CA FINAL SCMPE

SUPER 50

IMPORTANT QUESTIONS LIST

MASTER PRACTICAL QUESTIONS FROM

ICAI MODULE, RTP, PAST PAPERS, CASE STUDY DIGEST

FOR EXAM LAST DAY REVISION

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CHAPTER 1 REVISION VIDEO

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Value Chain Analysis

Question 1 (ICAI Suggested Answersheet July' 21 Q.4)

ABC & Associates, a law firm has recently undertaken an analysis of its activities, but is uncertain which activity relates to which part of the firm's Value Chain.

Consider the following lists of activities within ABC and various Value Chain classifications.

Activity		Value Chain Classification	
A	Dealing with claims of negligence by customer	1	Inbound logistics
B	Central control system that ensures each case isindependently reviewed	2	Service
C	Attending court cases	3	Infrastructure
D	Receiving strong data from client meetings	4	Operations

You are required to:

(i) DEFINE the "Value Chain".

(ii) IDENTIFY which activity relates to which dimension by pairing the appropriate letter and number.

Solution

Porter describes the Value Chain as "internal processes or activities a company performs to design, produce, market, deliver and support its product".

Value Chain encompass the full range of activities that are required and performed to bring a products or services from its conception to the point when these are consumed or used.

Porter defines "Value Chain'' as a representation of a firm's value-adding activities, based on its pricing strategy and cost structure.

Identification of Activity and Related Dimension by Pairing

Activity	Value Chain Classification	Reason
A. Dealing with claims of negligence by customer	**2.** Services	Services are the activities related to maintaining the value of your product or service to your customers, **once it's been purchased**.
B. Central control system that ensures each case is independently reviewed	**3.** Infrastructure	Infrastructure are a company's **support systems**, and the functions that allow it to **maintain** daily operations.
C. Attending court cases	**4.** Operations	Operation are the transformation activities that change inputs into outputs **that are sold to ustomers**. (representing them in court of law)
D. Receiving strong data from client meetings	**1.**Inbound Logistics	Inbound logistics are all the processesrelated to **receiving** , storing, and distributing **inputs** internally. (to prepare the case)

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CHAPTER 2 REVISION VIDEO

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Cost of Quality

Question 2 (RTP Nov 18) (Module)

Cool Air Private Ltd. manufactures electronic components for cars. Car manufacturers are the primary customers of these products. Raw material components are bought, assembled and the electronic car components are sold to the customers.

The market demand for these components is 500,000 units per annum. Cool Air has a market share of 100,000 units per annum (20% market share) for its products. Below are some of the details relating to the product:

Selling price	Rs.2,500per unit
Raw material cost	Rs. 900 per unit
Assembly & machine cost	Rs. 500 per unit
Delivery cost	Rs. 100 per unit
Contribution	Rs.1,000 per unit

The customers due to defects in the product return 5,000 units each year. They are replaced free of charge by Cool Air. The replaced components cannot be repaired and do not have any scrap value. If these defective components had not been supplied, that is had the sale returns due to defective units been nil, customers' perception about the quality of the product would improve. This could yield 10% increase in market share for Cool Air, that is demand for its products could increase to 150,000 units per annum.

Required

(i) ANALYZE, the cost of poor quality per annum due to supply of defective items to the customers.

(ii) The company management is considering a proposal to implement an inspection process immediately before delivery of products to the customers. This would ensure nil sales returns. The cost of having such a facility would be Rs.2 crores per annum, this would include materials and equipment for quality check, overheads and utilities, salaries to quality control inspectors etc. ANALYZE the net benefit, if any, to the company if it implements this proposal.

(iii) Quality control investigations reveal that defective production is entirely on account of inferior quality raw material components procured from a large base of 30 suppliers. Currently there is no inspection at the procurement stage to check the quality of these materials. The management has a proposal to have inspectors check the quality control at the procurement stage itself. Any defective raw material component will be replaced free of cost by the supplier. This will ensure that no product produced by Cool Air is defective. The cost of inspection for quality control (materials, equipment, salaries of inspectors etc.) would be Rs.4 crores per annum. ANALYZE the net benefit to the company if it implements this proposal? Please note that scenarios in questions (ii) and (iii) are independent and not related to each other.

(iv) Between inspection at the end of the process and inspection at the raw material procurement stage, ADVISE a better proposal to implement (a) in terms of profitability and (b) in terms of long term business strategy?

Solution:

(i) Customer demand for Cool Air's products is 100,000 units per annum. However, 5,000 defective units supplied are to be replaced free of charge by the company. Therefore, the total number of items supplied to customers per annum = 100,000 + 5,000 units = 105,000 units. The cost of replacement would include raw material cost, assembly & machining cost and delivery cost of 5,000 units = 5,000 units × (900+500+100) per unit = 5,000 units × Rs.1,500 per unit = Rs.75,00,000 per annum. Further, had the sale returns not happened, market share would have increased by 50,000 units. Contribution is Rs.1,000 per unit, for 50,000 units contribution would be Rs.5,00,00,000. Therefore, the cost of poor quality per annum = cost of replacement + contribution from lost sales = Rs.75,00,000 +Rs.5,00,00,000 = Rs.5,75,00,000 per annum.

(ii) Inspection at the end of the process would detect defects before delivery to the customers. This would ensure that the sale returns would be nil. Given in the problem, 5,000 units supplied are defective and would need to be replaced, in other words, they need to be manufactured again. In other words, inspection after production, before delivery to customers would not prevent production of defective units. However, compared to the current scenario, since these defective units have not yet been delivered to the customer, the cost for additional delivery of replaced products would be saved. This savings in the extra delivery cost = 5,000 units × Rs.100 per unit = Rs.5,00,000 per annum. Further, had the sale returns not happened, market share would have increased by 50,000 units. Contribution is Rs.1,000 per unit, for 50,000 units it would be Rs.5,00,00,000 per annum. Due to increase in sales from 100,000 units to 150,000 units there will be additional failure of units of 2500 units (50,000 x 5%) which will result into an additional cost of (2500 Units x Rs. 1400) = Rs. 3500,000.

Therefore, the total benefit from the inspection process before delivery to customers = savings on delivery costs + contribution from incremental sales - additional failure cost = Rs.5,00,000 + Rs.5,00,00,000 - 35,00,000 = Rs.4,70,00,000 per annum. The cost to the company to maintain good quality of its products through inspection = Rs.2,00,00,000 per annum.

Since the defective units have not been delivered to the customer, the cost would be net of delivery cost.

Therefore, Net Benefit = (50500,000 - 200,00,000 - 3500,000) = Rs.270,00,000

This part can also be analysed by taking 7,895 defectives on 1,50,000 good units. For 95,000 good units, gross production is 1,00,000 units. For, 1,50,000 good units, gross production would be 1,57,895 units (1,00,000/ 95,000x 150,000). Therefore , total defective units will be 7,895.

(iii) Inspection of raw material at the procurement stage could entirely eliminate defective production. The benefit would be two-fold, the current replacement cost for 5,000 units will no longer be incurred. Secondly, due to better customer perception, market share would increase, resulting in an increased contribution / revenue to the company. In other words, the cost of poor quality will be nil.

As explained in solution (i), the cost of poor quality per annum = cost of replacement + contribution from lost sales = Rs.75,00,000 + Rs.5,00,00,000 = Rs.5,75,00,000 per annum. This would be the benefit by implementing the proposal. Cool Air has to incur an inspection cost to ensure this highest standard of quality (0% defects) which would cost Rs.4,00,00,000 per annum. Therefore, the net benefit to the company would be Rs.1,75,00,000 per annum.

(iv)

(a) The proposal to implement inspection immediately before delivering goods to the customers results in a net benefit of Rs.3,05,00,000 per annum. Alternately, the proposal to implement inspection at the raw material procurement stage results in a net benefit of Rs.1,75,00,000 per annum. Therefore, from a profitability point of view, inspection immediately before delivery of goods to the customer would the preferred option.

(b) The drawback of inspection at the end of the production process is that (1) it cannot prevent production of defective goods and (2) information regarding the root cause of defective production, in this case, supply of defective raw materials will not get tracked. Therefore, inspection at the end of production does not contribute to resolving the root cause of defective production. On the other hand, inspection at the procurement stage can eliminate production of defective goods. This will ensure a much higher quality of production, better utilization of resources and production capacity. Therefore, from a long-term strategy point of view, inspection at the raw material procurement stage will be very beneficial.

Currently the cost of ensuring this highest quality of production (0% defects) is Rs.4 crores per annum. The cost of ensuring 100% quality is quite high, such that the net benefit to the company is lesser than the other proposal. However, due to its long-term benefit, Cool Air may consider some minimum essential quality control checks at the procurement stage. Although selective quality check might not ensure complete elimination of defective production, it can contribute towards reducing it. At the same time cost of selective quality check would not be so high as to override its benefits. To determine the extent of quality control inspection, Cool Air should determine its tolerance limit for defective production and do an analysis of the quality / cost trade-off.

Theory of constraints

Question 3: (RTP Nov 20 Question 4) (Module/ CSD)

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 is 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	0.8hrs.
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	Rs.16,000	Rs.4,000
Less:Material Costs per unit	Rs. 7,000	Rs.1,200
Throughput per unit	Rs.9,000	Rs.2,800
Machine Hour Required per unit	1.6	0.8
Throughput Return per hour	Rs. 9.000/1.6 = Rs. 5.625	Rs.2800/0.8 = Rs. 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. = Rs. 3,565
Cost per factory hour = 1,42,60,000/ 4 ,000 hrs. = 3.565

Optimum Production Plan

Product	Noof units	Machinehr. per unit	Total Machinehrs.	T/Pper hr.	TotalT/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	2,400/16 =1,500	1.6	2,400 (b/f)	5,625	1,35,00,000
Total					2,04,60,000
Less Total Factory Costs					1,4260,000
Profit					

(ii) Had there been no online booking first product Z should be produced = 2,000 units using 3,200 machine hours (2,000 x 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 (100x 1.6)	160hrs.
Throughput Lost for Product Z (160hrs.x 5,625)	Rs. 9,00,000
Throughput Return Earned for Product D (160hrs. x 3,500)	Rs.5,60,000
Throughput lost	Rs. 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 throughput accounting ratio of Product D (i.e. above 1.0). TA ratio could be improved by:

- Increasing the selling price of the 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 bottleneck, 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 x 1.6 hours per unit of production). 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.

