's life and a total of 1,000 units can be sold over the entire lifetime of the product.

Direct labour costs are expected to reduce as the volume of output increases due to the effects of 80% learning curve (index is -0.3219). The expected time to be taken for the first unit is 30 hours and the learning effect is expected to end after 250 units have been produced. Units produced after first 250 units will take the same time as the 250th unit.

Required

(i) CALCULATE the expected total labour hours over the lifetime of the product 'Kitchen Care'.

(ii) CALCULATE profitability of product 'Kitchen Care' that GEAL will earn over the lifetime of the product.

[2] The Relationship between Target Costing and Competitive Advantage, International Journal of Business and Management Vol. 7, No. 8; April 2012)

(iii) CALCULATE average target labour cost per unit over the lifetime of the product if GEAL requires an average profit of ₹ 800 per unit, to achieve its long-term objectives.

(iv) Implementation of the target costing technique requires intensive marketing research. Why intensive marketing research is required to implement target costing technique? COMMENT.

Note: $250^{-0.3219} = 0.1691$, $249^{-0.3219} = 0.1693$

Solution

(i) Calculation of 'Total Labour Hours' over the Lifetime of the Product 'Kitchen Care'

The average time per unit for 250 units is

$$Y_x = ax^b$$
$$Y_{250} = 30 \times 250^{-0.3219}$$
$$Y_{250} = 30 \times 0.1691$$
$$Y_{250} = 5.073 \text{ hours}$$

Total time for 250 units = 5.073 hours × 250 units = 1,268.25 hours

The average time per unit for 249 units is

$$Y_{249} = 30 \times 249^{-0.3219}$$
$$Y_{249} = 30 \times 0.1693$$
$$Y_{249} = 5.079 \text{ hours}$$

Total time for 249 units = 5.079 hours × 249 units = 1,264.67 hours

Time for 250th unit = 1,268.25 hours – 1,264.67 hours = 3.58 hours

Total Time for 1,000 units = (750 units × 3.58 hours) + 1,268.25 hours

= 3,953.25 hours

(ii) Profitability of the Product 'Kitchen Care'

Particulars	Amount (₹)	Amount (₹)
Sales (1,000 units)		50,00,000
Less: Direct Material	18,50,000	
Direct Labour (3,953.25 hours × ₹80)	3,16,260	
Variable Overheads (1,000 units × ₹1,000)	10,00,000	31,66,260
Contribution		18,33,740
Less: Packing Machine Cost		5,00,000
Profit		13,33,740

(iii) Average 'Target Labour Cost' *per unit*

Particulars	Amount (₹)
Expected Sales Value	50,00,000
Less: Desired Profit (1,000 units × ₹800)	8,00,000

Target Cost	42,00,000
Less: Direct Material (1,000 units × ₹1,850)	18,50,000
Variable Cost (1,000 units × ₹1,000)	10,00,000
Packing Machine Cost	5,00,000
Target Labour Cost	8,50,000
Average Target Labour Cost *per unit* (₹8,50,000 ÷ 1,000 units)	850

(iv) Target cost is the difference between the estimated selling price of a proposed product with specified functionality and quality and the target margin. This is a cost management technique that aims to produce and sell products that will ensure the target margin. It is an integral part of the product design. While designing the product, the company needs to understand what value target customers will assign to different attributes and different aspects of quality. This requires the use of techniques like *value engineering* and *value analysis*. Intensive marketing research is required to **understand customer preferences** and **the value they assign** to each attribute and quality parameter. This insight is required to be developed before the product is introduced. The company plays within the space between the maximum attributes and quality that the company can offer and the minimum acceptable to target customers. Therefore in the absence of intensive marketing research, the target costing technique cannot be used effectively.

Case Scenario

Queenstown Wood Co. (QWC) began 20 years ago, as a small family-run business supplying custom-made school furniture. Now QWC has grown into a thriving hub of experts specializing in either custom-made, locally sourced or quality imported commercial grade furniture. The newly appointed CFO is concerned about the trends in dropping sales volumes, increasing costs, and hence falling profits over the last three years. He observed that the reason of these trends is increased cut-throat competition that has emerged over the last three years. For many years, QWC has been known for high quality but now this quality is being matched by the competitors. QWC's share of the market is declining due to equivalent products being sold by competitors at lower prices. It is considered that, to offer such low prices, the furniture's production costs of the competitors must be lower than QWC's.

Required

ADVISE how QWC can improve its sales volumes, costs and profits using Value Analysis and Functional Analysis.

Solution

Value Analysis is viewed as a reduction in cost and problem-solving technique. Such technique analyses an *existing product* to identify and cutback or eliminate any cost which do not give any contribution to performance or value. It is a planned, scientific approach to cost reduction which reviews the *material composition* of a product and *production design* so that modifications and improvements can be made which do not reduce the value of the product to the customer or to the user. (i.e., quality for purpose should not be compromised.)

Functional analysis is applied to the design of *new products* and breaks the product down into functional parts. For example, a new chair may have a moveable feature. The value that the customer places on each feature is considered and added to give a target cost. Thus, functional analysis aims to increase profits by reducing costs through elimination of *unnecessary features* and/or by adding cost-effective *new features* that are so *attractive to customers* that the product becomes more lucrative.

The result of the above analysis is to improve the value of the furniture while maintaining costs and/or cut back the costs of the furniture without compromising with value. It is clear from the scenario that QWC needs to cut back its selling prices to compete in the market. This selling price reduction can only be possible through a reduction in QWC's unit costs; however, such reduction must not be accomplished by compromising with quality. Both value analysis and functional cost analysis may be used for QWC; however, value analysis is likely to be a more useful technique because office tables and chairs are such items which are demanded more on the basis of their use value rather than their esteem value.

C. LIFE CYCLE COSTING

The term life cycle can be used in reference to industry, product, and customer; but life cycle costing is largely connected with product.

Life cycle costing is a system that identifies and accumulates the actual costs and corresponding revenues, attributable to cost object, from its inception to abandonment. Life cycle costing aims to maximize the profit that a product is able to generate over its life, using the strategies which are the best complement to the features of each stage of the life cycle.

1. Product Life Cycle

Each product has a life cycle, which may vary from a few days to months to several years depending upon the aging process of product. The product life cycle is a pattern of types of cost, amount of expenditure, quantum and value of sales and amount of profit over the stages from conceiving the idea till the deletion of product from the product range.

The life cycle of any product consists of **four phases,** which are –

- Introduction (market development or launch)
- Growth
- Maturity
- Decline

Note- *It is important here to note that the abovementioned phases are based upon the marketing of the product. In reality, there is one additional phase which takes place prior to the introduction of the product to market i.e., Product development phase (in which R&D related to product take place). But from academic aspects it is merged into the introduction phase only.*

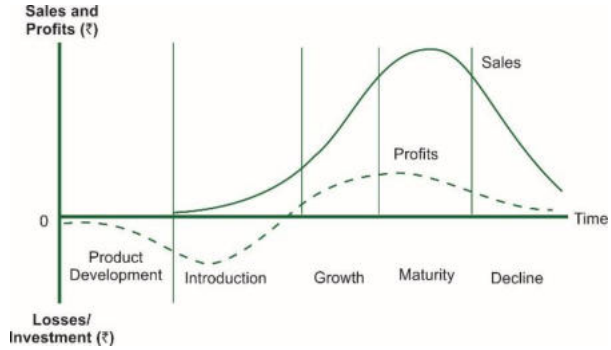


Figure C.1 – Stages of Product Life Cycle

Note- *It is equally important to note that,* ***Raymond Vernon*** *defines five phases in a product's life cycle with respect to the Product Life Cycle Theory, which he developed in response to the failure of the Heckscher-Ohlin model to explain the observed pattern of international trade. These phases are Introduction, Growth, Maturity,* ***Saturation****, and then Abandonment.*

It is really important to consider the features of each of four phases and best fit strategies, prior to developing understating on life cycle costing.

1.1 Stage I: Introduction Stage

Stage one is where the new product is launched in the market. As the product is novel, there is minimal awareness and acceptance of it. Competition is almost negligible, and profits are non-existent. The length of the introduction stage differs from product to product depending on various factors.

Characteristics

Decisions about the product branding, packaging and labelling	High distribution and promotional expenses	Profits are low or negative due to low initial volume
Pricing may be low-penetration or high-skimming pricing	Huge efforts to attract various marketing channels	Aggressive promotional efforts to increase awareness
Product refinements are not possible	Few competitors produce basic version of products	Focus on those buyers who are the most ready to buy

Strategies

- Attracting customers by raising awareness of the product through promotional activities.
- Inducing customers to try and buy the product.
- Strengthening or expanding channel and supply chain relationships.
- Building on the availability and visibility of the product that boost channel intermediaries to support the product.
- Setting price in alignment with the competitive realities of the market.

1.2 Stage II: Growth Stage

The next stage in the product life cycle is the growth stage. Sales are beginning to expand rapidly because of greater customer awareness. Competitors often enter the market in large numbers. As a result of competition, profit starts declining near the end of the growth stage.

Characteristics

Strategies

- Establish a clear brand identity through promotional campaigns.
- Maintain control over product quality to assure customer satisfaction.
- Maximize availability of the product through strong distribution channel.
- Find the ideal balance between price and demand as per price elasticity.
- Overall strategy shifts from acquisition to retention of customers, from motivating product trial to generating repeat purchases and building brand loyalty.

- Development of long-term relationships with customers and partners for the maturity stage.
- Value-based pricing strategies may be considered.
- Leverage the product's *perceived* differential advantages to secure a strong market position.

1.3 Stage III: Maturity Stage

During the stage of maturity sales continue to increase, but at a decreasing rate. When sales level off, profits of both producers and middlemen decline. The main reason is intense price competition; some firms extend their product lines with new models. This stage poses difficult challenges.

Characteristics

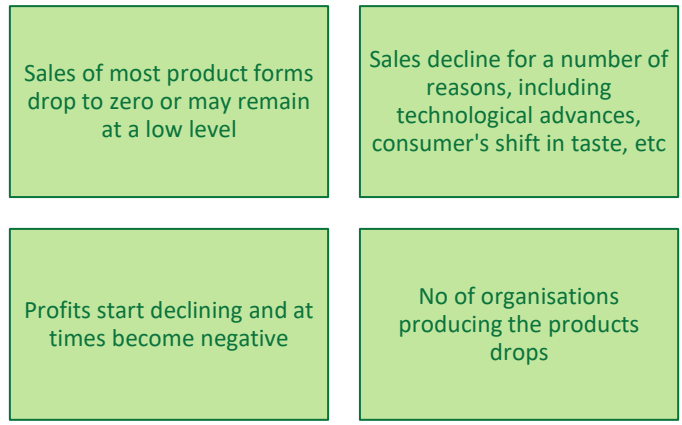
Strategies

- Strong marketing efforts are needed to win over the competitor's customers.
- Product features may be improved or enhanced to differentiate the product from that of the competitors.
- Prices may have to be reduced to attract the price-sensitive consumers.
- Various sales promotion incentives are necessary for the consumers as well as dealers to maintain their interest in the product.
- Distribution becomes more intensive, and incentives may be offered to encourage product over competing products.

1.4 Stage IV: Decline Stage

A decline in sales volume characterizes this last stage of the product life cycle. The need or demand for products disappears. The availability of better and less costly substitutes in the market accounts for the arrival of this stage.

Characteristics



Strategies

- The product can be maintained in the market by differentiation, keeping low cost for some more time by adding certain new features and finding new uses.
- The firm can continue to offer the product to its loyal customers (niche segment) at a reduced price.
- The firm can even discontinue the product.
- Use the product as replacement product for launching another new product successfully in the market.
- The various marketing decisions in the decline stage will depend on the fact that it is being revived, or given a new lease of file, or left unchanged if it is being liquidated.
- The price may be maintained or reduced drastically if liquidated.

Life Cycle Characteristics[3]

	Introduction	Growth	Maturity	Decline
Objectives	Create product awareness & trial	Maximise market share	Maximise profits while defending market share	Reduce expenditures & milk the brand
Sales	Low sales	Rapidly rising	Peak sales	Declining sales
Costs per Customer	High cost per customer	Average cost per customer	Low cost per customer	Low cost per customer
Profits	Negative	Rising profits	High profits	Declining profits
Customers	Innovators	Early adopters	Middle majority	Laggards
Competitors	Few	Growing number	Steady number beginning to decline	Declining number

Strategies[3]

	Introduction	Growth	Maturity	Decline
Product	Offer basic product	Offer product extensions, service & warranty	Diversify brands and models	Phase out weak items
Price	Cost plus profit	Price to penetrate market	Price to match or beat competitors	Price cutting
Advertising	Build product awareness amongst early adopters & dealers	Build awareness & interest in mass market	Stress on brand differences and benefits	Reduce level to keep hard core loyalty
Distribution	Build selective distribution	Build Intensive distribution	Build more intensive distribution	Go selective: Phase out unprofitable outlets
Sales Promotion	Use heavy sales promotion to entice trial	Reduce to take advantage of heavy consumer demand	Increase to encourage brand switching	Reduce to minimal level

[3] Stages- Characteristics/ Strategies: Marketing Strategy, Text and Cases By O. C. Ferrell, Michael Hartline; Principles of Marketing By Philip Kotler

Practical Insight

Maruti 800 (SS80 with 800 cc F8B engine)

Maruti 800 is a small city car that was manufactured by Maruti Suzuki in India from 1983 to 2014. With life cycle of over 31 years (of production), Maruti 800 remains the second longest production car in India, next only to Hindustan Ambassador. About 2.87 million 800s were produced during its course of which 2.66 million were sold in India itself.

Introduction Stage (1983-1986)

- First Car imported and sold in 1983.
- Cheapest car in the market.
- Huge gap between demand and supply, it took them 3 years to clear the waitlist.

