

CA Final SPOM Set B – Strategic Cost & Performance Management
ICAI Module Questions Compilation

Chapter 4 - SPECIALIST COST MANAGEMENT TECHNIQUES

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 H1	8.50
Component H2	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 H1	8.50
Component H2	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.

Case Scenario 1

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.

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

- Calculate the expected total labour hours over the lifetime of the product 'Kitchen Care'.
- Calculate profitability of product 'Kitchen Care' that GEAL will earn over lifetime of the product.
- 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.
- 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 2

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.

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 incur 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)

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 through put 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.

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.

TEST YOUR KNOWLEDGE**Question 1 - Target Costing**

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.

Solutions

- (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 / 1,00,000 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 be taken the product quality, characteristics and utility are maintained.

Question 2 - Life Cycle Costing

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

Solution

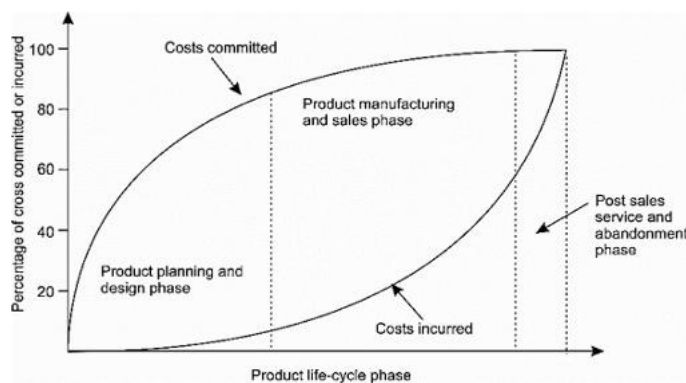
- (i) Statement Showing Budgeted Life-Cycle Operating Income

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 $(2,40,000 \times \frac{₹4,000}{3,00})$	32,00,000
Fixed	1,12,00,000
Marketing Costs:	
Batch $(2,40,000 \times \frac{₹24}{96})$	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.

Question 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

Solution -

- (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)	1,60,000
(80,000 units / 500 units × 1 visit × ₹500)	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.

Question 4

P & G International Ltd. (PGIL) has developed a new product 'α3' which is about to be launched into the market. Company has spent ₹ 30,00,000 on R&D of product 'α3'. It has also bought a machine to produce the product 'α3' 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:

	Rs. 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 'α3' 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 total contribution statement for each of the remaining two stages of product's life cycle.
 - (ii) DISCUSS Pricing Strategy of the product 'α3'.
 - (iii) FIND possible reasons for the changes in cost during the life cycle of the product 'α3'.
- Note: Ignore the time value of money.*

Solution

(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 α³

PGIL is following the skimming price strategy that's why it has planned to launch the product α³ 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 α³ 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 'α3'

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

Question 5

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 ?

Solutions

- (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.

Question 6

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.

Solution

- (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.

Question 7

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.

Solution

(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 (Through put 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 Z 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 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:

- Demand for the product is elastic, more demand when prices are low.
- Large scale production of the product yields economies of scale.
- 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:

- There seem to be no competitors providing similar products.
- 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.

Question 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

- Calculate the product wise profitability based on the original cost allocation.
- Recalculate product wise profitability based on activity-based costing (Environment driven costs).
- Analyze the difference in product profitability as per both the methods.

Solution

(i) Product Wise Profitability as per Original Allocation Methodology

(Figures in Rs. Per unit of leather produce)

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 Rs. Per unit of leather produce)

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 Rs. Per unit of leather produce)

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.