(Based on Theory of Chapter 7)

(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 credit-worthiness . 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 macro economic and legal factors should also be given importance while chalking out a pricing strategy.

(Based on Theory of Chapter 4)

(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 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 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 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) 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.

Customer lifetime value

Question 4: (RTP May 19) (Module/CSD)

Cineworld is a movie theater is located in a town with many colleges and universities around it. The town has a substantial student population, most of whom are avid movie goers. Business for Cineworld has been slow in the recent years due to the advent of streaming websites, that show the latest and popular movies online. However, the management of Cineworld continue to feel students would still enjoy the watching movies on big-screen, along with the facilities and ambience that only a movie theater can offer. Accordingly, they have framed a plan to attract students by offering discounts on movie tickets.

The average time a student spends at the college or university is 4 years, which i s the average duration of any course. For a nominal one-time subscription fee, Cineworld plans to offer students discounts on movie tickets for a period of 4 years. By attracting more footfalls, Cineworld targets to cross sell it food & beverages and souvenirs. This would help it sustain a reasonable revenue each year.

Cineworld would attract attention to the plan by initially offering free tickets, food and beverage and gift vouchers. This one time initial expense, net of the one-time subscription fee collected, would cost Rs.5,000 per student. On subscription to the plan, the viewership and purchases of each student is expected to be as follows:

Particulars	Years 1 and 2	Years 3 and 4
Spend on movie tickets per year	2,000	1,500
Spend on food and beverage per year	4,000	3,000
Spend on souvenirs and accessories per year	2,250	750

Assumptions

1. Only 50% of the subscribers are expected to visit the theatres in years 3 and 4.
2. Across all years, only 75% of the subscribers who visit the theatre are expected to buy food and beverage.
3. Only 25% of the subscribers who visit are expected to buy souvenirs in years 1 and 2, and 10% of them in years 3 and 4.

Given that PVIFA of Rs.1 for 4 years at 10% = 3.169 and PVIFA of Rs.1 for 2 years at 10% = 1.735.

Required

CALCULATE the customer lifetime value per subscriber for the above plan.

Solution

Customer lifetime value per subscriber can be found by calculating the present value of the revenue that is generated over the period of 4 years. This netted out with the cost incurred to attract subscribers, would give the customer lifetime value per subscriber.

Sr. No.	Particulars	Revenue (per year)	PVIFA	PV of Revenue	Probability of Usage	Net Revenue
1	Net cost of attracting students(onetime expense)					5,000
2	Net revenue from movie tickets					
	Years 1-2	2,000	1.735	3,470	100%	3,470
	Years 3-4 (refer note 1)	1,500	1.434	2,151	50%	1,076
3	Sale of food and beverages					
	Years 1-2	4,000	1.735	6,940	75%	5,205
	Years 3-4 (refer note 2)	3,000	1.434	4,302	37.5%	1,613
4	Sale of souvenirs and accessories					
	Years 1-2	2,250	1.735	3,904	25%	976
	Years (refer note 3)	750	1.434	1,076	5%	54
5	Total revenue (Steps 2+3+4)					12,394
6	Net revenue from subscriptionplan (steps 5-1)					7,394

Note 1:

PVIFA (10%, 4 years) = 3.169 and PVIFA (10%, 2 years) is 1.735. Therefore , PVIF for years 3 and 4 = PVIFA (10%, 4 years) - PVIFA (10%, 2 years) = 3.169 - 1.735 = 1.434.

Note 2:

Only 50% of the subscribers are expected to attend in years 3 and 4. Out of those only 75% are expected to buy food and beverage. Therefore, only 38% of the subscribers (75% of 50% subscribers who visit) are expected to buy souvenirs in years 3 and 4.

Note 3:

Only 50% of the subscribers are expected to attend in years 3 and 4. Out of those only 10% are expected to buy souvenirs. Therefore, only 5% of the subscribers (10% of 50% subscribers who visit) are expected to buy souvenirs in years 3 and 4

Present value of total revenue generated over the four -year period by a customer is Rs.12,393 while the corresponding expense is Rs.5,000. Therefore, the customer lifetime value per subscriber is Rs.7,393. Cineworld has to multiply this with the expected number of subscribers each year, to find out if this would be a profitable proposition.

Gain sharing arrangement

Question 5: (RTP May 20, Question 1) (Module)

Raya Health Care Limited is a leading healthcare service provider in Mumbai, it has approximately 450 potential beds, it provides diagnostic and day care speciality facilities also. In diagnostic centres they are using traditional devices for CT Scan and MRI which are not enough as per demand. Patients waited more than weeks for CT and MRI scans , this problem can cause delay in diagnosing illness; waste of time and other resources ; not just in radiology but throughout the healthcare system.

Raya has planned to outsource CT scan and MRI services to Livlife, which has world class international chain of diagnostic centre. Livlife promise to provide radiologist report within 24 hours. However, finance manager of Raya doubt that it will not be a profitable arrangement. For the satisfaction of Raya, Livlife has entered an agreement to provide its services to Raya with no guarantee of receiving payment. Raya agrees to the following conditions:

- Cost savings generated in first year , the same will be retained by Livlife.
- Cost savings generated in second and third year will be shared between Raya and Livlife at a ratio of 30%:70%.
- Cost savings generated in the fourth year will be passed to Raya.
- Any cost savings generated by an idea proposed exclusively by Raya that does not require capital investment by Livlife will be immediately passed along to Raya.

Required

DISCUSS the agreement between Raya and Livlife.

Solution:

The agreement between Raya and Livlife is Gain Sharing Arrangement. Gain sharing (also known as cost saving sharing) arrangement is an approach to the review and adjustment of an existing contract, or series of contracts , where the adjustment provides benefits to both parties. A fundamental form of gain-sharing is where a supplier agrees to perform its side of the contract with no guarantee of receiving a payment. Instead, any payment received is based upon the benefits that emerge to the customer as a result of the successful completion of the supplier's side of the bargain.

Livlife and Raya has also entered into such arrangement. This is clearly a risky stance for the supplier i.e. Livlife, because it could spend a fortune and walk away with nothing . Alternatively , if the benefits to Raya are substantial , Livlife could find itself rewarded with a large return. Cost savings might be attained from reducing the cost of supplies, implementing new skill and technologies , revised delivery time, improvements in operations etc.

The gain, benefit, or advantage to be shared is not necessarily financial , although financial benefits are expected to occur frequently. The Raya, for instance, will not necessarily take cost savings in the form of a lower contract value but might require a higher specification for medical treatment. However, to assess any financial benefit, both parties have to provide each other with access to relevant cost numbers to determine the basis for the assessment of the benefit and the calculation and sharing of the benefit.

Many contracts involving these arrangements have emphasis on greater openness and shared development and improvement. In the given case gain-sharing deals are, on the face of it, a win-win situation for both Raya and Livlife, interest of both are aligned. Livlife is trying to save costs of Raya while Raya is trying to get world class services .

Theory of Constraint

Question 6. (SBAQ. 18) (Qn. on Theory of Constraints) (CSD) (RTP + MODULE)

Ajanta Digital Solutions (ADS) is a renowned name for manufacturing a wide variety of digital stationery products for office and academic use. The 'Abacus division' of ADS is engaged in the production of basic calculators, capable of academic and commercial use. Presently Abacus is manufacturing only three models, named C-100, C-125, and C-500. These calculators are sold to customers through wide-spread retailers and distributors' network across the country.

During manufacturing process, each calculator needs to pass through various steps, before it gets ready. PC-IA is the essential step and performed manually, where processing chip is being installed, activated, and tested. The production capacity of Abacus is constraint by PC- IA. The basic information pertaining to top-line and the prime cost is as follows

(Amount in Rs.)

Particulars	C-100	C-125	C-500
Sale price per unit	140	200	450
Material cost per unit	72	104	200
Labour cost per unit	30	52.5	75

All the process and division at ADS are operating for a single shift of 8 hours in a day. Conversion cost per hour (including labour cost) is Rs.5600. The standard out-put for PC-IA during a day is the processing of either 800 units of C-100 or 560 units of C-125, or 320 units of C-500. ADS is capable of sale more than, what they are presently capable to produce in all range of models. The CEO of ADS recently attended a science fair, Robo-tech 4.0; where he saw a Robot developed by Synergy Robotics Limited, capable to assembly including installation of processing chip to any sort of device.

Required

Management hired you as cost consultant, advice on following aspects

(i) On a random day if 480 units, 140 units and 120 units of C-100, C-125, and C-500 respectively are produced and sold, CALCULATE at what efficiency level current constraint (bottleneck) is operational. INTERPRET the same. COMPUTE profit earned during such day.

(ii) FIND production of which model is more beneficial, considering the ranking (based upon throughput performance ratio).

(iii) APPLY Goldratt's five steps to remove the bottleneck at Abacus.

Solution

(i) Efficiency level can be measured with help of Efficiency Ratio, which is one among the control ratios.

Efficiency ratio indicates the degree of efficiency attained in production. It is expressed in term of standard hours for actual production as a percentage of the actual hours spent in producing that work.

$$\frac{\text{Standard hours for actual production}}{\text{Actual hours worked}} \times 100$$

$= (9.8/8) \times 100$

$= 122.5\%$

Working Note – Standard hour required for actual production.

Product	Actual output (Units) (a)	Standard Daily Output (Units) (b)	Standard Hourly Output (Units) (c) (b)/8	Standard Hour Required (a)/(c)
C-100	480	800	100	4.8
C-125	140	560	70	2
C-500	120	320	40	3
Standard Time Required (in hours)				**9.8**

Interpretation – 122.5% signifies that efficiency (usage) of exploiting bottle-neck activity is 22.5% better than the standard use. PC-IA is producing out-put which require 9.8 hours, in 8 hours.

Profit earned during the day

Particulars	Amount in Rs.
Revenue [(480×140) + (140×200) + (120×450)]	1,49,200
Less: Material Cost [(480×72) + (140×104) + (120×200)]	73,120
Less: Conversion Cost (including labour cost) [5,600 × 8hrs.]	44,800
Profit	**31,280**

(ii) Statement of ranking, based upon throughput performance ratio (using throughput contribution)

Particulars	C-100	C-125	C-500
Sale price per units ...(a)	140	200	450
Material cost per unit ...(b)	72	104	200
Throughput contribution per unit ...(c) = (a) – (b)	68	96	250
Maximum possible production ...(d)	800	560	320
Maximum possible throughput contribution ...(e)= (c)×(d)	54,400	53,760	80,000
Conversion cost (including labour cost) (5,600×8hrs.) ...(f)	44,800	44,800	44,800
Throughput performance ratio ...(e)/(f)	1.21	1.20	1.78
Ranking	II	III	I

Considering the throughput performance ratio (or TA ratio) and ranking above most beneficial model to produce is C-500 followed by C-100 and C-125.

$$\text{TA Ratio} = \frac{\text{Throughput Contribution}}{\text{Conversion Cost}}$$

Throughput accounting developed by **Galloway and Waldron** which use the term factory cost and completely relay upon the **Goldratt's theory of constraints** which use the term operating expenses, but the meaning of factory cost and operating expenses used at both places are identical.