Growth Stage (1986-1998)

- Ensure people's expectations match product promise – Second generation launched (SB 308).
- Increase in production and sales.
- Increase in profits.
- Competition started getting stiffer - Tata Motors entered the passenger vehicle market in 1988 (In 1998 Tata launched the first fully indigenous Indian passenger car 'Indica') & In 1994 General Motor India start producing and selling Opel branded vehicles & Ford India began production in 1998 of Ford Escort model (later become Ford Ikon).

Maturity Stage (1998-2004)

- Sales touched 200000 units in 1999.
- It remained the best-selling car in India until 2004, when the Maruti Alto took the title.

Decline Stage (2004-2014)

- Drastic decrease in sales, Able to sell Just 33028 units in 2009-2010.
- Maruti Suzuki did not have plans to upgrade it to Euro IV or BS-IV emission norms.
- In April 2010 starts working on phase-out and halted the sale of car in 13 cities including all 4 metros.
- The last Maruti 800 was rolled off the production lines on 18 January 2014.
- Successor is Maruti Alto 800.

Test Your Understanding

*Can you see any connection between the **BCG matrix** and stages of product life cycle?*

Hint

Introduction → Question Mark; Growth → Star; Maturity → Cash Cow; Decline → Dog

2. Characteristics of Product Life Cycle

The major characteristics of the product life-cycle concept are as follows:

- The products have **finite lives** and pass through the cycle of development, introduction, growth, maturity, decline, and deletion at **varying speeds**.
- Product cost, revenue, and profit patterns tend to follow **predictable courses** through the product life cycle. Profits first appear during the growth stage and after stabilizing during the maturity stage, decline thereafter to the point of deletion.
- **Average cost and Profit per unit vary** as products move through their life cycles.
- Each stage of the product life cycle poses **different threats and opportunities** that give rise to **different strategic actions**.
- Products require **different functional emphasis** in each stage-such as an R&D emphasis in the development stage and a cost control emphasis in the decline stage.
- Finding new uses (**product extension**) or new users (**market extension**) or getting the present users to increase their consumption may extend the life of the product.

3. Benefits of Product Life Cycle Costing

The benefits of the product life cycle costing are summarized as follows:

- The product life cycle costing results in ***earlier actions to generate revenue or to lower costs*** than otherwise might be considered. There are a number of factors that need to be managed in order to maximise return on a product.
- Better decisions should follow from a ***more accurate and realistic assessment of revenues and costs***, at least within a particular life cycle stage.
- Product life cycle thinking can promote ***long-term rewarding*** in contrast to short-term profitability rewarding.
- It provides an ***overall framework for considering total incremental costs over the entire life span of a product*****,** which in turn facilitates analysis of parts of the whole where cost effectiveness might be improved.
- It is an approach used to provide a ***long-term picture of product line profitability*****,** feedback on the effectiveness of life cycle planning and cost data to clarify the economic impact of alternatives chosen in the design, engineering phase etc.
- It is also considered as a way to enhance the ***control of manufacturing costs***. The thrust of product life cycle costing is on the distribution of costs among categories changes over the life of the product, as does the potential profitability of a product. Hence it is important to track and measure costs during each stage of a product's life cycle.
- Product life cycle costing ***traces research and design and development costs*** etc., incurred to individual products over their entire life cycles, so that the total magnitude of these costs for each individual product can be reported and compared with product revenues generated in later periods.

Test Your Understanding

Can you list the factors which are capable to maximise a product's return over its lifecycle?

Hint

- Value Engineering at the design phase to commit the cost as low as possible.
- Reduce the time to get into the market.
- Maximise the life cycle of the product – especially extent the growth phase as much as possible.

4. Uses of Product Life Cycle (PLC)

- As a **Planning tool**, it characterizes the marketing challenges in each stage and poses major alternative strategies, i.e., application of kaizen.
- As a **Control tool**, the PLC concept allows the company to measure product performance against similar products launched in the past.
- As a **Forecasting tool**, it is less useful because sales histories exhibit diverse patterns, and the stages vary in duration.

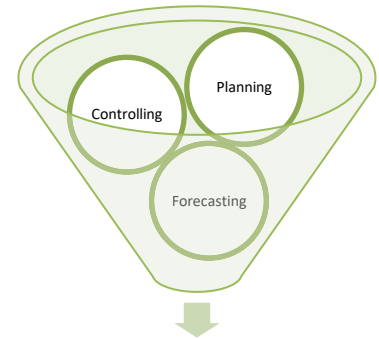


Figure C.2 – Uses of Product Life Cycle

Illustration 3

In WM Ltd. the 'OB' equipment is about to be replaced either by 'CF' system or by an 'OF' system. Finance costs 12% a year and the other estimated costs are as follows:

	CF (₹)	OF (₹)
Initial Cost	28,000	40,000
Annual Operating Costs	24,000 p.a.	18,000 p.a.

Required

If the company expected the new system (either CF or OF) to last at least for 12 years, which system should be chosen? COMMENT.

Solution

Calculation of Life-cycle Costs

	CF (₹)	OF (₹)
Initial Cost	28,000	40,000
Add: Present value of annual operating costs over the lifetime	1,48,656 (₹ 24,000 x 6.194)	1,11,492 (₹ 18,000 x 6.194)
Total Life Cycle Costs	1,76,656	1,51,492

The annuity factor of 12% finance costs for 12 years is 6.194.

Analysis

When we compare only the initial cost, we will tend to purchase CF system, for its cheap acquisition cost. But when we compare the total life-cycle costs, the OF system is most preferable, for its lowest total life-cycle costs.

Illustration 4

Lite Limited willing to inculcate life cycle costing in its costing system. Product manager define the phases of the product as Design, Manufacturing, Operations, and End of life; Can you assist the management accountant to LIST the type of cost which will be significantly incurred at Lite limited under identified four phases?

Solution

Although the four phases are Introduction, Growth, Maturity, and Decline, It may be possible for any organisation to customise the model as per their need and wisdom to analyse the cost and corresponding revenue over the life of the product.

Type of Costs, Lite Limited is expected to incure during different stages

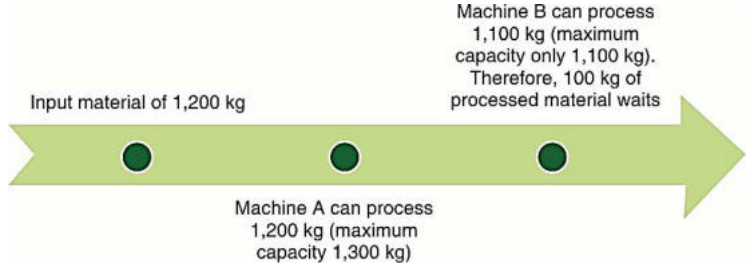
Phase/Stage	Cost
Design	Research, Development, Design & Testing
Manufacturing	Material, Labour, Overheads, Machine Set-up, Inventory, Training, Production Machine, Maintenance, and Depreciation
Operation	Distribution, Advertising, and warranty claims
End of Life	Environmental Clean-up, Disposal and Discommissioning

Note *– The above categorisation of cost is purely based upon significance %age of the cost incurred, it may possible that certain category of the cost incurred over more than one phase of the life cycle. For example, product development cost needs to be incurred in each phase till maturity phase, earlier for creation and then for differentiation (even in decline phase too with intent to product extension)*

D. THEORY OF CONSTRAINTS[4]

During the 1980s Goldratt and Cox advocated a new approach to production management called optimised production technology (OPT). OPT is based on the principle that profits are expanded by increasing the throughput of the plant. The OPT approach determines what prevents throughput being higher by distinguishing between bottleneck and non-bottleneck resources. This approach advocates that *bottleneck resources/activities should be fully utilised while non-bottleneck resources/activities should not be utilized to 100% of their capacity since it would result in an increase in inventory.*

Example–Machine A capacity is to process 1,300 kg of material per hour and then the processed material goes to Machine B for further processing. Machine B capacity is to process 1,100 kg of material per hour. Of an input of 1,200 kg, 100 kg of processed material must wait on the bottleneck machine (machine B) at the end of an hour of processing. So for each hour of processing 100 kg of partly processed material accumulates.



The traditional view is that machines should be working continuously, not sitting idle. o if the desired output from the above process were 10,800 kg, machine A would be kept in continual use and all 10,800 kg would be processed through the machine in nine hours. There would be a backlog of 900 kg [10,800 - (9 hrs × 1100)] of partly processed material in front of machine B. All this materialwould require handling cost and storage space and create the additional costs related to these non-value added activities. Its processing would not increase throughput contribution. In fact, working capital will also be blocked.

The concept behind the system was first formulated and developed by Goldratt and Core (1986) in USA. Goldratt developed the concept and eventually gave it the name the Theory of Constraints (TOC).

1. Operational Measures of Theory of Constraints

The theory of constraints focuses on revenue and cost management when faced with bottlenecks. It advocates the use of three key measures. These are:

Core Measures	Definition
Throughput (T)	▪ Throughput as a TOC measure is the rate of generating money in an organization through Sales. ▪ Throughput = (Sales Revenue – Unit Level Variable Expenses)/ Time ▪ Direct Labour Cost is viewed as a fixed unit level expenses and is not usually included.

[4] Cost Management: Accounting and Control By Don Hansen, Maryanne Mowen, Liming Guan; Management and Cost Accounting By Colin Drury

Investment (I)	▪ This is money associated with turning materials into Throughput and do not have to be immediately expensed. ▪ Includes assets such as facilities, equipment, fixtures and computers.
Operating Expense (OE)	▪ Money spent in turning Investment into Throughput and therefore, represent all other money that an organisation spends. ▪ Includes direct labour and all operating and maintenance expenses.

Based on these three measures, the objectives of management can be expressed as increasing throughput, minimizing investment and decreasing operating expenses.

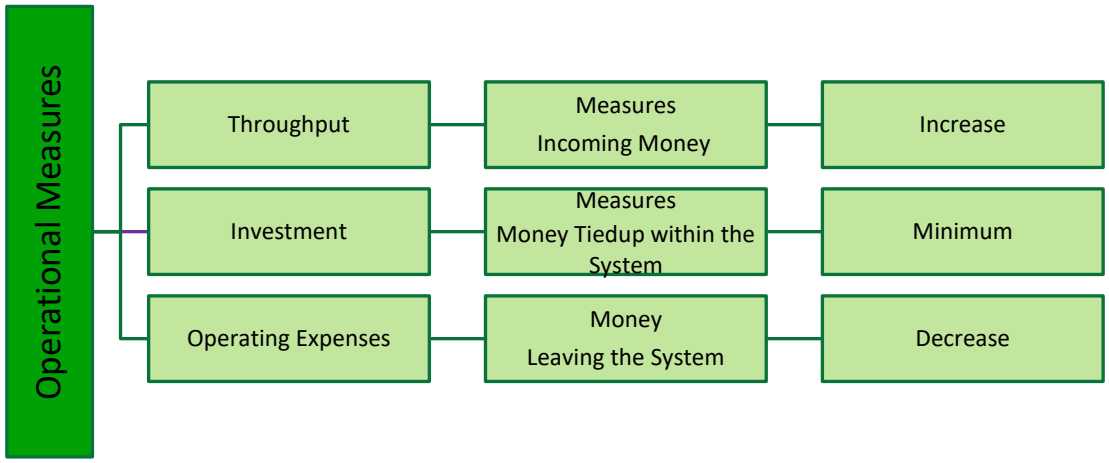


Figure D.1 – Operational Measures

2. Goldratt's Five-Step Method for Improving Performance

The theory of constraints describes the process of identifying and taking steps to remove the bottlenecks that restrict output. The theory of constraints considers short-run time horizons and assumes other current operating costing to be fixed costs. The key steps in managing bottleneck resources are as follows:

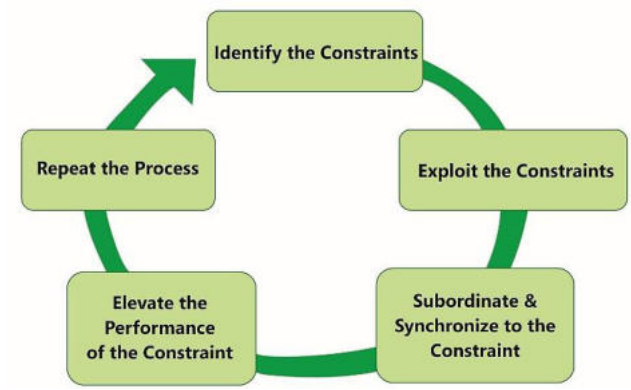


Figure D.2 – Goldratt's Five Step

1. **Identifying the System Bottlenecks:** This step involves identification of constraints which restrict output from being expanded.
2. **Describe How to Exploit the Bottlenecks:** Having identified the bottlenecks it becomes the focus of attention since only the bottleneck can restrict or enhance the flow of products. It is therefore essential to ensure that the bottleneck activity is fully utilised. Decision regarding the optimum mix of products to be produced by the bottleneck activity must be made.
3. **Subordinate Everything Else to the Decision in Step-2:** This step requires that the *optimum production of bottleneck activity should determine the production schedule of the non-bottleneck activities*.

   Let us consider an organisation dealing with a product which requires multiple parts and is processed on different machines. With multiple parts in a product, dependencies arise among operations; some operations cannot be started until parts from previous operations are available. Waiting time appear for two reasons:

   - Parts that require processing at a bottleneck machine must wait in line until the bottleneck machine is free, and
   - Parts made on non-bottleneck machines must wait until parts coming off the bottleneck machines arrive.

   Therefore, the workers of non-bottleneck machines should not be motivated to improve their productivity if the additional output cannot be processed by bottleneck machine. *Producing more non-bottleneck output results in an increase in WIP inventories and no increase in sales volume*. Therefore, the preferred course of action is that bottleneck machine should setup pace for non-bottleneck machine.
4. **Elevate the System Bottlenecks or Increase Bottleneck Efficiency and Capacity**: This step involves taking action to remove (that is elevate) the constraint. This might involve replacing a bottleneck machine with a faster one or providing additional training for a slow worker or changing the design of the product to reduce the processing time required by a bottleneck activity.
5. **Repeat the Process as a New Constraint Emerges:** If the bottleneck activity has been elevated and replaced by a new bottleneck activity it is necessary to return to step 1 and repeat the process.