Theory of constraints consider short-run time horizons and assume other current operating cost to be fixed costs.

Higher the throughput performance ratio (or TA ratio) is better and beneficial.

All the products/models which have throughput performance ratio (or TA ratio) more than one may be produced/continued to produce, depending upon constraint function.

Service level arrangement

Question 7. (The CA Student Journal)

About Problem	Target Verb/ (s)
Service Level Agreement	Compute, Explain

Red Star Limited (RSL) is the largest manufacturer of Air- Conditioners. RSL is not good at attending the customer calls due to lack of capabilities, but it is an important activity from the aspect of the value chain. Hence, in order to improve customer experience (downstream supply chain), RSL decided to hire Krishna Infotech & BPO Services (KIBS) for attending the calls of their existing and prospective customer.
Service level agreement (SLA) was duly entered and service level (SL) of 90/20 has been prescribed to keep a check on service quality. Invoice will be generated monthly, and SL will also be observed on monthly basis. For the first month along with the invoice, KIBS provide the following details to RSL-

? Total calls offered 5,120
? Calls answered within threshold time 4,850
? Short or Abandon calls within threshold time 115

CFO while authorising the payment queues generated by the account executive in ERP, come across the KIBS payment; he immediately seeks a copy of SLA from legal but not able to understand the technical aspects hence he decided to calls you (management accountant) to EXPLAIN few terms (including SL) and certain COMPUTATIONS.

Required

(i) What is the SLA threshold and what is the threshold time in this case?
(ii) Explain the significance of 90/20 SL.
(iii) Compute the SL level for the first month.
(iv) Whether KIBS attained the SL level to full the terms of SLA?
(v) For how many calls KIBS can bill to RSL?Required

Solution

(i) A service-level agreement (SLA) threshold is the activity response time specified in a service level agreement. In the current case, the SLA threshold is the number of seconds within which a call shall be responded to by a tele-caller at KIBS. The threshold time, in this case, is 20 seconds it is represented by a service level (SL) of 90/20.

(ii) A service-level agreement (SLA) defines the level of service you expect from a vendor, laying out the metrics by which service is measured. Service level basically measures the performance. Service level (SL) of 90/20 signifies that 90% of the calls shall be answered within 20 seconds.

Concept Insight

SLA is the document that outlines the wider service agreements between a service provider and its customer, whereas SL is the acceptable level of service performance regarding which agreement has been entered.

Mind it, both the SLA and SL are not the same

(iii) Service Level (SL) measure the performance and can be computed for voice calling BPO services using the following formula-.

$$SL = \frac{\text{Total calls answered within threshold time}}{\text{(Total calls offered - Short or abondon calls within threshold time)}}$$

SL = 4,850/ (5,120 - 115)

SL = 4,850/ 5,005

SL = **96.90%**

(iv) Against the expected service level of 90%, KIBS attain the service level of 96.90% which means out of each 100 calls nearly 97 class are answered within 20 seconds (threshold time), whereas the requirement was minimum requirement is 90%; hence KIBS attain the SL level to full the terms of SLA.

(v) No, doubt SL used for measuring the performance which relies upon the calls answered within the threshold time, but the calls answered beyond threshold time also cause costs and resources at end of the BPO vendor (KIBS in this case) hence billing shall be for total calls responded/answered (rather only those which are answered in threshold time). Hence, in a given case, the KIBS can raise an invoice for 5,005 calls i.e., 5,120 (total calls offered) – 115 (short or abandon calls within threshold time).

Student Notes:

Q.	Concept	Resource	Pg
8	JIT	Module	19-21
9	JIT	Module	22-24
10	TAKT Time Processing Cycle Efficiency	RTP	25-27
11	OEE	Module	28-29
12	Reverse	RTP MAY 21	30-33
13	JIT	Case study Digest	34-37
14	Kanban System	Case study digest	38-41
15	ROCA	RTP/ module	42-47

CHAPTER 3 REVISION VIDEO

SCAN QR OR CLICK HERE

Question 8: (RTP May 2018) (ICAI Case Study Digest - SBAQ #13) (Module)

Revolution Ltd. has entered into a contract to supply a component to a company which manufactures electronic equipments.

Expected demand for the component will be 70,000 units totally for all the periods. Expected sales and production cost will be

Period	1	2	3	4
Sales (units)	9,500	17,000	18,500	25,000
Variable cost per unit	30	30	32.50	35

Total fixed overheads are expected to be Rs.14 lakhs for all the periods. The production manager has to decide about the production plan.

The choices are:

Plan 1: Produce at a constant rate of 17,500 units per period. Inventory holding costs will be Rs. 6.50 per unit of average inventory per period.

Plan 2:Use a just-in-Time (JIT) system

Maximum capacity per period normally.....18,000 units It can produce further up to 10,000 units per period in overtime.

Each unit produced in overtime would incur additional cost equal to 30% of the expected variable cost per unit of that period.Assume zero opening inventory.

Required

Calculate the incremental production cost and this savings in inventory holding cost by JIT production system and advise the co. on the choice of plan.

Solution:

(i) Working

Statement Showing 'Inventory Holding Cost' under Plan 1

Particulars	Pd. 1	Pd. 2	Pd. 3	Pd.4
Opening Inventory ...(A)	---	8,000	8,500	7,500
Add: Production	17,500	17,500	17,500	17,500
Less: Demand/ Sales	9,500	17,000	18,500	25,000
Closing Inventory ...(B)	8,000	8,500	7,500	---
Average Inventory $\frac{(A+B)}{2}$	4,000	8,250	8,000	3,750
Inventory Holding Cost @ Rs.6.50	26,000	53,625	52,000	24,375

Inventory Holding Cost ***for the four periods*** = Rs 1,56,000

(Rs 26,000+ Rs 53,625+ Rs 52,000 + Rs 24,375)

Statement Showing 'Additional Cost-Overtime' under Plan 2 (JIT System)

Particulars	Pd. 1	Pd. 2	Pd. 3	Pd.4
Demand/ Sales	9,500	17,000	18,500	25,000
Production in Normal Time	9,500	17,000	18,000	18,000
Production in Over Time ...(A)	---	---	500	7,000
Variable Cost *per unit*	30.00	30.00	32.50	35.00
Additional Cost - Overtime *per unit* ...(B) (@ 30% of Variable Cost)	9.00	9.00	9.75	10.50
Additional Cost - Overtime ...(A) × (B)	---	---	4,875	73,500

Total Additional Payment (Overtime) = Rs 78,375
(Rs 4,875 + Rs 73,500)

Statement Showing 'Additional Variable Cost*' under Plan 2 (JIT System)

Particulars	Pd. 1	Pd. 2	Pd. 3	Pd.4	Total
Production (Plan 1)	17,500	17,500	17,500	17,500	70,000
Variable Cost ...(A)	5,25,000	5,25,000	5,68,750	6,12,500	22,31,250
Production (Part 2, JIT)	9,500	17,000	18,500	25,000	70,000
Variable Cost ...(B)	2,85,000	5,10,000	6,01,250	8,75,500	22,71,250
Total				...(B) - (A)	40,000

*excluding overtime cost

Incremental Production Cost in JIT System = Rs. 78,375 + Rs. 40,000
= Rs. 1,18,375

Therefore, Saving in JIT System (Net) = Rs. 1,56,000 - Rs. 1,18,375
= Rs. 37,625

.(ii) Advice

Though Revolution Ltd is saving 37,625 by changing its production system to Just-in-time but it has to consider other factors as well before taking any final call which are as follows:--

Revolution Ltd has to ensure that it receives materials f rom its suppliers on the exact date and at the exact time when they are needed. Credentials and reliability of supplier must be thoroughly checked.

To remove any quality issues, the engineering staff must visit supplier 's sites and examine their processes, not only to see if they can reliably ship high- quality parts but also to provide them with engineering assistance to bring them up to a higher standard of product.

.(ii) Advice

Though Revolution Ltd is saving 37,625 by changing its production system to Just-in-time but it has to consider other factors as well before taking any final call which are as follows:--

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To remove any quality issues, the engineering staff must visit supplier 's sites and examine their processes, not only to see if they can reliably ship high- quality parts but also to provide them with engineering assistance to bring them up to a higher standard of product.

Revolution Ltd should also aim to improve quality at its process and design levels with the purpose of achieving "Zero Defects' in the production process

Revolution Ltd should also keep in mind the efficiency of its work force. Revolution Ltd must ensure that labour's learning curve has reached at steady rate so that they are capable of performing a variety of operations at effective and efficient manner. The workforce must be completely retrained and focused on a wide range of activities.

JIT

Question 9 : (Nov, 2018 RTP) (Module)

A manufacturer is considering implementing Just in time inventory system for some of its raw material purchases. As per the current inventory policy, raw materials required for 1 month's production and finished goods equivalent to the level of 1 week's pro duction are kept in stock. This is done to ensure that the company can cater to sudden spurt in consumers' demand. However, the carrying cost of inventory has been increasing recently. Hence, the consideration to move to a more robust just in time purchasing system that can reduce the inventory carrying cost. Details relevant to raw material inventory are given below:

- Average inventory of raw material held by the company throughout the year is Rs.1 crore. Procurement of raw material for the year is Rs.12 crore. By moving to just in time procurement system, the company aims at eliminating holding this stock completely in its warehouse. Instead, suppliers of these materials are ready to provide the goods as per its production requirements on an immediate basis. Suppliers will now be responsible for quality check of raw material such that the raw material can be used in the assembly line as soon as it is delivered at the company's factory shop floor.
- Increased quality check service done by the suppliers as well as to compensate them for the risk of holding the inventory to provide just in time service, the company is willing to pay a higher price to procure raw material. Therefore, procurement cost will increase by 30%, total procurement cost will be Rs.15.6 crore per year. Consequently, quality check and material handling cost for the company would reduce by Rs.1 crore per year. Similarly, insurance cost on raw material inventory of Rs.20 lakh per year need not be incurred any longer.
- Raw material is stored in a warehouse that costs the company rent of Rs.3 crore per annum. On changing to Just in time procurement, this warehouse space would no longer be required.
- Production is 150,000 per year. The company plans to maintain its finished goods inventory equivalent to 1 week's production. Despite this, in order to have a complete cost benefit analysis, the management is also factoring the possibility of production stoppages due to unavailability of raw material from the suppliers. This could happen due to of delay in delivery or non-conformance of goods to the standard required. Labor works in one 8-hour shift per day and will remain idle if there is no material to work on. Due to stoppage of production for the above reason, it is possible to have stockout of 3,000 units in a year. Stockout represents lost sales opportunity due to unavailability of finished goods, the customer walks away without purchasing any product from the company. Therefore, in order to reduce this opportunity cost and to make up for the lost production hours, labor can work overtime that would cost the company Rs.10 lakh per annum. This is the maximum capacity in terms of hours that the labor can work. With this

overtime, stockout can reduce to 2,000 units.