E. THROUGHPUT ACCOUNTING

The concept of Throughput Accounting (TA) was created by David Galloway and David Waldron (1988-89) from the theory of constraints. In their opinion, accounting should monitor the rate at which businesses make money. With this important goal in mind, they focused on the *return per product per bottleneck hour*. They treated only direct material as variable and all labour and overhead costs as fixed. Several ratios were defined by Galloway and Waldron based on the definition of throughput.

Throughput Accounting Ratio:

$$\frac{\text{Throughput per Bottleneck Minute}}{\text{Factory Cost per Bottleneck Minute}}$$

Note

Galloway and Waldron define factory cost in the same way that Goldratt defines operating expense. See throughput.

If the TA ratio is greater than 1 the product in question is "profitable" because, if all capacity were devoted to that product, the throughput generated would exceed the total factory cost. If there was a bottleneck product could be ranked by a variant of the TA ratio (although the ranking is the same as that derived by the use of throughput per bottleneck minute).

Other Performance Ratios suggested including –

$$\frac{\text{Throughput}}{\text{Labour Cost}} \text{ and } \frac{\text{Throughput}}{\text{Material Cost}}$$

Illustration 5

H. Ltd. manufactures three products. The material cost, selling price and bottleneck resource details per unit are as follows:

Particulars	***Product X***	***Product Y***	***Product Z***
Selling Price (₹)	*66*	*75*	*90*
Material and Other Variable Cost (₹)	*24*	*30*	*40*
Bottleneck Resource Time (Minutes)	*15*	*15*	*20*

Budgeted factory costs for the period are ₹ 2,21,600. The bottleneck resources time available is 75,120 minutes per period.

Required

(i) Company adopted throughput accounting and products are ranked according to 'product return per minute'. Select the highest rank product.

(ii) CALCULATE throughput accounting ratio and COMMENT on it.

Solution

(i) Calculation of Rank According to 'Product Return *per minute*'

Particulars	**X**	**Y**	**Z**
Selling Price	66	75	90
Variable Cost	24	30	40
Throughput Contribution	42	45	50
Minutes *per unit*	15	15	20
Contribution *per minute*	2.8	3	2.5
Ranking	II	I	III

(ii) Ranking Based on 'TA Ratio'

Contribution *per minute*	2.80	3.00	2.50
Factory Cost *per minute* (2,21,600 / 75,120)	2.95	2.95	2.95
TA Ratio (Cont. *per minute* / Cost *per minute*)	0.95	1.02	0.85
Ranking Based on TA Ratio	II	I	III

Comment

Product Y yields more contribution compared to average factory contribution per minute, whereas X and Z yield less.

1. Advantages and Disadvantages

Advantages	Disadvantages
Reduction in inventory.	Focus on short-term goals as opposed to long-term with ABC.
More productive machines.	Main emphasis on increasing sales and volume, not quality as opposed to Total Quality Management.
Ability to meet shorter lead times.	Might result in loss of the overall picture while looking at specific constraints.
More flexible.	Focuses on the push approach as opposed to pull approach of JIT.
Better customer service.	Valid only if applied to the total supply chain process including management, production, resources and support.
Better product mix.	Dependent on circumstances, operating expenses under TOC/TA are regarded as fixed, which is simplistic in the view of detractors. Therefore, TOC and TA are basically the same thing as variable costing.
Better customer relationship.	

2. Conclusion

TOC/TA-based approach as a direct costing approach may be more suitable for short term product mix decisions. This approach is clearer than approaches that allocate indirect costs more or less arbitrarily (Boyd and Cox, 2002). On balance, it may be considered that TOC should not be ignored due to the comprehensibility of the approach. TOC is a tool and not a philosophy.

Practical Insight

Theory of Constraints Practices

A company produces parts for automotive. Its primary measure of productivity is labour absorption under the assumption that if more work is being done to create inventory, profits will increase. However, using this measure resulted in actions to increase inventory and build stock products rather than fill actual customer orders.

Process improvements (like Lean Sigma initiatives) were implemented to reduce costs. Efforts were made to decrease the labour involved in producing parts. This was done for all operations. Many non-constraints became faster, producing even more work than the constraints could handle. Even though labour went down, inventory increased, and it became more difficult to fulfill orders on time and to properly prioritize manufacturing jobs.

When management learned about throughput, it shifted its focus from absorbing costs into inventory to increasing how quickly work could be completed. Emphasis was given to improving constraints. By investing $89,000 in the facility and adding 3 additional workers to the day shift, output increased by 83%. Under traditional Cost Accounting, these expenses would not have been justified because local output efficiency would have declined on a per labour hour basis. However, the cost was minimal compared to the increase in throughput.

F. ENVIRONMENTAL MANAGEMENT ACCOUNTING [EMA]

Figure F.1 – Overview of Environmental Management Accounting

The awareness among business organisations regarding environmental issues (e.g., global warming, depletion of non-renewable resources, and loss of natural habitats, etc.) has grown significantly all across the globe in recent times.

It important here, to know the reason as well; poor environmental behaviour may have a real adverse impact on the business, which may include includes fines, lawsuits, destruction of brand values and damage of corporate image, loss of sales, and inability to secure finance, etc.

Insight on Background

The incidence like the Exxon Valdez oil spill (1989) trigger environmental consciousness among the nations and the business. United Nations come forward so that global understanding and commitment can be developed among the nations (and through them to their business houses) on environmental issues, hence various agreements, protocol, and declarations were made such as the Montreal Protocol, the Rio Declaration, and the Kyoto Protocol[5].

[5] https://academic.oup.com/jah/article/99/1/219/854785; https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3804363

Accounting, like any other business function, is also affected by environmental pressures to consider environmental issues. Initially, the need for mere external environmental reporting was felt, hence environmental disclosures become part of financial reports. Over the period of time independent environment reporting frameworks (GRI, EMAS & ISO 14001) emerge.

But the mere external reporting of environmental information is not enough for sustainability; hence the need to address the environmental issues at the time of making decisions (rather when their results are reported) is realised. Obviously, this requires changes to management accounting systems, hence resultantly EMA emerged.

1. What is the EMA?

EMA is the process of collection and analysis of the information relating to environmental cost for internal decision making. EMA identifies and estimates the costs of environment-related activities and seeks to control these costs. The focus of EMA is not on financial costs, but it also considers the environmental cost or benefit of any decisions made. EMA is an attempt to integrate best management accounting thinking with best environmental management practice.

EMA can be viewed as a part of the environmental accounting framework and is defined as using monetary and physical information for internal management use. Though EMA information can be used in any management decision making process, it is particularly useful for environmental decision making. EMA aims to make better use of or to modify sources of information and management accounting techniques and to evaluate sustainability and/or environmental efficiency of a company.

The major areas for the application for EMA are:

- Product Pricing
- Budgeting
- Investment Appraisal
- Calculating Costs and
- Savings of Environmental Projects or Setting Quantified Performance Targets.

Test Your Understanding

Why is EMA gaining importance among organisations?

Hint

- **Environment cost may represent a significant proportion of the operating costs**. Particularly for companies that are operating in highly industrialized sectors such as oil production. Amoco's environment costs at its Yorktown refinery were at least 22% of non-crude operating cost against the estimates of only 3%[6].

[6] Ranganathan and Ditz (1996) & case study of Ditz et al (1998)

- **Regulatory requirements** pertaining to environment protection are increasing worldwide at a rapid pace, consequences of non-compliance are severe too. In the largest ever seizure related to an environmental conviction in the UK, a plant hire firm, **John Craxford Plant Hire Ltd**, had to not only pay £85,000 in costs and fines but also got £1.2m of its assets seized. This company had illegally buried waste and breached its waste and pollution permits. And it's not just the companies that need to worry. Every person found guilty of breaching environmental regulations knowingly is liable to criminal prosecution as per the regulatory laws[7].
- Society prefers corporates that are **socially and environmentally responsible** and have a positive footprint. A 'carbon footprint' (as defined by the Carbon Trust) measures the total greenhouse gas emissions caused directly and indirectly by a person, organization, event, or product. People are now becoming aware of the 'carbon footprint' and recycling. Several companies have initiated CSR committees as they feel that portraying themselves as environmentally responsible makes them popular among consumers.

2. Environmental Information

The information pertaining to the environment (which is considered as pre-requisite for implementation of EMA) can be classified into two categories, the first one is **physical information,** and another is **monetary information**.

Physical environmental information includes the physical flow of energy, water, material (and output as a product), as well as wastes and emissions (as non-product output), etc. It is required to trace the inputs and outputs of resources/materials and to ensure that no resources/materials are left unaccounted for. It helps to create environmental performance indicators, which help an organisation to set environmental targets and report its environmental performance as well as to effectively manage environmental impacts.

Monetary environmental information accounts for environmental costs (including savings and earnings) that are clearly driven by efforts to control waste and emissions that can damage the surrounding environment.

3. Environmental Costs – Meaning and its Classifications

As per **Glossary of Environment Statistics** (Studies in Methods, 1997) by the United Nations, the **environmental costs** are costs connected with the actual or potential deterioration of natural assets due to economic activities.

Classification is essential to gain understating and application of control. There are 4 possible bases of **classification** of the environmental cost, these are:

3.1 Classification 1 - Generic Classification

Based upon business boundary environmental cost can be split into internal cost and external cost-

[7] https://thenewsnigeria.com.ng/2017/11/30/practical-treatment-of-environmental-management-cost/

Internal Environmental Costs	External Environmental Costs
The costs which are incurred by the organisation out of pocket and have an impact on its income statement. It includes- ▪ Waste disposal costs. ▪ Cost incurred to improve the systems and checks to avoid violation. ▪ Regulatory costs including duty, taxes, and cess. ▪ Up-front and back-end costs (permission and decommissioning etc.).	Instead of organisation that causes these costs, these costs are born by society. It includes- ▪ Use of water and energy resources. ▪ Emission of carbon and change in climate. ▪ The cost of health care of a person is affected by the environmental effect of business activity. ▪ Soil orison and forest degradation ▪ Increase in average temperature level

Note- *There is an* ***inverse relation between above mentioned two categories of environment cost****, if organisation incurs a reasonable amount of internal environmental cost, then the external adverse impact will be less, which will reduce the external environmental cost.*

Practical Insight

Governments and regulatory agencies are well aware of the impact of external cost and also aware of the relation between internal and external environment cost, hence using the available measures either –

- Promote organisation to enhance the internal environmental cost (e.g., tax benefits for the purchase of environmental pollution control equipment) ***or***
- Converting external cost to internal costs (e.g., charging clean energy cess and insert provisions like CSR in legislation).

3.2 Classification 2 – United States Environmental Protection Agency (known as US EPA)

US EPA in June 1995 published a paper titled **an introduction to environmental accounting as a business management tool: environmental as a business management tool: key concepts and terms**. In exhibit 2 of this paper environmental costs were classified into four sections –

- **Conventional Costs -** The costs of using raw materials, utilities, capital goods, and supplies are usually addressed in cost accounting and capital budgeting but are not usually considered environmental costs. However, decreased use and less waste of raw materials, utilities, capital goods, and supplies are environmentally preferable, reducing both environmental degradation and consumption of nonrenewable resources.
- **Potentially Hidden Costs** – The costs that may be obscured through treatment as overhead or R&D, distorted through improper allocation to cost centers, or simply overlooked. Simply means the costs which lose their identity in general overheads **e.g.,** upfront environmental costs, back-end environmental costs, and regulatory (including voluntary) environmental costs.

- **Contingent Costs** - Costs that may or may not be incurred at some point in the future **e.g.,** penalty, fines, legal expenses, and personal injury damages. (for better understanding take an example of the cost that is needed to clean the sea in event of an oil spill by oil or shipping corporations).
- **Relationship & Corporate Image Costs** – Some environmental costs are called "less tangible" or "intangible" because they are incurred to affect subjective (though measurable) perceptions of management, customers, employees, communities, and regulators **e.g.,** the costs of preparing environmental reports.

Practical Insight

Corporate Image

Blast at the Deepwater Horizon rig (Gulf of Mexico) in April 2010 caused a loss of life of 11 people and one of the worst oil spills. Authorities found that control failures at BP, its associates, and the regulatory agencies caused blasts which otherwise can be avoided. Since, BP is in the core role, hence accident causes then huge reputation loss, and it became synonymous with 'malfunctioning in oil exploration'[8].

3.3 Classification 3 - Hansen and Mendoza

Hansen and Mendoza believe that environmental cost incurred because of poor quality control cost, hence in their paper published in the year **1999;** they classify the environmental cost into 4 categories (in a similar manner to the classification of cost of quality) as follows –

- **Environmental Prevention Costs –** Those costs are associated with *preventing* adverse environmental impacts. Examples include –
  - Evaluating and picking pollution control equipment.
  - Creating environmental policies.
  - Environmentally driven R & D.
  - Site and feasibility studies.
  - Investment in protective equipment.
- **Environmental Appraisal Costs –** The cost of activities executed to determine whether products, process and activities are in *compliance* with environmental standards, policies and laws. Examples include –
  - Monitoring, testing, inspection and reporting.
  - Improved systems and checks in order to prevent fines/ penalties.
  - Regulatory compliances.
  - Performing contamination tests.
  - Audit of environmental activities.
- **Environmental Internal Failure Costs –** Costs incurred from activities that have been produced but *not discharged* into the environment. Examples include –

[8] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9200171/
https://www.epa.gov/enforcement/deepwater-horizon-bp-gulf-mexico-oil-spill

- Recycling scrap.
- Disposing of toxic material.
- Back-end costs such as decommissioning costs on project completion.

❑ **Environmental External Failure Costs –** Costs incurred on activities performed *after discharging* waste into the environment. These costs have an adverse impact on the organisation's *reputation* and *natural resources*. Examples include–

- Cleaning up contaminated soil.
- Restoring land to its natural state.

Hansen and Mendoza advocated that a periodical report of environmental cost should be prepared wherein the cost under each category must be shown as a percentage of either sales or operating cost for purpose of easy comparison.

Now, some companies have started linking their environmental strategy to concrete performance measures via **balanced scorecard framework**.

3.4 Classification 4 - The United Nations Division for Sustainable Development

United Nations Division for Sustainable Development (UNITED NATIONS, New York, **2001**) in their publication **Environmental Management Accounting Procedures and Principles** suggested that environmental costs as comprising of –

❑ **Costs incurred to protect the environment** i.e. measures taken to prevent pollution, and

❑ **Costs of wasted material, capital, and labor** i.e. inefficiencies in the production process.

4. EMA Methodology Related to the Management of Environmental Cost

Managing the environmental cost is phased and continues effort, the phases involved are -

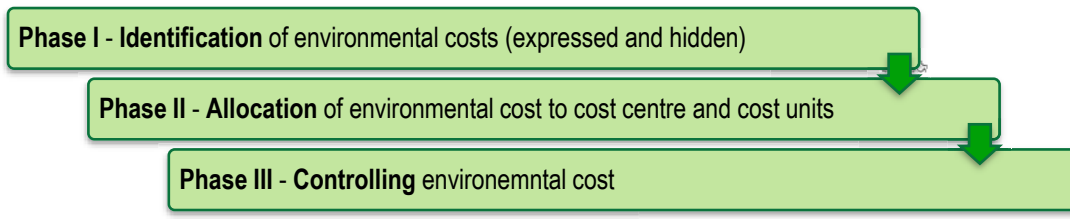


Figure F.2 – Phases for managing the environmental cost

4.1 Identification and Allocation of Environmental Costs

To manage the environmental cost, we need to start with the process of **identification of environment cost**, which involves an intense review of the general ledger containing costs of materials, utilities, energy, water, and waste disposal, etc. Since the portion of **environmental costs is generally 'hidden' in general overheads** of the company, hence it becomes difficult for management to identify opportunities to cut environmental costs; but it is crucial for them to do so.

Note- *One should recognise that environmental costs are not a separate type of cost, rather they are part of money flowing throughout a corporation; hence identification is important and critical.*

Full cost accounting and taking informed business decisions are getting importance. Both of these require **allocation of identified environmental cost** to the cost centres and cost units so that decision must be well-informed.

For example, a pharmaceutical company has to decide on the production of one of its drugs. In order to incorporate environmental aspects into its decision, it needs to know exactly how many products are input into the process compared to its outputs; how much waste is created during the process; how much labour and fuel is used in making the drug; how much packaging the drug uses and what percentage of that is recyclable etc. Only by identifying these costs and allocating them to the product can an informed decision be made about the environmental effects of continued production.

In Environmental Management Accounting Procedures and Principles published 2003, the UNDSD identified four management accounting techniques for the Identification and Allocation of Environmental Costs:

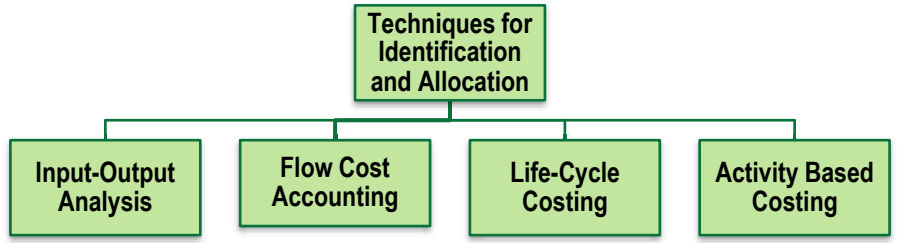


Figure F.3 – Techniques for identification and allocation of environmental costs

Concept Insight- Selection of techniques

- The benefit of each such technique must be a tradeoff against the cost of additional information.
- These techniques are not mutually exclusive.

4.1.1 Input-Output Analysis

This technique involves the preparation of records for material inflows and then balances these inflows with the quantum of outflows relying on principle '**what enters in the production system, must move out, either at a productive output or unproductive output (waste)**'.

Note- *It is important here to note, UNDSD (in Environmental Management Accounting Procedures and Principles published in 2003) stated that wasted materials account for 40% to 90% of environmental costs according to a survey.*

So, if 100kg of materials have been bought and only 80kg of materials have been produced, for example, then the 20kg difference must be accounted for in some way. It may be, for example, that 10% of it has been sold as scrap and 90% of it is wasted. By accounting for outputs in this way, both in terms of physical quantities and, at the end of the process, in monetary terms too, businesses are forced to focus on environmental costs.

4.1.2 Flow Cost Accounting

In the flow cost accounting, the organisational structure is also considered apart from material flows. Material losses incurred at various stages of production are also recorded. Further to bring transparency apart from the quantity of material, the cost per unit and value in total are also recorded.

Practical Insight

Material Flow Cost Accounting is an instrument used by manufacturing companies to improve their material efficiency. By avoiding material losses (waste), energy, costs, and CO2 emissions should be saved. MFCA can be used to calculate the actual costs of waste (Hidden Costs) i.e., environmental cost. The method originated in Germany, but the breakthrough came in Japan. The camera manufacturer **Canon**, which was able to save more than €30 million in material costs between 2004 and 2012 through Material Flow Cost Accounting[9].

The material flows are divided into three categories, material, system (cost of in-house handling), and delivery and disposal (costs of flows leaving the company).

As per UNDSD, EMA can be benefited from flow cost accounting because it aims to reduce the quantities of materials, which leads to increased ecological efficiency and reduction of cost in long run.

4.1.3 Life Cycle Costing

Lifecycle costing has a feature of full cost accounting, because it takes into account the costs and revenues of a product over its whole life rather than one accounting period; hence therefore, the full environmental cost associated of producing a product will be taken into account irrespective of the fact who born it.

4.1.4 Activity Based Costing (ABC)

Activity Based Costing is technique, which basically deals with the allocation of cost pool to the cost centres using cost drivers on the basis of consumption or benefit received.

As per **UNDSD**, Activity-based costing represents a method of managerial cost accounting that allocates all internal costs to the cost centres and cost drivers on the basis of the activities that caused the costs.

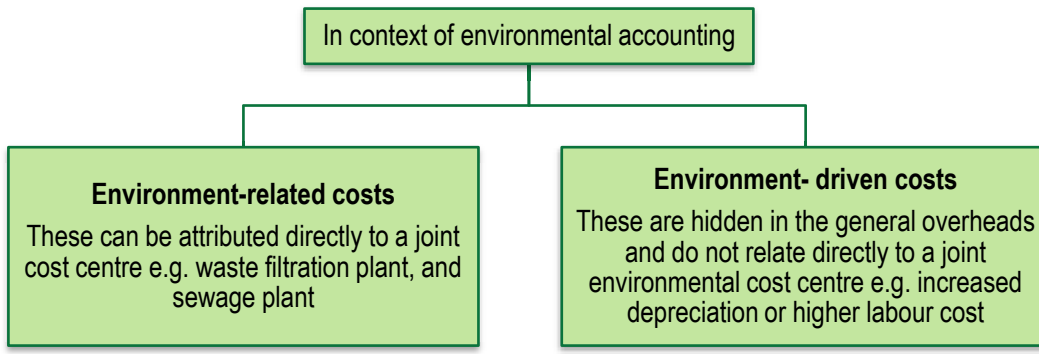


Figure F.4 – Environment related costs vs Environment driven costs

***Note-** The **environment-driven costs** are removed from general overheads and traced to products or services. The cost drivers are determined based on the environmental impact that activities have, and costs are charged accordingly. This should give a good attribution of environmental costs to individual products and should result in better control of costs.*

[9] https://www.ifu.com/material-flow-cost-accounting/

Test Your Understanding

'Allocation of environmental cost is undoubtedly crucial for obtaining correct information'. Can you suggest some of the allocation key (measures of allocation)?

Hint

The four major allocation keys (a measure of allocation) are:

- Volume of emissions or waste.
- Toxicity of emission and waste treated.
- Environmental impact added (volume × input per unit of volume) volume of the emissions treated.
- The relative costs of treating different kinds of emissions.

Note – The above measures are suggested by **Schaltegger and Muller** in **1998,** while they stressed upon the **'importance of the choice of an adequate allocation key'**.

Illustration 6

A chemical company produces two chemicals SX and ZX. Environmental activities and costs associated with the two chemicals are as follows –

	SX	***ZX***
Unit produced (kg.)	*6,00,000*	*15,00,000*
Packing Materials (kg.)	*80,000*	*40,000*
Energy Usage (KWH)	*60,000*	*30,000*
Toxin releases (Pounds into the air)	*2,00,000*	*40,000*
Pollution control machine hours	*32,000*	*8,000*

Cost of environmental activities:

Packing material Costs	*₹ 3,60,000*
Energy Costs	*₹ 96,000*
Fines for release of toxins into the air	*₹ 48,000*
Operating costs of pollution control equipment	*₹ 1,12,000*

Required

CALCULATE the environmental cost per kilogram for each chemical produced by the company.

Solution

Environmental costs can be allocated to Chemicals SX and ZX using Activity Based Costing.

Sr. No.	Type of Environment cost	Allocation Basis	Cost Allocation ₹		
			Chemical SX	Chemical ZX	Total
1.	Packing Material Costs	Packing Materials (kg.) SX 80,000 kg. ZX 40,000 kg.	2,40,000	1,20,000	3,60,000
2.	Energy Cost	Energy Usage (KWH) SX 60,000 kwh ZX 30,000 kwh	64,000	32,000	96,000
3.	Fines for Release of Toxins into Air	Toxins Released (Pounds into air) SX 200,000 pounds ZX 40,000 pounds	40,000	8,000	48,000
4.	Operating Costs of Pollution Control Equipment	Pollution Control Machine Hours SX 32,000 hrs. ZX 8,000 hrs.	89,600	22,400	1,12,000
5.	Total Cost Allocation	Sum of Steps 1 to 4	4,33,600	1,82,400	6,16,000
6.	Units Produced (kg.)		6,00,000	15,00,000	21,00,000
7.	Environment Cost per unit produced (St.5/6)		**₹ 0.7227**	**₹ 0.1216**	₹ 0.2933

The environment cost allocation per kilogram for Chemical SX is ₹0.7227 per kg and Chemical ZX is ₹0.1216 per kg.

The average environment cost per kg for overall production is ₹0.2933 per kg.

4.2 Controlling Environmental Costs

After identification and allocation of environmental costs, the organisation needs to head towards controlling these costs starts. The **method** applied to control environmental cost **can be** oriented to **individual cause** or **individual elements** (such as water, energy) or **uniform wide across the organisation** for all the causes.

Note- *The techniques used for identification of environmental cost has implication in the selection of method or tool for controlling the environmental cost. Moreover, the* ***choice of approach*** *to control cost is highly impacted by the nature of industry, because the* ***type of environmental cost and their percentage to total cost*** *will* ***vary significantly across the sectors****.*

For example, in order to reduce lifecycle costs (including full environmental cost) an organization may adopt a TQM approach. It is arguable that TQM and environmental management accounting are inextricably linked insofar as good environmental management is increasingly recognized as an essential component of TQM. Such organizations pursue objectives that may include zero complaints, zero spills, zero pollution, zero waste, and zero accidents. Information systems need to be able to support such environmental objectives via the provision of feedback - on the success or otherwise - of the organizational efforts in achieving such objectives.

Let's understand how environmental costs can be controlled by focusing on individual elements (throughout the organisation).

4.2.1 Waste – 'Mass balance' approach can be used to determine how much material is wasted in production, whereby the weight of *materials bought is compared to the product yield*. From this process, potential cost savings may be identified. In addition to these monetary costs to the organization, waste has environmental costs in terms of lost land resources (because waste has been buried) and the generation of greenhouse gases in the form of methane. Costs of unused raw materials and disposal; taxes for landfill; fines for compliance failures such as pollution are considered as environmental cost associated with waste.

Practical Insight

EMA Practices

Xerox Limited, a subsidiary of Xerox Corporation, introduced the concept of lifecycle costing for its logistic chain. Manufacturing photocopiers is the core business of Xerox. The photocopiers are leased rather than sold. This means the machines are returned to Xerox limited at the end of their lease. Previously, machines were shipped in a range of different types of packaging, which could rarely be re-used by customers to return the old copiers. The customer had to dispose of the original packaging and to provide new packaging to return the machine at the end of its lease, which in turn could not be used to re-ship other machines. So, Xerox ultimately lost the original costs and even had to bear the additional costs of disposal of the new packaging.

A new system was invented which used a standard pack (tote). Two types of totes were introduced to suit the entire range of products sold by Xerox. Totes can be used for both new machine delivery and return carcasses. The whole-chain cost analysis showed the considerably lower cost of the tote system compared to the previously existing system and the supply chain became more visible. The tote system resulted not only in cost savings but also in reduced 'de-pack' times and improved customer relations.

Based upon life Cycle Costing and Packaging at Xerox Ltd, by M Bennett and P James, in The Green Bottom line – Environmental Accounting for Management: Current Practice and Future Trends (Greenleaf Publishing, Sheffield, 1998b)

4.2.2 Water - Businesses pay for water twice, firstly to buy it and secondly to dispose of it. If savings are to be made in terms of reduced water bills, it is important for organizations to identify where water is used and how consumption can be reduced.

4.2.3 Energy - Often, energy costs can be reduced significantly that too at very little cost. EMA may help to identify inefficiencies and wasteful practices therefore creating opportunities for cost savings.

4.2.4 Transport and Travel - Again, EMA techniques may be used to identify savings in terms of travel and transport of goods and materials. At a simple level, a business can invest in more fuel-efficient vehicles.