- Currently, sale price of phone is Rs.5,000 per unit, variable production cost is Rs.2,000 per unit while variable selling, general and administration (SG&A) cost is Rs.750 per unit. Raw material procurement cost is currently Rs.800 per unit, that will increase by 30% to Rs.1,040 per unit under Just in time inventory system.
- On an average, the long-term return on investment for the company is 15% per annum.

Required

(i)CALCULATE the benefit or loss if the company decides to move from current system to Just in Time procurement system.

(ii) RECOMMEND factors that the management needs to consider before implementing the just in time procurement system.

Solution:

(i) Implementing Just in time procurement system will benefit the company by Rs. 11,27,000 per year as explained below: Therefore,

Particulars	Current Purchasing Policy (Rs.)	JIT Procurement System (Rs.)
Raw material procurement cost per year	12,00,00,000	15,60,00,000
Quality check and material handling cost (No longer required in JIT)	1,00,00,000	---
Insurance Cost on raw material inventory (No longer required in JIT)	20,00,000	---
Warehouse rental for storing raw material (No longer required in JIT)	3,00,00,000	---
Overtime Charges under JIT to reduce Stockouts (note1)	---	10,00,000
Stockout Cost (note 2)	---	40,20,000
Total Relevant Cost	16,20,00,000	1610,20,000

Therefore, moving to just in time procurement system results in savings of Rs.980,000 per year for the company. If reinvested, long term return on investment for the company at 15% would yield a return of Rs.147,000 per year.

.In addition, by switching over to JIT system, company will also save working capital requirement of Rs. 1 crore on account of average inventory of raw material held at present. Company can earn further 15% on this amount i.e. Rs 15,00,000 per year.

Therefore the total benefit for the company would be Rs. 26,27,000 per year.

Note 1: Should overtime cost be incurred to reduce Stockouts?

Contribution per unit = Sale price - Variable production cost - Variable selling, distribution cost per unit; Variable production cost under the just in time system = Rs.2,000+ Rs.(1,040-800) = Rs.2,240 per unit; Contribution per unit = Rs.5,000 - Rs.2,240-Rs.750 per unit = Rs.2,010 per unit.

Overtime cost can reduce stockouts from 3,000 units to 2,000 units that is customers' demand of 1,000 units more can be met.

Contribution earned from selling these 1,000 units = 1,000 × Rs.2,010 per unit = Rs.20,10,000.

Therefore, the contribution earned of Rs.20,10,000 is more than the related overtime cost of Rs.10,00,000. Therefore, it is profitable to incur the overtime cost.

Note 2: Stockout Costs

Out of the total shortfall of 3,000 units, by spending on overtime 1,000 units of demand can be met. Therefore, actual stockout units is only 2,000 units. As explained above, contribution per unit is Rs.2,010 per unit. Therefore, stockout cost = 2,000 units × Rs.2,010 per unit = Rs.40,20,000.

(ii)The company plans to eliminate its raw material inventory altogether. Raw material will be delivered as per production schedule directly at the factory shop floor, from whence production will begin. The management should therefore carefully consider the following points:

(a)The entire production process has to be detailed and integrated sequentially. This is essential to know because it should be known in advance when in the sub- assembly process is each raw material is required and in what quantity.

(b)Since production is dependent on delivery and quality of raw material, heavy reliance is being placed on suppliers. They should be able to guarantee timely delivery of raw material of the appropriate quality. The company is paying a premium of 30% of original cost, that is Rs.240 per unit (Rs.1,040 - Rs.800 per unit) in order to ensure the same. Each unit gives a contribution of Rs. 2,010 per unit, which is 40.2% of the sale price per unit. Lost sales opportunities due to unavailability of raw material or non-conformance of the material can result in substantial losses to the company. While, portion of this has been factored while doing the cost benefit analysis of implementing Just-in-time systems, it needs careful consideration and monitoring even after implementation. Therefore, to hedge its loss, the management and suppliers should agree on penalties or costs the supplier should incur should there be any delay or non-conformance in quality of materials beyond certain thresholds.

(c)Accurate prediction of sales trends is important to determine the production schedule and finished goods planning.

(d) Continuous monitoring of the system even after implementation is essential to ensure smooth operations. Management commitment and leadership support is essential for its successful implementation and working.

Takt time processing cycle efficiency

Question 10: (RTP May 20, Q.8) (Case Study Digest)

Pearson Metal and Motor Works (PM2W) deals in manufacturing of the copper wired electronic motor, which is specifically designed . PM2W is thinking to shift from traditional system to JIT system as part of process innovation .

CEO among the other top bosses at PM2W are hopeful that implementation of JIT will not only improve value in value chain for end consumer , but also improve overall manufacturing cycle efficiency. JIT pre-implementation team was formed to evaluate the probabilities , which collects following actual and estimated data about process;

Activity Category	Traditional System (Actual)	JIT System (Estimated)
Inspection	40	30
Storage	80	20
Moving	20	10
Processing	60	40

All data in minutes

Further, PM2W decided to practice single piece flow under JIT. PM2W received an order which is due to manufacture and delivered for 10 such motors. Total available production time to produce what customer demands is 480 minutes out of which it normal practice that 30 minutes will be spent in shutdown and cleaning. CEO is also considering JIT purchase apart from JIT production .

Required

(i)EXPLAIN just in time.

(ii)CALCULATE the 'takt time' and INTERPRET the results. (New Concept & Important)

(iii)ADVISE whether company should shift to JIT.

Solution

(i) Just-in-time (JIT) is a collection of ideas that streamline a company's production process activities to such an extent that wastage of all kind viz. , of time, material and labour systematically driven out of the process with single piece flow after considering takt time. In JIT, production facility is required to be integrated with vendor system for signal (Kanban) based automatic supply which depends upon demand based consumption. Under JIT system of inventory storage cost is at lowest level due to direct issue of material to production department as and when required and resultantly less/no material lying over in store or production floor. Prerequisite of JIT system is integration with vendor, if vendor is not integrated properly or less reliable , then situation of stock out can arise and which can result into loss of contribution. Multitasking by employee is another key

feature of JIT, group of employees should be made based upon product instead based upon function. Hence, functional allocations of cost become less appropriate .Overall , JIT enhance the quality into the product by eliminating the waste and continuous improvement of productivity.

(ii) Takt time is the rate at which you need to complete a product to meet customer demand. For eg: If you received a new product order every 4 hours, your team needs to finish a product in 4 hours or less to meet the demand.
Takt Time is the maximum available time to meet the demands of the customer; this will help to decide the speed of/ at manufacturing facility. Takt time is the average time between the start of production of one unit and the start of production of the next unit, when these production starts are set to match the rate of customer demand.

$$\text{Takt Time} = \frac{\text{Available Production Time}}{\text{Total Quantity Required}}$$

Here,
Available Production Time is 'total available time for production' - 'planned downtime i.e. spent in shutdown and cleaning' i.e. 450 minutes = 480 minutes - 30 minutes.
Total Quantity Required is 10 units

$$\text{Takt Time} = \frac{\text{450 Minutes}}{\text{10 Units}} = \text{45 Minutes}$$

Note - Heijunka can be applied in order to reduce variation between 'Takt times' over the production.

Interpretation
Customer's demand is 10 units, to calculate the takt time, divide the available production time (in minutes) by the total quantity required. The takt time would be 45 minutes. This means that process must be set up to produce one unit for every 45 minutes throughout the time available. As order volume increases or decreases, takt time may be adjusted so that production and demand are synchronized.

(iii) Advise on Shifting to JIT

To evaluate how much of the old cycle time was spent in inventory, we need to know how organizations assess the efficiency of their manufacturing processes. One commonly used measure is process cycle efficiency and to calculate the same every process is breakdown into combination of activities such as value added activities , non-value added activities and non-value added activities but

strategic activities. In order to generate highest value to customer, only value added activities are included in process. But those non-value added activities , which are strategic in nature, also need to be part of process . Therefore, it may be possible that entire process is not efficient.

To measure efficiency of process, managers keep track of the relation between 'times taken by value added activities' in comparison 'total cycle time'. Such relation/ratio is processing cycle efficiency.

$$\text{Process Cycle Efficiency} = \frac{\text{Value Added Time}}{\text{Cycle Time}}$$

Processing time is considered as value added time; whereas time spend on inspection , storage and moving is non-value added time and included in cycle time. The higher the percentage, less the time (and costs) needs to be spent on non-value added activities such as moving and storing etc.

Computation of Processing Cycle Efficiency

Sr. No.	Activity Category	Traditional System (Actual)	JIT System (Estimated)
A.	Inspection	40	30
B.	Storage	80	20
C.	Moving	20	10
D.	Processing	60	40
E.	Value Added Time ...(D)	60	40
F.	Cycle Time ...(A)+(B)+(C)+(D)	200	100
G.	Process Cycle Efficiency (E)/ (F)x100	30%	40%

Of the 200 minutes required for manufacturing cycle under PM2W's traditional system, only 60 minutes were spent on actual processing. The other 140 minutes were spent on non- value added activities , such as inspection, storage, and moving. The process cycle efficiency formula shows that processing time equaled to 30% of total cycle time. The cycle time is reduced substantially in the JIT system from 200 minutes to 100 minutes . In addition to this, the amount of time that used up in inventory i.e. non-value-added activities is also reduced. Therefore, process cycle efficiency has been increased from 30% to 40%. This significant improvement in efficiency over the previous system comes from the implementation of JIT system. Therefore , it is advantageous to shift to JIT system.