4.2.5 Consumables and Raw Materials - These are directly attributable costs and discussions with management can reduce such costs. For example, toner cartridges for printers could be refilled rather than replaced. This should produce a saving both in terms of the financial cost for the organization and a waste saving for the environment.

5. Role of EMA in Product/ Process Related Decision Making

The full and correct costing of products is a pre-condition for making sustainable business decisions such as the volume and choices of products to be produced. EMA converts many environmental overhead costs into direct costs and allocates them to the products that are responsible for their incurrence. The results of improved costing by EMA may include:

- Different pricing of products as a result of re-calculated costs.
- Re-evaluation of the profit margins of products.
- Phasing out certain products when the change is dramatic.
- Re-designing processes or products in order to reduce environmental costs and
- Improving housekeeping and monitoring of environmental performance.

6. Pros and Cons of EMA

6.1 Pros

- **Improving Revenue** – The awareness among the customers of product or service's environmental impact is a significant factor that induces them to buy the product and cause their purchasing behaviour. It may also be possible to sell such products for a premium price. It is possible that good environmental management resulting in improved sales, poor management will lead to losses.
- **Cost Reductions** – Paying close attention to the use of resources can lead to reductions in cost. Often simple improvements in processes can lead to significant cost savings.
- **Improve the image** of the organisation (as a corporate citizen) among the stakeholders.

Practical Insight

EMA (Green Accounting and Reporting) at Denmark to reap benefits

In **Denmark**, EMA materials accounting by Danish companies are promoted via the requirements of the **Green Accounts Act**, which requires that a priority set of companies report the following –

- Data on consumption of water, energy, and raw materials.
- Significant types and volumes of pollutants are emitted to air, water, and soil.
- Significant types and volumes of pollutants in production processes, waste, or products.

A 1999 evaluation of the 1995 Act revealed that 41% of regulated enterprises have achieved environmental improvement through "green accounting," while 52% have gained an economic profit[10].

[10] https://sustainabledevelopment.un.org/content/documents/EMAGovernment.pdf

6.2 Cons

- **Increases in Costs** – Cost of complying with legal and regulatory requirements, and additional costs to improve the environmental image of the organization may result in an increase in some costs. However, some of these costs may be offset by government grants and this expenditure may save money in the long term as measures are taken may prevent future losses.
- **Additional burden on top management** in order to implement EMA, which may cause diversion form core activities.
- **Costs of Failure** – Significant costs may be incurred if there is poor environmental management. Thus, the cost of clean-up and fines on violation of any government environmental policy may be huge.

7. Conclusion

The major difficulty associated with EMA is the identification and allocation of environmental costs. Due to which, Management Accounting Techniques can distort and misrepresent environmental issues, leading to decisions that are not sustainable and causing harm to both businesses and the environment. Environmental issues need to be managed before they are reported, and this requires changes to management accounting systems, because poor environmental behaviour may have a real adverse impact on the business and its finances.

SUMMARY

- Cost Reduction and Cost Control– Cost Control involves a comparison of actual with the standards or budgets, to regulate the actual costs. Cost Reduction is the achievement of real and permanent reduction in unit cost of products manufactured.
- Scope of Cost Reduction– Cost Reduction efforts can be put in the following areas- a) Product Design, b) Organisation, c) Factory lay-out Equipment, d) Production Plan Programme and Method. It may be extended to administrative, selling and distribution methods, personnel management, purchase and material control, financial management, and other services.
- Target Costing– A structured approach to determining the cost at which a proposed product with specified functionality and quality must be produced, to generate a desired level of profitability at its anticipated selling price.
- Advantages of Target Costing–It reinforces top-to-bottom commitment to process and product innovation, it uses management control systems to support and reinforce manufacturing strategies, proactive approach to cost management, implementation of target costing enhances the employee awareness and empowerment, fosters partnership with suppliers, encourages the adoption of value- added activities with higher pay-off and elimination of non-value- added activities to residual level, it enhances product life by reducing the time to market, target Costing takes a market-driven approach towards cost, in which value is defined not only by what customers demand but also by what they are willing to pay for.

- Components of Target Costing System–

  Value Analysis is a planned, scientific approach to cost reduction which reviews the material composition of a product and production design so that modifications and improvements can be made which do not reduce the value of the product to the customer or to the user.

  Value Engineering is the application of value analysis to new products. Value engineering relates closely to target costing as it is cost avoidance or cost reduction before production.

  The initial value engineering may not uncover all possible cost savings. Thus, Kaizen Costing is designed to repeat many of the value engineering steps for as long as a product is produced, constantly refining the process and thereby stripping out extra costs.

  Further, Target Costing System is based on involving representatives of all the Value Chain such as suppliers, agents, distributors, and existing after-sales service in the target costing system.

  Issues dealt with during a Value Analysis/ Value Engineering review-

  - Can we eliminate functions from the production process?
  - Can we eliminate some durability or reliability?
  - Can we minimize the design?
  - Can we design the product better for the manufacturing process?
  - Can we substitute parts?
  - Can we combine steps?
  - Can we take supplier's assistance?
  - Is there a better way?

  A mix of all the value engineering steps noted above must be applied to each product design to ensure that the maximum permissible cost is safely reached.

- Problems with Target Costing– Development process can be lengthened to a considerable extent, large amount of mandatory cost cutting can result in finger-pointing in various parts of the company, difficult to reach a consensus on the proper design, requires the development of detailed cost data, reduce the quality of products due to the use of cheap components which may be of inferior quality, requirement of a good team leader.
- Most Useful Situations for Target Costing– Assembly-oriented industries, diversified product lines, factory automation through use of technologies, having shorter product life cycles, implementing JIT, value engineering, etc.
- Theory of Constraints – The theory of constraints focuses on revenue and cost management when faced with bottlenecks. It advocates the use of three key measures – Throughput, Investments and Operating expenses. The objectives of management can be expressed as increasing throughput, minimizing investment and decreasing operating expenses.

  (a) Throughput = (Sales Revenue – Unit Level Variable Expenses)/ Time

  (b) Investment is money associated with turning materials into Throughput and do not have to be immediately expensed.

(c) Operating expense is the money spent in turning Investment into Throughput and therefore, represents all other money that an organisation spends.

(d) Five step method of improving performance – Identify System Bottlenecks, Exploit the Constraint, Subordinate and Synchronise to the Constraint, Increase Bottleneck efficiency and Capacity, Repeat the process as and when a new constraint arises.

- Throughput Accounting Ratio = $\frac{\text{Throughput per bottleneck minute}}{\text{Factory cost per bottleneck minute}}$
- Life Cycle Costing– Life Cycle Costing involves identifying the costs and revenue over a product's life, i.e. from inception to decline. The life cycle of a product consists of four stages viz., Introduction; Growth; Maturity; and Decline.
- Benefits of Product Life Cycle Costing– Results in earlier actions to generate revenue or to lower costs than otherwise might be considered, more accurate and realistic assessment of revenues and costs, promote long-term rewarding in contrast to short-term profitability rewarding, provides an overall framework for considering total incremental costs over the entire life span of a product, provides long-term picture of product line profitability, enhance the control of manufacturing costs, traces research and design and development costs etc.
- Environmental Management Accounting [EMA] – EMA is the process of collection and analysis of the information relating to environmental cost for internal decision making. EMA identifies and estimates the costs of environment-related activities and seeks to control these costs. The focus of EMA is not on financial costs, but it also considers the environmental cost or benefit of any decisions made.
- The major areas for the application for EMA are: Product Pricing, Budgeting, Investment Appraisal, Calculating Costs and Savings of Environmental Projects, or Setting Quantified Performance Targets.
- Environmental Costs (Hansen and Mendoza)–

  Environmental Prevention Costs- Pollution Control Equipment, Environmental Policy Formulation, etc.

  Environmental Appraisal Costs- Monitoring, Testing and Inspection Costs, Reporting Costs, etc.

  Environmental Internal Failure Costs- Cost of Recycling or Disposing of Waste or Harmful Materials, Decommissioning Costs on Project Completion, etc. *Environmental External Failure Costs*- Carbon Emissions and the Adverse Impact these have on the Global Climate.
- Identification of Environmental Costs– Four management accounting techniques for the Identification and Allocation of Environmental Costs are - Input/Outflow Analysis, Flow Cost Accounting, Activity Based Costing and Lifecycle Costing.

  Input-Output Analysis- This technique records material inflows and balances this with outflows on the basis that what comes in, must go out. By accounting for outputs in this way, both in terms of physical quantities and, at the end of the process, in monetary terms too, businesses are forced to focus on environmental costs.

  Flow Cost Accounting- Classic material flows are recorded as well as material losses incurred at various stages of production.

Life Cycle Costing- Lifecycle costing considers the costs and revenues of a product over its whole life rather than one accounting period. Therefore, the full environmental cost of producing a product will be taken into account.

Activity Based Costing (ABC)- ABC distinguishes between environment-related costs, which can be attributed to joint cost centres, and environment- driven costs, which tend to be hidden on general overheads.

- Advantages of EMA– Improved Revenues Cost Reductions, Improve Brand Image.
- Disadvantages of EMA– Increases in Costs for legal and regulatory requirements, Costs of Failure if there is poor environmental management, Additional burden on top management.

TEST YOUR KNOWLEDGE- MCQS

MCQ 1

Which of the following techniques is not relevant to target costing?

Options

a. Value Analysis

b. Variance Analysis

c. Functional Analysis

d. Activity Analysis

Key - b

Reason – Option (b) Variance Analysis is not relevant to target costing. Variance analysis is the comparison of actual performance with standards / budgeted performance. Variance analysis helps in monitoring costs against a benchmark. Analysis is done after the cost is incurred. Target costing helps to determining the cost at which a proposed product (with specified functionality and quality) must be produced, to generate a desired level of profitability at its anticipated selling price. It uses techniques like value analysis, functional analysis, and activity analysis. Analysis is done before the cost is incurred; target is the goal to be achieved in future.

TEST YOUR KNOWLEDGE- CASELET BASED MCQS

Art Décor is a marble sculpture making company based out of Jaipur, Rajasthan. It has been making miniature figurines (small statues) for the past many years. It now plans to foray into making larger sizes statues that can be displayed in gardens, resorts or large corporate offices. As a trial it has asked its main designer Raj to come up with an appropriate design model that would appeal to such customers. There is already a competitive market for such larger size statues. However, the management of Art Décor has a skilled artist like Raj who can come up with attractive designs for customers. Within the month, Raj has come up with the appropriate design. Jay is the product manager who likes the design but wants to price it competitively in the market. The costing for 200 statues is as below:

Cost	*Amount (₹)*
Design cost	*5,00,000*
Direct materials	*20,00,000*
Direct manufacturing labour	*25,00,000*
Variable manufacturing overhead	*20,00,000*
Fixed manufacturing overhead	*5,00,000*
Marketing	*10,00,000*

Required

MCQ 1

The target profit required is 25% of revenue. If the sale price per statue is ₹45,000 what is the target cost per statue?

Options

a. ₹33,750 per statue

b. ₹36,000 per statue

c. ₹42,000 per statue

d. ₹56,250 per statue

Key – a i.e., ₹33,750

Reason – Target profit per statue is 25% of ₹45,000. Therefore, target profit is ₹11,250 per statue. Hence, target cost = selling price – target profit = ₹45,000 - ₹11,250 = ₹33,750 per statue. Option (b) ₹36,000 calculates that cost by taking profit to be 25% of cost i.e. 20% of selling price. Therefore, target cost is ₹45,000 - ₹9,000 = ₹36,000 per statue. Options (c) and (d) are incorrect options.

MCQ 2

What is the cost estimate per unit as per the cost information given above?

Options

a. ₹45,000 per statue

b. ₹42,500 per statue

c. ₹30,250 per statue

d. ₹43,000 per statue

Key – b i.e., ₹42,500

Reason – Option (b) ₹42,500 per statue is the correct option. The calculation is given:

Cost	Amount (₹)
Design cost	5,00,000
Direct materials	20,00,000
Direct manufacturing labour	25,00,000
Variable manufacturing overhead	20,00,000
Fixed manufacturing overhead	5,00,000
Marketing	10,00,000
Total Estimated Cost	8,500,000

Estimated Cost per statue = ₹85,00,000 / 200 statues = ₹42,500 per statue.

MCQ 3

Given your calculations in (a) and (b) has the target cost per statue been met?

Options

a. Yes, the estimated cost is lower than the target cost per statue.

b. No, the estimated cost is higher than the target cost per statute.

Key – b i.e., No

Reason – The estimated cost is higher than the target cost per statue. The estimated cost is ₹42,500 per statue (2) while the target cost price is ₹33,750 per statue (1). Hence, the company has to find ways to reduce the estimate cost through value engineering.

MCQ 4

During the course of discussions, Jay the product manager found that the designer Raj plans to use high quality marble for these statues. Jay suggests that he use a much lower quality marble material for the statues. This would reduce the material cost by 60%. Skilled labour hours required will also be reduced resulting in direct manufacturing labour to reduce by 50%. Accordingly, what would the revised estimate cost per unit be if value engineering is applied?

Options

a. ₹45,000 per statue

b. ₹42,500 per statue

c. ₹30,250 per statue

d. ₹43,000 per statue

Key – c. i.e., ₹30,250 per statue

Reason – With 60% saving in direct material cost and 50% saving in direct manufacturing labour, the revised estimate cost per statue if value engineering is adopted would be:

Cost	Amount (₹)
Design cost	5,00,000
Direct materials	8,00,000
Direct manufacturing labour	12,50,000
Variable manufacturing overhead	20,00,000
Fixed manufacturing overhead	5,00,000
Marketing	10,00,000
Total Estimated Cost	60,50,000

Estimated Cost per statue = ₹60,50,000 / 200 statues = ₹30,250 per statue.

MCQ 5

Given your calculations in (1) and (4) has the target cost per statue been met?

Options

a. Yes, the revised estimate cost by adopting value engineering is lower than the target cost per statue.

b. No, the revised estimate cost by adopting value engineering is higher than the target cost per statue.

Key – a. i.e., Yes

Reason – Yes, the target cost per statue is (1) is ₹33,750 per statue while the revised estimate cost per statue if value engineering is adopted as per (4) is ₹30,250 per statue. Hence, value engineering technique does lower the cost per statue.

MCQ 6

Raj the designer does not agree with Jay's proposition given in (4) above. He feels that inferior quality material would affect the durability of the statue and hence would affect the demand for it in the long run. Instead of value engineering, he feels that 10% increased spending in marketing can increase the selling price per statue to ₹50,000 per statue. The target profit required is 25% of revenue. Given this scenario, what is the target cost per statue?

Options

a. ₹33,750 per statue

b. ₹37,500 per statue

c. ₹35,000 per statue

d. ₹36,250 per statue

Key – b i.e., ₹37,500 per statue

Reason – The target profit per statue is 25% of ₹50,000. Therefore, target profit is ₹12,500 per statue. Hence, target cost = selling price – target profit = ₹50,000 - ₹12,500 = ₹37,500 per statue.

MCQ 7

Given the situation in (6) what would be revised estimated cost per statue after increasing the spend on marketing?

Options

a. ₹45,000 per statue

b. ₹42,500 per statue

c. ₹30,250 per statue

d. ₹43,000 per statue

Key – Option (d), ₹43,000 per statue

Reason – The revised estimate cost per statue would be:

Cost	Amount (₹)
Design cost	5,00,000
Direct materials	20,00,000

Direct manufacturing labour	25,00,000
Variable manufacturing overhead	20,00,000
Fixed manufacturing overhead	5,00,000
Marketing	11,00,000
Total Estimated Cost	86,00,000

Estimated Cost per statue = ₹86,00,000 / 200 statues = ₹43,000 per statue.

MCQ 8

Given your calculations in (6) and (7) has the target cost per statue been met?

Options

a. Yes, the estimate cost after increased spend on marketing is lower than the target cost per statue.

b. No, the estimate cost after increased spend on marketing is higher than the target cost per statue.

Key – b i.e., No

Reason – No, the estimated cost after increased spending on marketing is higher than the target cost per statue. The estimated cost is ₹43,000 per statue (7) while the target cost price is ₹37,500 per statue (6). The 10% increase in marketing spend increases the cost per statue to ₹43,000 beyond the target cost of ₹37,500 per statue.

MCQ 9

What is the estimate profit earned per statue as per (4) (adopting value engineering) and (6) (increasing marketing spend)?

Options	Profit per statue with value engineering as per (4)	Profit per statue after increased marketing spend as per (6)
a.	₹14,750	₹7,000
b.	₹2,500	₹7,000
c.	₹11,250	₹12,500

Key – a i.e., ₹14,750, ₹7,000

Reason – Refer below given calculations. Jay the product manager's proposal of adopting value engineering as per (4) is more profitable as compared to Raj the designer's proposal. Adopting value engineering may be encouraged. At the same time, designer Raj's opinion is also critical since it affects the durability of the product, which also impacts the long run demand for these products. Hence, the management of Art Décor has to take strategic decisions on the quality of statues it wants to launch. Pricing will also be affected by the external competitive market conditions.

Particulars	Estimates as per value engineering (4)	Estimates as per marketing spend (6)
Selling price per statue	₹45,000	₹50,000
Estimated cost per statue	₹30,250	₹43,000
Profit per statue	₹14,750	₹7,000

TEST YOUR KNOWLEDGE

Target Costing

1. Storewell Industries Ltd. manufactures standard heavy duty steel storage racks for industrial use. Each storage rack is sold for ₹750 each. The company produces 10,000 racks per annum. Relevant cost data per annum are as follows:

Cost Component	Budget	Actual	Actual Cost p.a. (₹)
Direct Material	5,00,000 sq. ft.	5,20,000 sq. ft.	20,00,000
Direct Labour	90,000 hrs.	1,00,000 hrs.	10,00,000
Machine Setup	15,000 hrs.	15,000 hrs.	1,50,000
Mechanical Assembly	200,000 hrs.	200,000 hrs.	30,00,000

The actual and budgeted operating levels are the same. Actual and standard rates of material procurement and hourly labour rate are also the same. Any variance in cost is solely on account of difference in the material usage and hours required to complete production. Aggressive pricing from competitors has driven down sales. A comparable rack is available in the market for ₹675 each. Vishal, the marketing manager has determined that in order to maintain the company's existing market share of 10,000 racks, Storewell Industries must reduce the price of each rack to ₹675.

Required

(i) CALCULATE the current cost and profit per unit. IDENTIFY the non-value added activities in the production process.

(ii) CALCULATE the new target cost per unit for a sales price of ₹675 if the profit per unit is maintained.

(iii) RECOMMEND what strategy Storewell Industries should adopt to attain target cost calculated in (ii) above.

Life Cycle Costing

2. Tt Co. Ltd. makes digital watches. The company is preparing a product life cycle budget for a new watch. Development on the new watch is to start shortly. Estimates for new watch are as under:

Life Cycle Units Manufactured and Sold	2,40,000	***Marketing Costs:***	
Selling Price Per Watch	₹500	Variable Cost Per Batch	₹24
Life Cycle Costs:		Watches Per Batch	96
R&D and Design Cost	₹80 Lakh	Fixed Costs	₹8 Lakh
Manufacturing Costs:		***Distribution Costs:***	
Variable Cost Per Watch	₹120	Variable Cost Per Watch	₹240
Variable Cost Per Batch	₹4,000	Fixed Costs	₹45 Lakh
Watches Per Batch	300	***Customer Service Cost:***	
Fixed Costs	₹112 lakh	Variable Cost Per Watch	₹10

Required

(i) CALCULATE the budgeted life cycle operating income for the new watch.

(ii) COMPUTE % of budgeted total product life-cycle costs incurred till the R & D and design stages.

(iii) ADVISE the strategies to be adopted by the Tt Co. Ltd. to develop a new watch.

3. Mould & Dies (M&D) was established in 1980 and has enormous wealth of experience in the mould manufacturing industry and serves a wide range of plastic moulds all over the nation. Over the past decade, M&D has developed a reputation for quality products & services for a customer-focused approach. It deals in injection moulds, blow moulds, die sets, moulds base etc.

With a state-of-the-art infrastructure facility, M&D is able to meet the qualitative and quantitative demands of its clients. Its vision & mission is to provide high class manufactured products by using the best quality raw materials.

M&D has developed a new product "M" which is about to be launched into the market and anticipates to sell 80,000 of these units at a sales price of ₹ 300 over the product's life cycle of four years. Data pertaining to product "M" are as follows:

Costs of Design and Development of Molds, Dies, and Other Tools	₹ 8,25,000
Manufacturing Costs	₹ 125 per unit
Selling Costs	₹ 12,500 per year + ₹ 100 per unit
Administration Costs	₹ 50,000 per year
Warranty Expenses	5 Replacement Parts per 25 units at ₹ 10 per part; 1 Visit per 500 units (Cost ₹ 500 per visit)

Required

(i) COMPUTE the product "M"'s 'Life Cycle Cost'.

(ii) SUGGEST two ways to maximize "M''s lifecycle return.

Note: *Ignore time value of money*

4. P & G International Ltd. (PGIL) has developed a new product ' α^3 'which is about to be launched into the market. Company has spent ₹30,00,000 on R&D of product ' α^3 '. It has also bought a machine to produce the product ' α^3 ' costing ₹11,25,000 with a capacity of producing 1,100 units per week. Machine has no residual value. The company has decided to charge price that will change with the cumulative numbers of units sold:

Cumulative Sales (units)	Selling Price ₹ per unit
0 to 2,200	750
2,201 to 7,700	600
7,701 to 15,950	525
15,951 to 59,950	450
59,951 and above	300

Based on these selling prices, it is expected that sales demand will be as shown below:

Weeks	Sales Demand per week (units)
1-10	220
11-20	550
21-30	825
31-70	1,100
71-80	880
81-90	660
91-100	440
101-110	220
Thereafter	NIL

Unit variable costs are expected to be as follows:

	₹ per unit
First 2,200 units	375
Next 13,750 units	300
Next 22,000 units	225
Next 22,000 units	188
Thereafter	225

PGIL uses just-in-time production system. Following is the total contribution statement of the product ' α^3 ' for its Introduction and Growth stage:

	Introduction	Growth	
Weeks	1 - 10	11 – 30	
Number of units Produced and Sold	2,200	5,500	8,250
Selling Price per unit (₹)	750	600	525
Variable Cost per unit (₹)	375	300	300
Contribution per unit (₹)	375	300	225
Total Contribution (₹)	8,25,000	16,50,000	18,56,250

Required

(i) PREPARE the total contribution statement for each of the remaining two stages of the product's life cycle.

(ii) DISCUSS Pricing Strategy of the product 'α^3'.

(iii) FIND possible reasons for the changes in cost during the life cycle of the product 'α^3'.

Note: Ignore the time value of money.

Theory of Constraints

5. Z Plus Security (ZPS) manufactures surveillance camera equipment that is sold to various office establishments. The firm also installs the equipment at the client's place to ensure that it works properly. Each camera is sold for ₹2,500. The direct material cost of ₹1,000 for each camera is the only variable cost. All other costs are fixed. Below is the information for manufacturing and installation of this equipment:

Particulars	Manufacture	Installation
Annual Capacity (camera units)	750	500
Actual Yearly Production and Installation (camera units)	500	500

Required

The questions below are separate scenarios and are not related to each other.

(i) IDENTIFY the bottleneck in the operation cycle that ZPS should focus on improving. Give reasoning for your answer.

(ii) An improvement in the installation technique could increase the number of installations to 550 camera units. This would involve a total additional expenditure of ₹40,000. ADVISE ZPS whether they should implement this technique?

(iii) Engineers have identified ways to improve manufacturing technique that would increase production by 150 camera units. This would involve a cost of ₹100 per camera unit due to necessary changes to made in direct materials. ADVISE ZPS whether they should implement this new technique.

6. ZED produces two types of products, Z and D at its manufacturing plant. Both the products are produced using the same materials, machinery and skilled labour. Machine hours available for the year are 4,000 hours.

Information relating to products are as follows:

Particulars	Z	D
Selling Price *per unit*	₹16,000	₹4,000
Material Costs *per unit*	₹7,000	₹1,200
Machine Hours *per unit*	1.6 hrs.	0.8 hrs.
Maximum Annual Demand	2,000 units	1,600 units
Online Booking (already accepted for)	400 units	1,200 units

Due to poor productivity levels, late order and declining profits over recent years, the CEO has suggested the introduction of throughput accounting in the company.

The total of all factory costs is ₹1,42,60,000, excluding material.

Required

(i) Using throughput accounting, PREPARE statement to determine the optimum production mix and maximum profit for the next year.

(ii) CALCULATE the amount of profit lost due to acceptance of online booking of the products.

(iii) RECOMMEND the options to be followed in order to avoid any loss of profit.

(iv) LIST various ways through which price customization could be done.

(v) Given that products Z and D are respectively in 'maturity stage' and 'introduction stage' of their life cycle. STATE the most appropriate pricing policy that could be followed by the ZED for Z and D as per their life cycle.

Environmental Management Accounting

7. Following three independent situations pertaining to environmental management and sustainability are provided to you:

Situation I

Wasco Limited is a chemical company which uses chloro-fluorocarbons (CFC) in the production of chemical. As awareness of the environmental damage caused by CFC spread, Wasco Limited stopped using CFC in its production processes and analysed and redesigned its product range much before the legislation controlling use of CFC introduced by the Government.

Situation II

Energy drink manufacturer Cool Limited was ordered to submit a yearly report to the Ministry of Environment and Forests on activities, which contains information concerning collection, recovery and recycling of packaging waste, fulfilment of the targets, volume of recovered and recycled packaging waste by type of material and declaration that all compulsory contributions and taxes have been paid.

Situation III

KOA Limited has achieved a 25% reduction of energy consumption through its "Go Renewable" initiative. For, the company a 25% reduction represents a cost saving of about Rs. 30,00,000/-.

Required

Read the above three situations and EXPLAIN:

(i) Why Wasco Limited stopped using CFC and redesigned its product range much before legislation introduced by Government?

(ii) The risk exposure of Cool Limited.

(iii) How does focusing on environmental sustainability provides opportunity to KOA Limited for reducing costs?

8. "QR" Ltd. is the leading manufacturer and exporter of high-quality leather products - Product Q and Product R.

The selling price per unit of Product Q and Product R is ₹620 and ₹420 respectively.

Both the products pass through three processes - Tanning, Dyeing and Finishing during manufacturing process. Allocation of costs per unit of leather products manufactured among the processes are given below:

Particulars	Tanning	Dyeing	Finishing	Total
Direct Materials Cost ₹ *per unit*	140	180	140	460
Direct Labour Cost ₹ *per unit*	90	120	90	300
Cost allocation to Product Q	70%	50%	70%	
Cost allocation to Product R	30%	50%	30%	

General overheads per unit of leather products Q or R manufactured are ₹115. This blanket absorption rate is derived after division of total general overhead with number of leather product be it Q or R. Above cost allocation is the basis for the decisions regarding pricing of the products.

In this Industry, all the major production processes have environmental impact at all stages of the process, including generation of waste, emission of harmful gases, noise pollution, water contamination etc.

The management of the company is worried about the above environmental impact and has taken initiative to preserve the environment like - research and development activities aimed at reducing pollution level, planting trees, treatment of harmful gases and airborne emissions, wastewater treatment etc.

The management of the company desires to adopt Environmental Management Accounting as a part of the strategic decision-making process. The pricing of products should also factor in the environmental cost generated by each product.