OEE

Question 11 : (RTP)

START AT 44:30 MIN

KIWI Ltd. manufactures spare parts and can be called "high volume based" manufacturing environment. The company is using the system of TPM for maintaining and improving the integrity of manufacturing process. There are several different automated manufacturing machines located in the plant, through which manufacturing of spare parts are done and supplied to cater the demand in the market.

A 12- hour shift is scheduled to produce a spare part in KIWI Ltd. as shown in the schedule below. The shift has three 15- minute breaks and a 10- minute clean up period.

Production Schedule for Automated machine NZ 10: Cycle: 10 (seconds),

Spare parts Manufactured: 3,360

SCRAP: 75

Unplanned Downtime: 36 minutes

Required

CALCULATE OEE (Overall Equipment Effectiveness) and comment on it.

Solution

Calculation of Planned Production Time

Total time (12 hrs. x 60 mins.)	720
Less: Planned downtime	
Break (3 x 15 mins.)	45
Clean up time	10
Planned Production Time	665

$$\text{Availability Ratio per shift} = \left(\frac{665 \text{ mins} - 36 \text{ mins}}{665 \text{ mins}}\right) \times 100$$

$$= \mathbf{94.59\%}$$

Actual Production = 3,360 parts

Standard time = 10 seconds

Standard Time Required = 3,360 parts x 10 seconds/ 60

= 560 minutes

Actual Time Taken = 665 mins. - 36 mins.

= 629 minutes

Performance Ratio = $\frac{560 \text{ Mins}}{629 \text{ Mins}} \times 100$

= 89.03%

Quality Ratio = $\left(\frac{3{,}360 \text{ parts} - 75 \text{ parts}}{3{,}360 \text{ parts}}\right) \times 100$

= 97.77%

Thus, **OEE** = 0.9459 x 0.8903 x 0.9777

= 82.34%

Comment: Since the OEE of KIWI Ltd is very close to 85% i.e. world class performance level, company should take measures to improve it and strive to attain 85% level. Availability Ratio of machine NZ 10 is 94.59% exceeding the ideal value of > 90% which is good but the Performance and Quality Ratios need attention as they are below their ideal values of . 95% and 99% respectively.

REVERSE OEE

Question 12. **(ICAI - RTP May 21 Question) (Module)**

Sheetal Bearing Balls Limited (SBBL) is the famous name for bearing balls of different sizes. Mr. Syal recently joined as Manager Production and Operations at Unit 3 of Ludhiana (in Punjab) plant of the SBBL, wherein 10mm diameter steel ball bearings for bicycles are manufactured. The plant is largely automated and lashed with the latest technology machines.

From Mr. Singh, Plant Accountant Mr. Syal come to know that since machines are of the latest technology and workers are motivated due to the liberal workman policy of SBBL, hence productivity and quality is and was never an issue, but availability is. Over lunch, when Mr. Syal greets Mr. Kumar, Plant Head, he also expresses his worry over excessive downtime and optimal use of limiting factors.

Mr. Syal, while navigating the ERP and reviewing the files & other documents handed over to him, which was prepared and maintained by his predecessor; come across the OEE rate of 93.555% measured during last week for machine '107-10M-Bearing' (which is limiting factor – caused bottleneck activity) during a normal shift. Since the said machine has a high-performance rate of 105%; hence Mr. Syal decided to dig deep into the composite OEE.

In the normal shift of 9 hours workers are allowed to take 2 short breaks of 15 minutes each and a lunch break of 30 minutes. During such a normal shift, out of the total manufactured 27,216 bearing balls by said machine, only 272 balls are found defective.

Required

(i) DETERMINE the unplanned downtime witnessed by machine 107-10M-Bearing and advise Mr. Syal, the best way-out to reduce the same (in brief).

(ii) MEASURE the Ideal Cycle Time to manufacture a single bearing ball.

(iii) APPLY, Goldratt's five steps that can be applied to remove the bottleneck at the Ludhiana plant of SBBL.

SOLUTION

(i) Unplanned downtime of machine 107-10M-Bearing

Overall equipment effectiveness (OEE) is a quantitative metric for measuring the productivity of individual equipment in a manufacturing plant. According to Seiichi Nakajima who introduced OEE, it is capable to identify and measure the losses in a manufacturing process through availability rate, performance rate, and quality rate.

OEE = Availability Rate × Performance Rate × Quality Rate

Quality Rate

Particulars	Units
Output units – total count	27,216
Rejected units out of the above	272
Good units – good count (which met the quality criteria) (27,216 - 272)	26,944
Quality Rate (Good Counts / Total Counts) (26,944 units / 27,216 units) ? 99.00%	

Since the quality rate is 99.00% and performance rate (105%), as well as overall equipment effectiveness (93.555%), is also given in the case; hence availability rate can be measure-

Availability Rate × 105.00% × 99.00% = 93.555%

The Availability rate is 90% i.e., run time [or net operating time (NOT)] / planned production time [or net available time (NAT)]

Planned Production Time

Particulars	Time in minutes
Total possible time (9 hours × 60 minutes) [scheduled time]	540
Less: Planned down time [scheduled loss]	
Short breaks (2 breaks × 15 minutes)	30
Meal break (30 minutes)	30
Planned production time	**480**

Since the Availability rate is 90% and planned production time is 480 minutes, hence run time shall be 432 minutes (run time / 480 minutes = 90.00%).

Since unplanned downtime is the difference between run time and planned production time, hence unplanned downtime of machine 107-10M-Bearing is 48 minutes.

Particulars	Time in minutes
Planned production time	480
Less: Run time (actual time taken)	432
Unplanned Downtime	**48**

Note: Alternate Working

Unplanned downtime = Planned production time (1 – availability rate) 480 minutes (1 - 90%) = 48 minutes.

Advise– In order to reduce the unplanned downtime, preventive maintenance shall be practiced either before or after each shift; and the shine (out of 5S) principle shall be adopted by the workman as part of the TPM initiative. It is expected that the time spends on preventive maintenance will be less than the current unplanned downtime of 48 minutes.

Alternate advices are also possible, provided shall be valid and reasonably relevant.

(ii) Ideal Cycle Time to manufacture a single bearing ball

Performance rate can be computed by dividing standard time required [or ideal operating time] with run time. Since performance rate (105%) is given in the case and run time (432 minutes) computed above; hence the standard time required to manufacture 27,216 bearing balls is 453.6 minutes (standard time required / 432 minutes = 105.00%)

So, standard time required to manufacture a single bearing ball (i.e., ideal cycle time) is 1 (one) second (453.6 minutes × 60 / 27,216 balls) i.e., 60 bearing balls per minute.

Note: Alternate Working

OEE = (Good count × Ideal cycle time) / Planned production time

93.555% = (26,944 × Ideal cycle time) / 480 minutes

Ideal cycle time = 1 second per bearing ball

For Your Understanding

Seiichi Nakajima led the introduction of TPM, OEE and the Six Big Losses in the early 1970s while at the Japanese Institute of Plant Maintenance. OEE is a quantitative metric for measuring productivity of individual equipment in a manufacturing plant. OEE identifies and measures losses of crucial parts in a manufacturing process namely availability rate, performance rate and quality rate.

OEE = Availability × Performance × Quality

OEE Factors are calculated as follows–

1. Availability: NOT / NAT = (432 / 480) × 100 = 90.00%
2. Performance: IOT / NOT = (453.60 / 432) × 100 = 105.00%
3. Quality: (IOT – LOT) / IOT = (453.60 – 4.533….) / 453.60 × 100 = 99.00…%

OR

$$\left\{\frac{27{,}216 \text{ units} - 272 \text{ units}}{27{,}216 \text{ units}}\right\} \times 100$$

OEE = A × P × Q = 90.00% × 105.00% × 99.00…% = **93.555…%**

Alternative Presentation-I

Good Counts = 27,216-272 = 26,944 units

Planned Production Time= 540 mins. – 60 mins. = 480 mins. (or NAT) OEE = (Good Counts × Ideal Cycle Time)/ Planned Production Time

{(26,944 / 60 units (per min.)} / 480) x 100 = **93.555…%**

Alternative Presentation-II

OEE = (Ideal operating time –loss operating time)/ Net Available Time

{(453.60 – 4.533….)/ 480} × 100 = 93.555…%

Workings

1. Scheduled Time (total time) = 540 Minutes (9hrs. × 60 mins.)
2. Planned Down Time = 2 short breaks × 15 minutes + meal break 30 minutes = 60 minutes
3. Net Available Time (NAT) = 540 – 60 = 480 minutes
4. Unplanned Downtime = 48 minutes
5. Net Operating Time (NOT) = Net Available Time – Unplanned Downtime NOT = 480 – 48 = 432 minutes
6. Ideal Operating Time (IOT): 27,216 total units / 60 (units per min.) = 27,216 / 60 = 453.60 minutes
7. Lost Operating Time (LOT): 272 units / 60 (units per min.) = 272 / 60 = 4.533… minutes

Question 13. (SBAQ - Question 5) (RTP MAY 21)

Delight Engineering Solutions (DES)

Delight Engineering Solutions (DES) (a hypothetical company) is manufacturing product CAF-5 from use of single raw material CAI-100. The two major departments operational in Delight Engineering Solution are purchase and production. DES is facing high competition due to large number of competitors in market. Demand of CAF-5 is fluctuating, therefore high storage cost is prime cause of low financial performance. DES Company decided to move from traditional system to JIT system.

From purchase and store following data is collected. Annual consumption is of 1,800 units of CAI-100. List Price of each unit of CAI-100 is Rs. 4,000. The cost of placing order is Rs.2,000 and cost of carrying one unit of CAI-100 for a year is 2%. Company presently use EOQ model of ordering.

Purchase Manager further estimated that, if JIT system of inventory is implemented, ordering cost will increase by 50% from current level, whereas carrying cost can be avoided up-to 90%. But there is prospective order of 5 units of CAF-5 which can't be served, due to non-availability of stock and failure of delivery by supplier. Contribution from each unit of CAF-5 is Rs. 1,200. Stock insurance cost will reduce by Rs. 400 on annual basis. There will also be reduction in working capital requirement, which will result in interest saving of Rs. 500 on Annual basis.

Further, Production and Engineering department supported by marketing department provide details that presently average production of CAF-5 is 150 units of per month, although for next 4 months expected demand will be 120, 160, 140, 180 units. Maximum capacity from man-hours perspective is 150 units. 20 man-hours required for producing each unit and labour rate per hour is Rs. 3. Casual labour is not available in market. Overtime rate will be 200%. Average monthly cost of storage of each item of CAF-5 is Rs.65.