General overheads blanket rate per unit of leather products (be it Q or R) manufactured are ₹115 which includes –

Treatment cost of harmful gases.....₹40

Wastewater treatment cost.....₹50

Cost of planting of trees.....₹10

Miscellaneous.....₹15

Process wise information related to generation of wastewater and harmful gases is given as below–

	Tanning	Dyeing	Finishing	Total
Wastewater generated (litres per week)	900	600	0	1,500
Emission of harmful gases (cc per week)	400	300	100	800
Cost allocation to Product Q	70%	50%	70%	
Cost allocation to Product R	30%	50%	30%	

The remaining overheads cost (miscellaneous) and cost of planting trees can be allocated equally between Product Q and Product R.

Required

(i) CALCULATE the product wise profitability based on the original cost allocation.

(ii) RECALCULATE the product wise profitability based on activity-based costing (Environment driven costs).

(iii) ANALYZE the difference in product profitability as per both the methods.

ANSWERS/ SOLUTIONS

1. (i) The current cost and profit per unit are calculated as below:

Cost Component	Units	Actual Cost p.a. for 10,000 racks (₹)	Actual Cost per rack (₹)
Revenue	10,000 racks	75,00,000	750
Direct Material	5,20,000 sq. ft.	20,00,000	200
Direct Labour	1,00,000 hrs.	10,00,000	100
Machine Setup	15,000 hrs.	1,50,000	15
Mechanical Assembly	200,000 hrs.	30,00,000	300
Total Cost		61,50,000	615
Profit		13,50,000	135

Therefore, the current cost is ₹615 p.u. while the profit is ₹135 p.u. Machine setup is the time required to get the machines and the assembly line ready for production. In this case, 15,000 hours spent on setting up does not add value to the storage racks directly. Hence, it is a non-value add activity.

(ii) New sale price per rack is ₹675 per unit. The profit per unit needs to be maintained at ₹135 per unit. Hence, the new target cost per unit = new selling price per unit – required profit per unit = ₹675 - ₹135 = ₹540 per unit.

(iii) As explained above, current cost per unit is ₹615 while the target cost per unit is ₹540. Hence, the cost has to be reduced at least by ₹75 per unit. Analysis of the cost data shows the variances between the budget and actual material usage and labour hours. It is given that the material procurement rate and labour hour rate is the same for budgets and actuals. Hence, the increment in cost of direct materials and labour is due to inefficient use of material and labour hours to complete the same level of production of 10,000 storage racks.

Corrective actions to address these inefficiencies could result in the following savings:

(a) Inefficiencies resulted in use of extra 20,000 sq. ft. of material.

Material cost per sq. ft. = Actual cost / Actual material usage = ₹20,00,000 / 5,20,000 sq. ft. = ₹3.85 per sq. ft.

Therefore, inefficiencies resulted in extra cost = 20,000 sq. ft. × ₹3.85 per sq. ft. = ₹77,000.

If corrective action is taken, for 10,000 racks this translates to a saving of ₹7.70 per unit.

(b) Inefficiencies resulted in extra 10,000 hrs. to be spent in production.

Labour cost per hr. = Actual cost / Actual labour hrs. = ₹10,00,000 / 10,000 hrs. = ₹10 per hr.

Therefore, inefficiencies resulted in extra cost = 10,000 hrs. × ₹10 per hour = ₹100,000.

If corrective action is taken, for 10,000 racks this translates to a saving of ₹10 per unit.

(c) Machine setup cost is a non-value added cost. Value analysis can be done to determine if the setup time of 15,000 hrs. can be reduced. However, since these activities have been carried out for a reason, care should be taken to ensure that this change should not adversely impact the production activity later down the stream.

(d) Mechanical assembly cost is almost half of the total cost. These are costs incurred during the production process on the assembly line. Value analysis can be done to determine if the production process can be made more efficient. For example, the process can be streamlined, such that steps can be combined that can be handled by fewer people (process centering). Similarly, value analysis / value engineering can focus on the product design.

Some questions to raise may be:

- Can the product be designed better to make the production more efficient?
- Can the design be minimized to include fewer parts and thus make it easier and efficient to manufacture?
- Can be substitute parts to make it more efficient? *Or*
- Is there simply a better way of producing the same product?

While target costing is a dynamic and corrective approach, care must the taken the product quality, characteristics and utility are maintained.

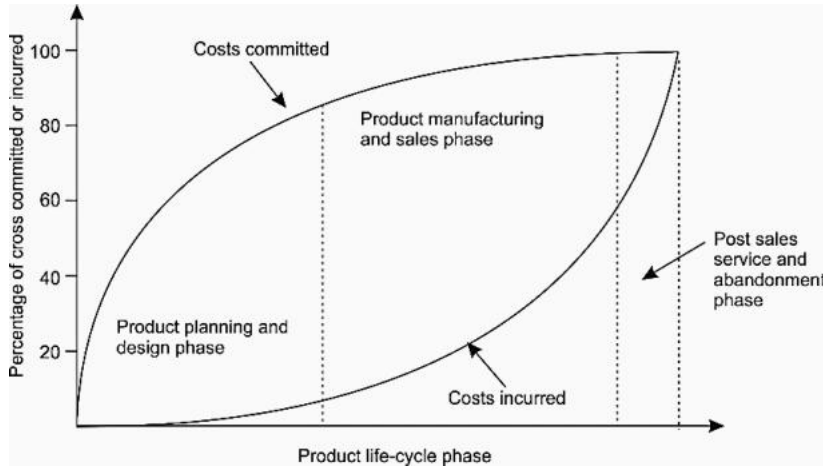
2. (i) Statement Showing Budgeted Life-Cycle Operating Income

Particulars	(₹)
Revenues (₹500 × 2,40,000 units)	12,00,00,000
Less: R&D and Design Costs	80,00,000
Manufacturing Costs:	
Variable (₹120 × 2,40,000 units)	2,88,00,000
Batch $\left(2,40,000 \times \frac{₹4,000}{3,000}\right)$	32,00,000
Fixed	1,12,00,000
Marketing Costs:	
Batch $\left(2,40,000 \times \frac{₹24}{96}\right)$	60,000
Fixed	8,00,000
Distribution Costs:	
Variable (₹240 × 2,40,000)	5,76,00,000
Fixed	45,00,000
Customer Service Costs:	
Variable (₹10 × 2,40,000)	24,00,000
Total Costs	11,65,60,000
Operating Income	34,40,000

(ii) % of Budgeted Total Product Life-Cycle Costs incurred till the R & D and Design Stages:

$$\left(\frac{₹80,00,000}{₹11,65,60,000} \times 100\right) = 6.86\%$$

(iii) We can see from the below figure that approximately 80% of a product's cost are committed during the planning and design stage. At this stage product designers determine the product's design and the production process. In contrast, the majority of costs are incurred at the manufacturing stage, but they have already become locked in at the planning and design stage and are difficult to alter.



The pattern of cost commitment and incurrence will differ based on the industry and specific product introduced. For developing a watch, Tt Co. Ltd. needs to incur only ₹80 lacs for its R&D and design Cost. So, Cost Management of Tt Co. Ltd can be most effectively exercised during the planning and design stage of its new watch and not at the manufacturing stage when the product design and processes have already been determined and costs have been committed. At the manufacturing stage only cost containment is possible rather than on cost management. An understanding of life-cycle costs and how they are committed and incurred at different stages throughout a product's life cycle of the watch will also led to the emergence of target costing, a technique that focuses on managing costs during a product's planning and design phase.

3. (i) Statement Showing "M's Life Cycle Cost (80,000 units)"

Particulars	Amount (₹)
Costs of Design and Development of Molds, Dies, and Other Tools	8,25,000
Manufacturing Costs (₹125 × 80,000 units)	1,00,00,000
Selling Costs (₹100 × 80,000 units + ₹12,500 × 4)	80,50,000
Administration Costs (₹50,000 × 4)	2,00,000
Warranty (80,000 units / 25 units × 5 parts × ₹10) (80,000 units / 500 units × 1 visit × ₹500)	 1,60,000 80,000
Total Cost	1,93,15,000

(ii) Following ways are suggested to maximize "M" lifecycle return:

R&D Costs

Often **significant part of cost (even above 80%) is committed at the R&D phase of new product**, hence M&D should carefully plan and design its new product "M" as it will determine the number of parts, production process to be used etc. M&D can apply ***value engineering*** here. It involves improving product quality, reducing product costs, fostering innovation, eliminating unnecessary and costly design elements, ensuring efficient investment in product, and developing implementation procedures. Value engineering is most successful when it is performed early in the product development stage. A value engineering study should be performed within the first 25-30% of the design effort prior to selecting the final design alternative. Here, it is also important that R&D team should work as a part of cross functional team i.e. (participate in a group of people from different functional areas), to minimise lifecycle cost and the production cycle time in new development.

Speed up the Product Launch

In cutthroat competitions, it is important for M&D to get new product 'M' launch into the market as soon as possible since this will give "M" a ***long stay*** in the marketplace *without competition* in the market. Competitors always try to launch a rival product as quickly as possible in order to gain a 'competitive edge'. M&D may lose overall profitability if it delays in launching of Product 'M'. It is usually worthwhile incurring extra costs to keep the launch on schedule or to speed up the launch.

4. (i) Total Contribution Statement

"Total Contribution- for remaining two stages"

Particulars	Maturity		Decline
Weeks	31 - 50	51 - 70	71 - 110
Number of units Produced and Sold	22,000	22,000	22,000
Selling Price per unit (₹)	450	450	300
Less: Unit Variable Cost (₹)	225	188	225
Unit Contribution (₹)	225	262	75
Total Contribution (₹)	49,50,000	57,64,000	16,50,000

(ii) Pricing Strategy for Product α^3

PGIL is following the skimming price strategy that's why it has planned to launch the product α^3 initially with high price tag.

A skimming strategy may be recommended when a firm has incurred large sums of money on research and development for a new product.

In the problem, PGIL has incurred a huge amount on research and development. Also, it is very difficult to start with a low price and then raise the price. Raising a low price may annoy potential customers.

Price of the product α^3 is decreasing gradually stage by stage. This is happening because PGIL wants to tap into the mass market by lowering the price.

(iii) Possible Reasons for the changes in cost during the life cycle of the product 'α^3'

Product life cycle costing involves tracing of costs and revenues of each product over several calendar periods throughout their entire life cycle. Possible reasons for the changes in cost during the life cycle of the product are as follows:

PGIL is expecting reduction in unit cost of the product α^3 over the life of product as a consequence of economies of scale and learning / experience curves.

The learning effect may be a possible reason for the reduction in per unit cost if the process is labour intensive. When a new product or process is started, the performance of the worker is not at its best and the learning phenomenon takes place. As the experience is gained, the performance of a worker improves, time taken per unit reduces and thus his productivity goes up. The amount of improvement or experience gained is reflected in a decrease in cost.

Till the stage of maturity, PGIL is in the expansion mode. The PGIL may be able to take advantage of quantity discount offered by suppliers or may negotiate the price with suppliers.

Product α^3 has the least variable cost ₹188 in last phase of maturity stage; this is because a product which is in the mature stage may require less marketing support than a product which is in the growth stage so, there is a saving of marketing cost per unit.

Again, the cost per unit of the product α^3 jumps to ₹225 in decline stage. As soon as the product reaches its decline stage, the need or demand for the product disappears and quantity discount may not be available. Even PGIL may have to incur heavy marketing expenses for stock clearance.

Workings

Cumulative Sales along with Sales Price and Variable Cost

Weeks	Demand *per week*	Total Sales	Cumulative Sales	Selling Price per unit (₹)	Variable Cost per unit (₹)
1 - 10	220	2,200	2,200	750	375
11 - 20	550	5,500	7,700	600	300
21 - 30	825	8,250	15,950	525	300
31 - 50	1,100	22,000	37,950	450	225

51 - 70	1,100	22,000	59,950	450	188
71 - 80	880	8,800	68,750	300	225
81 - 90	660	6,600	75,350	300	225
91 - 100	440	4,400	79,750	300	225
101 - 110	220	2,200	81,950	300	225

5. **(i)** Ever increasing and demanding environmental regulation is forcing companies to change their practices. In many countries, numerous pieces of legislation cover areas such as air quality, climate change, hazardous substances, packaging, waste, and water quality.

The trend is very much in the direction of increased and more stringent legislation. Environmental sustainability is not an issue that can be avoided by any organisation.

Organisations need to consider how environmental regulation will impact their operations and the cost of doing business.

By stopping the use of CFC much before the legislation, Wasco Limited gained advantages over its rivals. Wasco's actions were integral to its own strategic success, and instrumental in driving through the subsequent legislation from which the company later benefited. This will also help Wasco Limited to improve their brand image among the stakeholders as corporate citizens.

(ii) Organizations increasingly have to demonstrate that they are managing all of their risks systematically and responsibly. This includes environmental risks- risks that are a result of the impacts of the organization on the environment. By assessing the environmental risks associated with their activities, processes, product, and services, organizations can identify their potential legal and business exposure. Non-compliances can cause enormous financial impacts, such as fines, penalties, legal costs, and damages.

Thus, Cool Ltd is exposed to environmental risks.

(iii) Focusing on environmental sustainability will often provide opportunities for reducing costs. For example, reducing carbon impacts often also saves energy costs. Similarly, programmes for reducing waste improve environmental performance and reduce operating costs.

Reducing environmental impacts can also reduce or eliminate associated fines, levies, and other compliance costs.

Focusing on environmental sustainability thereby making investments in developing clean technologies and more energy-efficient products and processes will not only save the organization money but could also be patented and/ or sold to other organizations, providing an additional source of income. KOA Limited may have carbon credit for efficiency in reducing energy and selling on the open market, thereby actually generating revenue.

6. (i) Identification of Bottleneck: Installation of cameras is the bottleneck in the operation cycle. The annual capacity for manufacturing and installation are given to be 750 camera units and 500 camera units respectively. Actual capacity utilization is 500 camera units, which is the maximum capacity for the installation process. Although ZPS can additionally manufacture 250 camera units, it is constrained by the maximum units that can be installed. Therefore, the number of units manufactured is limited to 500 camera units, subordinating to the bottleneck installation operation. Therefore, ZPS should focus on improving the installation process.