Required

(i) EXPLAIN the JIT purchasing & JIT production and the effect of its introduction.
(ii) COMPUTE cost savings if it moves to JIT Purchasing.
(iii) COMPUTE cost savings if it moves to JIT Production.

Solution

(i) Just-in-time (JIT) is a collection of ideas that streamline a company's production process activities to such an extent that wastage of all kind viz., of time, material and labour systematically driven out of the process.

JIT purchasing suggests that materials should only be purchased as and when required. While JIT production shows that finished products should only be produced as and when required by customers. Whereas in traditional manufacturing system, to smooth out production and to meet forecasted demand, materials and finished goods are stored in advance.

JIT Purchasing reduces the inventory level which will result in reduction of carrying cost of inventory, as well as reduces the level of working capital which will save the opportunity cost in form of interest expenditure. On the other hand, JIT Production gives opportunity to customize the product as per customers' needs, conformance to customers' need is essential to quality. It also reduces the level of working capital which save the opportunity cost in form of interest expenditure.

Prerequisite of JIT purchasing or production is integration with vendor, if vendor is not integrated properly or less reliable, then situation of stock out can arise and which can result into loss of contribution.

Multitasking by employee is another key feature of JIT, group of employees should be made based upon product instead based upon function. Hence, functional allocations of cost become less appropriate.

Overall, JIT enhance the quality into the product by eliminating the waste and continuous improvement of productivity.

(ii) Cost Savings in JIT Purchasing

Reorder Size under present regime:

Under current scenario reorder size of CAI-100 will be EOQ. Formula for EOQ is mentioned below-

$$\sqrt{\frac{2 \times A \times O}{C}}$$

Where:

A = Annual Consumption i.e., 1,800 units of CAI-100

O = Ordering Cost per order i.e., 2,000 per order

C = Carrying Cost per unit per annum i.e., Rs. 80 (2% of Rs. 4,000) per unit per annum

$$\sqrt{\frac{2 \times 1{,}800 \times 2{,}000}{80}}$$

EOQ (reorder size under present regime) of CAI-100 is 300 Units

Cost Comparison under present and JIT regime (annual basis)

Particulars	Present System (Rs.)	JIT System (Rs.)
Ordering Cost (1,800 units/ 300 units) × Rs. 2,000 JIT-150% of present cost	12,000	18,000
Carrying Cost (300 units/2 × Rs. 80) JIT- Reduced by 90% in comparison to present cost	12,000	1,200
Stock-out Cost (5 units × Rs. 1,200)	-	6,000
JIT- Reduction in Stock Insurance Cost on annual basis	-	(400)
Opportunity Cost (saved) on reduced amount of working capital on annual basis	-	(500)
Net Cost of Inventory Management	**24,000**	**24,300**
Incremental Cost in shifting to JIT	**(300)**	

Since implementation of JIT Purchasing results in **incremental cost of Rs.300** per annum basis, hence it is **not economically worth** to move to JIT system of inventory purchase.

(iii) Cost Savings in JIT Production

Carrying Cost in Present Scenario (for next four months)

Month	I	II	III	IV
Opening Stock	-	30	20	30
Add: Production	150	150	150	150
Less: Demand	120	160	140	180
Closing Stock	30	20	30	-
Average Stock*	15	25	25	15
Carrying Cost (Rs. 65 per unit)	975	1,625	1,625	975
Total Carrying Cost for 4 months				**Rs. 5,200**

*Average Stock = Opening Stock + Closing stock/2

Student Notes:

Overtime Cost in JIT Scenario (for next four months)

Month	I	II	III	IV
Demand	120	160	140	180
Production	120	160	140	180
Bottleneck	150	150	150	150
Shortfall*	-	10	-	30
Labour hrs. as overtime required (20 hours for each unit of CAF-5)	-	200	-	600
Overtime Cost (Payment at rate of Rs. 6 per hour)	-	Rs.1,200	-	Rs.3,600
Total Overtime Cost for 4 months	**Rs.4,800**			

*Shortfall good need to produce in overtime, due to limited man-hour available and casual labour is not available in market.

Based upon comparative cost for upcoming four month under present and JIT scenario, there is **cost saving of Rs.400** (Rs.5,200 vs. Rs.4,800) in move to JIT system production. Hence, it is economically **worth** to move to JIT Production.

14. Case Scenario 2 – Kanban System
Surmount Cable Cars (SCC) (Case study digest)

Surmount Cable Cars (SCC) engaged in assembly of cabin used on ropeways. In order to assemble cabin, 3 major parts of different shapes and sizes are used. These parts are assembled with help of specially designed dome nut and bolt made of brass (Product Code – Brass DIN 85), which are manufactured by Reliable Hardware and Metal Works. Plant layout design of SCC comprises assembly line, where multiple products are assembled at one point of time. Hence there are multiple workers, who are using such nut and bolts simultaneously. Such nut and bolts come in set along with washer and all three spares collectively consider as set.

Since the plant facility of SCC is situated in remote area hence majority of worker are either unskilled or semi-skilled and literacy rate is also low among workers. This causes variety of problems including not informing production supervisor, about the re-ordering of such (Brass DIN 85), a class of store and spares items. Due to ignorance in workers towards understanding of the stock levels and their relevance, many a times stock of such spares ordered later then it should be, hence got out of stock. This further leads to stock out situation in some of the cases, which result in contribution loss.

Reliable Hardware and Metal Works (RHMW) is long standing supplier of Brass DIN 85 to SCC, hence reliable in term of both quality and delivery time. RHMW took single day as lead- time to deliver the re-ordered quantity. Despite the reliability of supplier SCC wish to maintain safety stock equivalent to 3 (three) days consumption for production facility. SCC is using latest version of SAP as enterprise resource planning, which is installed just 3-4 month back. Employees are being trained to use the respective modules of SAP and integration among various function/modules is ongoing.

Plant of SCC works for 6 days in a week and during a week period 1,200 units of Brass DIN 85 is required for production. Consumption of Brass DIN 85 in order to assemble the cabin cars are constant through-out the year. SCC during first phase of its drive to implement lean manufacturing, is working on its operational efficiency and tries to reduce inventory by introducing a Kanban system.

Required

(i) EXPLAIN the Kanban in inventory management for entity like SCC? Also, EXPLAIN Kanban be applied to non- manufacturing entities?

(ii) CALCULATE is Kanban size and number of Kanban required in case of SCC?

(iii) LIST the factors to be considered and specific precautions/pre-requisites, prior to SSC took task of applying Kanban system.

Solution

(i) Kanban system is a **visual signal-based** workflow management technique. Taiichi Ohno an industrial engineer, developed the first Kanban system for Toyota automotive in Japan.

Kanban in inventory management

Kanban can be used in **pull system of inventory,** where supplier supplies the material based upon consumption. Kanban (a yellow line, originally used in Toyota) is **visual cue** to worker (may be unskilled or even illiterate) to understand that further material is required. Kanban **reduce the cycle time and enhance the predictability,** in order to promote value to customer. Kanban system hold specific amount of material (divided in Kanban Size). Kanban system also maintain information regarding quantity, storage location, vendor and details on product/part.

While calculating Kanban size and number of Kanban required following assumption need to be taken-

- Consumption is constant throughout the period; else smoothing factor need to be used in calculation of Kanban size.
- The supplier will deliver material directly to the point of use area (assembly line)
- Requirement in term of space to store number of Kanban is met.

Kanban in non-manufacturing facilities

Kanban originally designed for manufacturing entities but can be applied to non-manufacturing concern as well, for smoothening of workflow rather inventory management. In Kanban, signal based dashboard is used to manage and improve the flow of work to be followed and also categories the work into to do, on-going and done (in some of cases backlog category also be added).

(ii) Kanban Size and Number of Kanban

Kanban Size can be calculated using formula i.e. **(C) x (LT) x (L) x (SF)**

Whereas C stands for consumption,

LT stands for lead time (Note – Lead Time should be in terms of consumption pattern means if consumption is considered for week/s time then lead time shall also be considered in term of week/s)

L stands for location of Kanban (Note - When so even any entity implement the Kanban then keep one container of material at both the location (entity it-self and supplier), hence L is 2 unless otherwise provided)

SF stands for smoothing factor, which is used to set-off seasonal variations in

consumption; obviously if consumption and level of stock throughout the period remain same then smoothing factor can be one.

Calculation of Kanban Size

C – Consumption per day is **200** i.e., 1,200/6
LT – Lead time is **1** days
L – Locations are **2** (RHMW and SCC) and
SF – Smoothing Factor is **1**
Therefore, the **Kanban Size is** 200×1×2×1 = **400 Units** in each Kanban.
Note – EOQ can also be practice as Kanban size

Number of Kanban depends upon the maximum quantity of inventory which comprises of demand/consumption during lead period and quantity of safety stock. It can be determined using following formula–

$$\text{Number of Kanban} = \frac{\text{Quantity of safety stock + consumption during lead period}}{\text{Kanban Size}}$$

(iii) Factors to be considered and specific precautions/pre-requisite to Kanban system

Kanban try to **smoothen the workflow** process by 'visualise the flow of the work, reducing WIP, managing process, making process policies explicit, incorporate feedback and using scientific techniques'. In order to do so, while applying Kanban system SCC need to consider following factors–

1. Will supplier ready to supply material in the lot **size equal to Kanban Size?**
2. Will supplier participate in pull system of inventory and **agree** upon Kanban Stocking program? – reliability on supplier.
3. Will supplier agree to **supply material directly at point of use** i.e., assembly line?
4. Is the **consumption pattern** comprising significant variations or constant throughout?
5. What is **requirement regarding handling and storage** of material?
6. **Contribution margin** on sale of product in which raw material is used.

Note – these factors have major impact on calculation of Kanban size as well.

Some specific precautions for SCC

1. Since the worker are unskilled and literacy rate is low among them hence it is needed to be assured that **worker must understand the visual cue.** Training can be provided to them.

2. **Demand/Consumption need to be predicted with reasonable assurance** in order to implement Kanban, although one thing, which is in favour to SCC is that it knows the consumption of Brass DIN 85 is constant throughout the period..
3. SAP which is used as **ERP** system in SCC, **need to be integrated with suppliers** system in order to practice pull system of inventory and various modules of SAP need to be tightly integrated.

Question 15. (RTP May 21) (RTP/module)

It has been resolved that cellular manufacturing shall be adopted in order to improve productivity, in the recent board meeting of Raptor Bearing and Shaft Limited. In favour of the resolution, Mr. Nayak (the executive director) who is responsible for production and operation function gave a briefing over different layouts of cells. The Managing Director, Mr. Syal believes that each possible cell formation and layout need to be studied in advance by a cross functional team.

Chief HR officer Mr. Mishra shown his concern over the utility of cellular manufacturing to enhance productivity. In response to him, Mr. Nayak mentioned 'Although scientific management is quite an old theory of management pronounced by Frederick Winslow Taylor, which analyses and synthesizes workflows with the objective of improving economic efficiency, especially labour productivity; but still has relevance. This relevance multi-folds when Time and Motion studies are considered in nexus with cellular manufacturing'.

Mr. Nayak constituted a cross-functional team with the term of reference stated in said board resolution. You are also part of teams as a representative of Management Accounting Division. The team started with the study of different possible layouts and machine cell designs. While analysing the production flow it is observed that 5 different parts/ components (P101, P104, P105, P107, and P108) are complexly involved in processing at 5 different machines (M2, M7, M13, M13A, and M15).

Part-Machine Incident Matrix for Production Flow Analysis for the said product is given below-

	P101	P104	P105	P107	P108
M2	1*				
M7		1#			1
M13	1*			1	
M13A		1#	1		
M15				1	

Interpretation

(*) P101 requires processing at M2 and M13, whereas (#) P104 requires processing at M7 and M13A.

Required

(i)DISCUSS the concern expressed by Mr. Mishra over the utility of cellular manufacturing.

(ii) EXPLAIN on utility of at-least three machine cell designs, which can be used.

(iii) FIND logical part families and machine groups based upon Part-Machine Incident Matrix to showcase Machine-Part grouping using Rank Order Clustering Algorithm.

Solution

(i) Cellular manufacturing is a lean way to enhance productivity by improving (reducing) the performance in the context of time and motion involved in the production.

Cellular manufacturing is an application of **group technology** in the manufacturing in which all or a portion of a firm's manufacturing system has been converted into **manufacturing cells.**

Here is important to note that a manufacturing cell is a cluster of machines or processes located in close proximity and dedicated to the manufacturing of a family of parts.

Cellular Manufacturing results in following benefits to improve productivity–

(a) Reduce setup times by using part family tooling and sequencing.

(b) Reduce flow times by reducing material handling and transit time and using smaller batch sizes (even single piece flow – this also results in the requirement of less floor space).

(c) Reduce lead time.

(d) Reduced work-in-process inventory.

(e) Better use of human resources. Hence, reduced direct labour but heightened sense of employee participation.

(f) Better scheduling, easier to control, and automate.

(g) Increased use of equipment & machinery, hence reduced investment on machinery & equipment.

Hence, concern expressed by Mr. Mishra, regarding the utility of cellular manufacturing to enhance productivity is not material.

(ii) The Machine Cell Design can be classified based on the number of machines and the degree to which the material flow is mechanized between the machines. The most common designs are–

(a) Single Machine Cell consists of a machine plus supporting fixtures and tooling to make one or more part families. This can be applied (useful) to work parts that are made by one type of process such as turning or milling.

(b) Group Machine Cell with manual handling consists of more than one machine used collectively to one or more part families and no provision for mechanical part movement between machines. In this, human operators run the cell and perform material handling.

Note– If the size of the part is huge or there is a large number of machines in the cell, then regular handling crew may be required.

Preferable cell shape is U-shaped (single/few workers). U shape is useful in the movement of multi-functional workers.

Since the design simply includes certain machines in the group and restrict their use for specified part family hence often achieved without rearranging the process type layout; So, bring the cost-saving (on rearranging) but lock-in material handling benefits of group technology.

(c) **Group Machine Cell with semi-integrated handling** consists of more than one machine used collectively to one or more-part families and uses a mechanical handling system, such as conveyor, to move parts between machines in the cell.
Note– There may be in-line layout (identical or similar routing - machines are laid along a conveyor to match the processing sequence) and loop layout (allows parts to circulate in the handling system and permits different processing steps in the different parts in the system).

(d) **Flexible Manufacturing System** is a highly automated machine cell in group technology that combines automated processing stations with a fully integrated material handling system.

(iii) Rank Order Clustering Algorithm to form machine-part groups–

Assign Binary Weight ($BW_j = 2^{n-j}$) to each column j of the matrix, where n =5 (the number/ types of components). Calculate the Decimal Equivalent (DE_i) of the binary values of each row i using the formula:

$$De_i = \sum_{j=1}^{n} = (Bw_j)\,(a_{ij})$$

Rank the rows in decreasing order of their DEi values i.e., the largest value is ranked as 1.

j / i	P101	P104	P105	P107	P108	DEi	Rank
M2	1					16	2
M7		8 1			1 1	9	4
M13	1			1		18	1
M13A		8 1 +	4 1			12	3
M15				1		2	5
BWj	2^{5-1} =	2^{5-2} =	2^{5-3} =	2^{5-4} =	2^{5-5} =		
	16	8	4	2	1		

Now, Re-arrange the rows in the running order of the rankings.mSince further rearrangement is necessary, assign Binary Weight ($BW_i = 2^{m-i}$) to each row i of the matrix, where m =5 (the number of machines). Calculate the Decimal Equivalent (DE_j) of the binary values of each column j using the formula:

$$De_j = \sum_{I=1}^{m} = (Bw_i)\,(a_{ij})$$

Rank the columns in decreasing order of their DEj values i.e., the largest value is ranked as 1.

i \ j	P101	P104	P105	P107	P108	BWi	
M13	1			1		2^{5-1}=	16
M2	1					2^{5-2}=	8
M13A		1	1			2^{5-3}=	4
M7		1			1	2^{5-4}=	2
M15				1		2^{5-5}=	1
DEj	24	6	4	17	2		
Rank	1	3	4	2	5		

Now, Re-arrange the columns in the running order of the rankings.nSince further rearrangement is necessary, assign **Binary Weight** ($BW_j = 2^{n-j}$) to each column j of the matrix, where n =5. Calculate the **Decimal Equivalent** (DE_i) of the binary values of each row i using the formula:

$$De_i = \sum_{j=1}^{n} = (Bw_j)\,(a_{ij})$$

Rank the rows in decreasing order of their DEi values.

i \ j	P101	P107	P104	P105	P108	DEi	Rank
M13	1	1				24	1
M2	1					16	2
M13A			1	1		6	4
M7			1		1	5	5
M15		1				8	3
BWj	2^{5-1} =	2^{5-2} =	2^{5-3} =	2^{5-4} =	2^{5-5} =		
	16	8	4	2	1		

Now, **Re-arrange** the rows in the running order of the rankings.mSince further rearrangement is necessary, assign **Binary Weight** ($BW_i = 2^{m-i}$) to each row i of the matrix, where m =5. Calculate the **Decimal Equivalent** (DE_j) of the binary values of each column j using the formula:

$$De_j = \sum_{I=1}^{m} = (Bw_j)\,(a_{ij})$$

Rank the columns in decreasing order of their DE_j values.

i \ j	P101	P107	P104	P105	P108	BWi	
M13	1	1				$2^5-1=$	16
M2	1					$2^5-2=$	8
M15		1				$2^5-3=$	4
M13A			1	1		$2^5-4=$	2
M7			1		1	$2^5-5=$	1
DEj	24	20	3	2	1		
Rank	1	2	3	4	5		

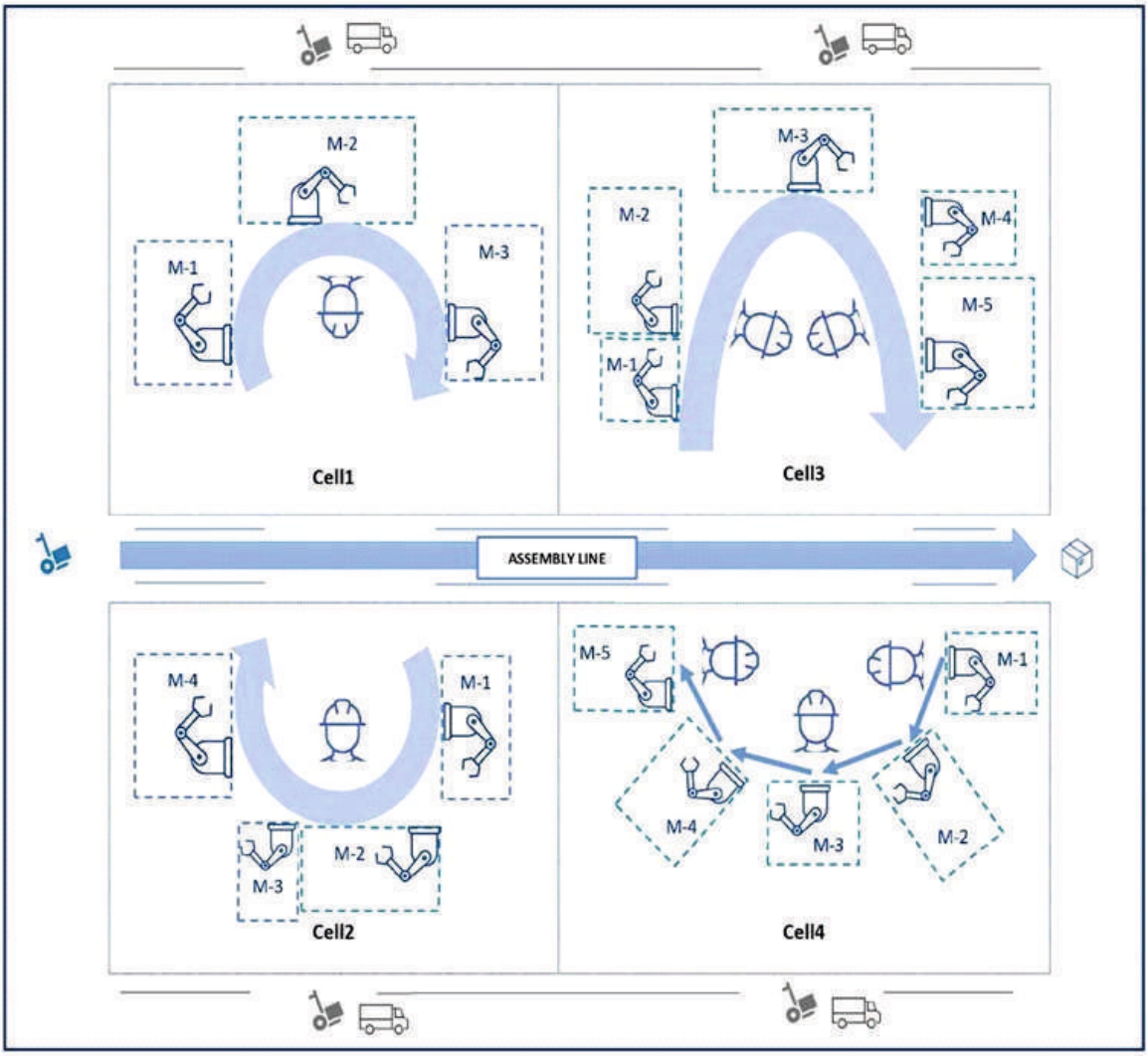
Since the ranking is now neatly arranged in order, stop the process. We can now identify the groupings.