(ii) Improving Capacity of Installation Technique: Every camera sold increases the throughput contribution by ₹1,500 per camera unit (sale price ₹2,500 per camera unit less direct material cost ₹1,000 per camera unit). By improving the current installation technique an additional 50 camera units can be sold and installed. This would involve a total additional expenditure of ₹40,000. Hence, the incremental benefit would be:

Particulars	Amount (₹)
Increase in throughput contribution (Additional 50 camera units ₹1,500 per camera unit)	75,000
Less: Increase in total expenditure	40,000
Incremental benefit	35,000

Since the annual incremental benefit is ₹35,000 per annum, ZPS should implement this improvement to installation technique, the current bottleneck operation.

(iii) Improving Manufacturing Capacity: Every camera sold increases the throughput contribution by ₹1,500 per camera unit (sale price ₹2,500 per camera unit less direct material cost ₹1,000 per camera unit). By improving the current manufacturing technique an additional 150 camera units can be produced. This would involve a cost of ₹100 per camera unit due to the necessary changes to be made in direct materials. Therefore, the number of units manufactured can increase to 650 camera units. However, production of 150 camera units will not translate into additional sales, because each sale also requires installation by ZPS. In a year only 500 camera installations can be made, leading to an inventory pile up of 150 camera units. This is detrimental to ZPS, since it does not earn any contribution by holding inventory. Therefore, ZPS should not go ahead with the proposal to improve the manufacturing technique.

7. (i) Statement Showing Machine Hours

Product	Maximum Demand	Machine Hours/ Unit	Total Machine Hours
Z	2,000 units	1.6	3,200
D	1,600 units	0.8	1,280
Total machine hours required to meet maximum demand			4,480
Machine hours available			4,000
Shortage of machine hours			480

'Machine hours' is the bottleneck activity.

Statement of Ranking

Particulars	Z	D
Selling Price *per unit*	₹16,000	₹4,000
Less: Material Costs *per unit*	₹7,000	₹1,200
Throughput *per unit*	₹9,000	₹2,800
Machine Hour Required *per unit*	1.6	0.8
Throughput Return *per hour*	₹9,000/1.6 = ₹5,625	₹2,800/0.8 = ₹3,500
Throughput Accounting (TA) Ratio (throughput return per hour/ cost per factory hour)	5,625/3,565 =1.58	3,500/3,565 =0.98
Ranking	I	II

Cost per factory hour = ₹1,42,60,000/ 4,000 hrs. = ₹3,565

Optimum Production Plan

Product	No of units	Machine hr. per unit	Total Machine hrs.	T/P per hr. ₹	Total T/P ₹
Z (online orders)	400	1.6	640	5,625	36,00,000
D (online orders)	1,200	0.8	960	3,500	33,60,000
Z	2,400/1.6 =1,500	1.6	2,400 (b/f)	5,625	1,35,00,000
Total					2,04,60,000
Less: Total Factory Costs					1,42,60,000
Profit					62,00,000

(ii) Had there been no online booking first product Z should be produced = 2,000 units using 3,200 machine hours (2,000 × 1.6). Because of online booking already accepted for 1,200 units of product D, unfulfilled demand of product Z = 2,000 -1,900 = 100 units.

Machine Hrs. Required for 100 units of Z (100 × 1.6)	160 hrs.
Throughput Lost for Product Z (160 hrs. × 5,625)	₹9,00,000
Throughput Return Earned for Product D (160 hrs. × 3,500)	₹5,60,000
Throughput lost	₹3,40,000

(iii) Recommendation

Option-1

Throughput accounting ratio is the throughput return earned in an hour divided by the factory cost (labour and overheads) incurred by the factory in one hour. Factory cost is generally fixed in nature. *A ratio above 1 signifies that the throughput return is greater than the factory cost and therefore the product is profitable.* Product Z has a throughput accounting ratio of 1.58 while Product D has a throughput accounting ratio of 0.98, this indicates that hourly return from Product A can cover the hourly factory cost, it is profitable. Product D does not yield enough hourly return to cover the hourly factory cost, it is not profitable. Therefore, ZED should consider ways of ***improving the throughput accounting ratio of Product D (i.e. above 1.0)***. TA ratio could be improved by:

- Increasing the selling price of Product D but the demand may fall.
- Reducing the material cost per unit as well as operating costs. However, there may be quality issues.
- Improving efficiency e.g. increase number of units that are made in each bottleneck hour.
- Raising up bottleneck so that more hours are available of bottleneck resource.

Option-2

ZED has to ***prioritize production of Product Z*** since it is more profitable than Product D. As per the throughput accounting ratio, Product D does not yield sufficient return per hour to cover the hourly overhead cost, therefore, gets second priority over Product Z.

Since machine hours are the bottle neck, if production for entire 4,000 hours is focused on Product Z, return yielded would be sufficient to cover the factory overheads. However, Product Z has a maximum demand of 2,000 units, that requires 3,200 machine hours (2,000 units × 1.6 hours per unit of production). The remaining 800 machine hours can be devoted to Product D, during which 1,000 units can be produced (800 machine hours / 0.8 hours per unit). Maximum demand for Product D is 1,600 units. Therefore, the balance demand of 600 units of Product D will remain unsatisfied.

However, to meet unsatisfied demand of Product D, ZED may consider the ***option of sub-contracting either a part of whole of the production of Product D***. This way it can meet the entire demand for Product D for 1,600 units. If it subcontracts the entire production of Product D, it can also scale down its in-house capacity. Sub-contracting decision requires suitable cost benefit analysis. Moreover, the risk associated with outsourcing like unsatisfactory quality and service, or failure of supplier cannot be ignored.

Overall, to enhance profitability or avoid any type of loss of profit, ZED may consider the options recommended above with a *long-term perspective*.

(iv) Pricing of a product is sometimes customized keeping taste, preference, and perceived value of a customer into consideration. Price customization is done in the following ways:

- *Based on product line:* When products are customized as per the customer's requirements, pricing can be adapted based on the customer's specifications. Standard products can have a base price, to which the company can top-up charges to any additional customization.
- *Based on customer's past behavior:* Customers with good payment record have established their creditworthiness. To sustain business, they may be extended additional discounts as compared to other customers.
- *Based on demographics:* Different pricing strategies may be adopted based on age or social status. For example, railway fare discounts for senior citizens or concessional price tickets for military personnel.
- *Based on time differential:* Different price for different time periods. If a customer extends a long-term contract, an additional discount may be extended since business is contracted for a longer period of time. Example, discounted price for data usage provided by a broadband service provider if subscription paid for six months or more.

Apart from the above accounting principles, other macroeconomic and legal factors should also be given importance while chalking out a pricing strategy.

(v) The life cycle of a product has 4 stages namely Introductory stage, Growth stage, Maturity stage and Decline stage.

Product Z is given to be in the maturity stage. This third stage of the product life cycle is characterized by an established market for the product. After rapid growth in sale volume in the previous stages, growth of sales for the product will saturate. Competition would be high due to the large number of rivals in the market, this may lead to decreasing market share. Unit selling price may remain constant since the market is well established. Occasional offers may be used to tempt customers, otherwise this stage will mark consolidation of the market.

Product D is in the introduction stage, the first stage of the product life cycle. Penetration pricing is adopted to charge a low price in the initial stage for penetrating the market as quickly as possible. For a new product this low-price strategy will popularize the product. Once the market is established, the price may be increased. Penetration pricing will be suitable when:

(i) Demand for the product is elastic, more demand when prices are low.

(ii) Large scale production of the product yields economies of scale.

(iii) The threat of competition requires prices to be set low. It serves as an entry barrier to prospective competitors as well.

However, if Product D is a highly innovative product, it may adopt Skimming price policy. The product with unique features will differentiate it from other products leading to a revolutionary impact on market and customer behavior. Customers may not mind paying a premium for the unique product offering. Focus may be on promoting the product to gain market share. Skimming price policy may work when:

(i) There seem to be no competitors providing similar products.

(ii) Demand is inelastic.

Over time, competitors can reverse engineer and offer similar products. Therefore, the price may be lowered in the long run to retain market share.

8. (i) Product Wise Profitability as per Original Allocation Methodology

(Figures in ₹ per unit of leather produced)

Particulars	Product Q	Product R	Total
Selling Price	620	420	1,040
Direct Material (Refer Table 1)	286	174	460
Direct Labour (Refer Table 1)	186	114	300
Overheads	115	115	230
Total Expenses	587	403	990
Profit	33	17	50
Profitability (%)	**5.32%**	**4.05%**	×

Workings

Table 1 Cost Allocation to the Products

(Figures in ₹ per unit of leather produced)

Particulars	Tanning			Dyeing			Finishing			Total		
	Q	R	Total	Q	R	Total	Q	R	Total	Q	R	Grand Total
Direct Material	98	42	140	90	90	180	98	42	140	286	174	460
Direct Labour	63	27	90	60	60	120	63	27	90	186	114	300

(ii) Product wise profitability based on activity-based costing using *environment driven costs* requires the following steps:

- For convenience let presume only 2 units (1Q and 1R) are manufactured, currently the total overhead of ₹230 (115×2) is equally divided between Q and R i.e. ₹115 per unit of Q and R. But this is blanket or convention approach of allocation and misleading too. Hence the total overhead of ₹230 need to be divided such as ABC as required in question.

- Breakdown of total overhead cost of ₹230 per unit into treatment cost of harmful gases, wastewater treatment cost, cost of planting trees and other overhead costs. Refer Table 2 for the breakup.
- Treatment cost of harmful gases and wastewater treatment cost need to be individually allocated to various processes based on relevant cost drivers. Refer Table 3 for cost allocation to process.
- The overheads mentioned in the point above thus allocated to the various processes will be reallocated to products based on the specific ratios given in the problem. Refer Table 4 for cost allocation to products.

Product Wise Profitability Statement based on ABC using *environment driven costs*

(Figures in ₹ per unit of leather produced)

Particulars	Product Q	Product R	Total
Selling Price	620	420	1,040
Direct Material (Refer Table 1)	286	174	460
Direct Labour (Refer Table 1)	186	114	300
Allocation of Overheads			
Treatment Cost of Harmful Gases (Refer Table 4)	50	30	80
Wastewater Treatment Cost (Refer Table 4)	62	38	100
Cost of Planting Trees (shared equally)	10	10	20
Other Overhead Cost (shared equally)	15	15	30
Total Expenses	609	381	990
Profit	11	39	50
Profitability %	**1.77%**	**9.29%**	×

Workings

Table 2: Breakdown of General Overheads (at total level of ₹ 230)

Overhead	Amount (₹)	Allocation basis between products
Treatment Cost of Harmful Gases	80	Emission of Harmful Gases (cc per week)
Wastewater Treatment Cost	100	Wastewater Generated (litres per week)
Cost of Planting Trees	20	Equally *between* Products Q and R
Miscellaneous	30	Equally *between* Products Q and R
Total General Overheads	230	

Table 3: Allocation of Treatment Cost *to various process*

Process Wise Information (Basis of apportionment, Cost Driver and their volume)

Overhead	Amount (₹)	Allocation Basis Between Products	Tanning	Dyeing	Finishing	Total
Treatment Cost of Harmful Gases	80	Emission of Harmful Gases (cc per week)	400cc	300cc	100cc	800cc
Wastewater Treatment Cost	100	Wastewater Generated (ltr. per week)	900lt.	600lt.	---	1,500lt.

Cost Allocation to Process

Overhead	Amount (₹)	Allocation Basis Between Products	Tanning (₹)	Dyeing (₹)	Finishing (₹)	Total (₹)
Treatment Cost of Harmful Gases	80	Emission of Harmful Gases (cc per week)	40	30	10	80
Wastewater Treatment Cost	100	Wastewater Generated (litres per week)	60	40	0	100

Table 4: Reapportionment of Treatment Cost to Product Q and R **(₹)**

Overhead	Tanning	Dyeing	Finishing	Total
Treatment Cost of Harmful Gases	₹40	₹30	₹10	₹80
Cost Allocation % to Product Q	70%	50%	70%	×
Cost Allocation % to Product R	30%	50%	30%	×
Cost Allocation to Product Q	₹28	₹15	₹7	₹50
Cost Allocation to Product R	₹12	₹15	₹3	₹30
Wastewater Treatment Cost	₹60	₹40	---	₹100
Cost Allocation % to Product Q	70%	50%	70%	×
Cost Allocation % to Product R	30%	50%	30%	×
Cost Allocation to Product Q	₹42	₹20	---	₹62
Cost Allocation to Product R	₹18	₹20	---	₹38

(iii) Analysis of the difference in product profitability as per both the methods

In the first method, general overhead costs are allocated to the products Q and R, irrespective of the environmental costs that each product incurs. General overhead costs are to each product equally. The resultant product profitability shows that Product Q yields 5.32% and Product R yields 4.05% profitability. Therefore, "QR" Ltd. would conclude that Product Q is more profitable.

In the next method, general overhead costs are bifurcated to identify "hidden" environment costs that are incurred on account of manufacturing these products. Environment costs are first traced to the process that generates harmful gases and

wastewater, for which treatment is done. It can be seen that Tanning process, followed by Dyeing and Finishing process generates the maximum amount of waste. Therefore, by proportioning the cost based on the waste generated, more cost is allocated to Tanning the process. Similarly, Dyeing and Finishing are allocated lesser cost since they do not generate as much waste. It is further given that 70% of the cost of Tanning relates to Product Q. This is much higher than the 50% that was allocated to the Product as per the first method.

Accordingly, the revised workings show that Product Q yields 1.77% and Product R yields 9.29% profitability. The reason being, Product Q generates more environment driven costs as compared to Product R.

"QR" Ltd. will therefore increase the selling price of Product Q if it wants to maintain profitability as per the original method. However, the more sustainable approach would be find out ways of reducing wastewater and harmful gases the manufacturing process produces. This would in turn result in a reduction of environment driven costs such as wastewater treatment and treatment of harmful gases. This would sustain profits in the long run.

NOTES