Part Families and Machine Groups

Cluster/Cell	Part	Machine
I	P101andP107	M13,M2,andM15
II	P104,P105,andP108	M13AandM7

Student Notes:

Flow Shop or Assembly Line Workflow



Note- This illustrative layout has been given to assist students to comprehend the concept of **U-Shaped** Cells with single/ few workers.

Q.	Concept	Resource	Pg
16	Target Costing	Past paper	48-51
17	Pareto analysis	Module	52-53
18	EMA with ABC	Past paper	54-59
19	Target Costing	Module	60-61
20	Target Costing	Module	62-65
21	Target Costing with JIT	Module	66-73
22	Theory Qn on EMA	Module	74-75
23	EMA Classification of environment cost	RTP M22	76-79
24	Life cycle cost	Module	80-82

CHAPTER 4 REVISION VIDEO

SCAN QR OR CLICK HERE

Target Costing

Question 16 : (Past Paper)

NEC Ltd. manufactures two parts "P" and "Q" for Computer Industry.

P: Annual Production and sales of 1,00,000 units at a selling price of Rs 100.05 per unit.

Q: Annual Production and sales of 50,000 units at a selling price of Rs 150 per unit.

Direct and indirect costs incurred on these two parts are as follows:

(Rs in thousands)

Particulars of Cost	P	Q	Total
Direct Variable Cost (Variable)	4,200	3,000	7,200
Labour Cost (Variable)	1,500	1,000	2,500
Direct Machining Cost (See Note)*	700	550	1,250
Indirect Costs			
Machine Set Up Cost			462
Testing Cost			2,375
Engineering Cost			2,250

Note:Direct machining costs represents the cost of machine capacity dedicated to the production of each product. These costs are fixed and are not expected to vary over the long-run horizon.

Additional Information is as follows:

	P	Q
Production Batch Size	1,000 units	500 units
Set Up Time per batch	30 hours	36 hours
Testing Time per unit	5 hours	9 hours
Engineering Cost incurred on each product	8,40,000	14,10,000

A foreign competitor has introduced product very similar to "P". To maintain the company's share and profit, NEC Ltd.has to reduce the price to Rs 86.25. The company calls for a meeting and comes up with a proposal to change the design of the product "P". The expected effect of new design is as follows:

- Direct Material cost is expected to decrease by Rs 5 per unit.
- Labour Cost is expected to decrease by Rs 2 per unit.
- Machine Time is expected to decrease by 15 mins, previously it took 3 hours to produce 1 unit of P. The machine will be dedicated to the production of new design.

- Set up time will be 28 hours for each set up.
- Time required for testing each unit will be reduced by 1 hour.
- Engineering cost and batch size will remain unchanged.

Required:

(i) Company management identifies that cost driver for Machine Set Up cost is "Set up" hours used in batch setting and for testing costs is "testing time". Engineering costs are assigned to products by special study. Calculate the full cost per unit for P and Q using Activity Based Costing.

(ii) What is the mark up on full cost per unit of P?

(iii) What is the target cost per unit for new design to maintain the same markup percentage on full cost per unit as it had earlier? Assume cost per unit of cost drivers for the new design remains unchanged.

(iv) Will the new design achieve the cost reduction target?

(v) List four possible management action that the NEC Limited should take regarding new design.

Solution:

Working Notes:

	Particulars	P	Q
(a)	Production/Sales Quantity (units)	1,00,000	50,000
(b)	Batch Size (units)	1,000	500
(c)	No.of Batches .... (a/b)	100	100
(d)	Set up Time per batch (hours)	30	36
(e)	Total Set Up Hours ..... (c x d)	3,000	3,600
(f)	Machine Set Up Cost Rs 4,62,000		
(g)	Cost driver per Machine Setup Hour = Rs 4,62,000 / 6,600 hours = Rs 70		
(h)	Testing Time per Unit (Hours)	5	9
(i)	Total Testing Time (hours) .....(a x h)	5,00,000	4,50,000
(j)	Testing Cost Rs 23,75,000		
(k)	Cost Driver per Testing Hour = Rs 23,75,000/ 9,50,000 hours = Rs 2.50		

Statement Showing "Cost per unit – Activity Based Costing"

Particulars of Cost	Basis	P	Q
Direct Material	Direct	42,00,000	30,00,000
Direct Labour	Direct	15,00,000	10,00,000
Direct Machine -Cost	Direct	7,00,000	5,50,000
Machine Set Up Cost	3000 hours @ Rs 70 3600 hours @ Rs 70	2,10,000 -----	---- 2,52,000
Testing Cost	5,00,000@ Rs 2.50 4,50,000 @ Rs 2.50	12,50,000 ---	---- 11,25,000
Engineering Cost	Allocated	8,40,000	14,10,000
Total Cost (Rs)		87,00,000	73,37,000
Cost per unit (Rs)		87.00	146.74

Statement showing "Mark Up (Full Cost Basis)- Product P"

Particulars	Per Unit
Selling Price	100.05
Less: Full Cost	87.00
Markup	13.05
Percentage of MarkUp on Full Cost (13.05/87.00 x 100)	15%

Statement showing "Target Cost of Product P"

(After New Design is Implemented)

Paticulars	Amount (Rs)
Target Price (Given)	86.25
Markup (86.25 / 115.00 x 15)	11.25
Target Cost per unit	75.00

Statement showing "Cost of P" (New Design)

Particulars of Cost	Basis of Cost	Rate*	Total Cost
Direct Material	Decrease by Rs 5 p.u	37.00	37,00,000
Direct Labour	Decrease by Rs 2 p.u	13.00	13,00,000
Direct Machining Cost	No Change as Machine is Dedicated	7.00	7,00,000
Machine Set up Cost	100 Set up x 28 hours x Rs 70	1.96	1,96,000
Testing Cost	1,00,000 units x Rs 2.50 x 4 hrs	10.00	10,00,000
Engineering Cost	No Change	8.40	8,40,000
Total Cost		77.36	77,36,000

*** Rate per unit**

The target cost is Rs 75 per unit and estimated cost (new design) is Rs 77.36 per unit. The new design does not achieve the target cost set by NEC Ltd. Hence the target markup shall not be achieved.

(v) Possible Management Action

- Value engineering and value analysis to reduce the direct material costs.
- Time and motion study in order to redefine the direct labour time and related costs.
- Exploring possibility of cost reduction in direct machining cost by using appropriate techniques.
- Identification of non- value added activities and eliminating them in order to reduce overheads.
- The expected selling price based on the estimated cost of Rs 77.36 per unit is (Rs 77.36 + 15%) Rs 88.96. Introduce sensitivity analysis after implementation of new design to study the sales quantity changes in the price range of Rs 86.25 to Rs 88.96.

Pareto Analysis

Question 17: (ICAI Exam Module Question)

The information given below pertains to ABC Enterprises, a specialized car garage door installation company. ABC Enterprises use to get multiple service calls from the customers with variety of requirements. They may have to Install, Replace, Adjust or Lubricate some part or other to make the door functional. They work with 5 parts as given in the table, namely Door, Motor, Track, Trimmer and T-Lock.

	Parts	Typeof Service				Total
		Install	Replace	Adjust	Lube	
1	Door	2	5	1	0	**8**
2	Motor	3	2	16	9	**30**
3	Track	5	0	6	6	**17**
4	Trimmer	14	6	0	0	**20**
5	T-Lock	5	0	1	0	**6**
6	Miscellaneous	0	2	1	1	**4**
	Total	**29**	**15**	**25**	**16**	**85**

Required

(i) Using the above data, carry out a Pareto Analysis (80120 rule) of Total Parts.

(ii) Using the same data carry out the second level Pareto Analysis on the type of services with respect to Motors only.

(iii) Give your RECOMMENDATIONS on the basis of your calculations in (i) and (ii) above. (Do calculations to two decimals only)

OR

STATE the business situations in which you recommend to apply Pareto Analysis.

(i) Statement Showing "Pareto Analysis of Total Parts"

Parts	No.of Items	% of Total Items	Cumulative Total
Motor	30	35.29	35.29%
Trimmer	20	23.53	58.82%
Track	17	20.00	78.82%
Door	8	9.41	88.23%
T-Lock	6	7.06	95.29%
Miscellaneous	4	4.71	100.00%

(ii) Statement Showing "Pareto Analysis of Type of Services (Motor)"

Typeof Services	No.of Items	% of Total Items	Cumulative Total
Adjust	16	53.33	53.33%
Lube	9	30.00	83.33%
Install	3	10.00	93.33%
Replace	2	6.67	100.00%
	30		

(iii) Pareto Analysis is a rule that recommends focus on most important aspects of the decision making in order to simplify the process of decision making. The very purpose of this analysis is to direct attention and efforts of management to the product area where best returns can be achieved by taking appropriate actions .

Pareto Analysis is based on the 80/20 rule which implies that 20% of the products account for 80% of the revenue. But this is not the fixed percentage rule. In general business sense, it means that a few of the products, goods or customers may make up most of the value for the firm.

The present case stands in a difference to 80/20 rule. Because the company installs doors, they sometimes have multiple service calls to install each door piece by piece. They may have to install, replace, adjust, or lubricate some part to get the door working properly. They work with five main parts: door , motor, track, trimmer and lock. The service calls with reference to motors are heavy and accounted for as much as 35.29% of the number of calls attended. Motor together with trimmer accounted for 58.82%. So, these two parts are to be considered as key parts and ABC enterprises must be ever ready to cater to all provisional requirements for attending these classes without any inordinate delay. Any delay in service these calls is likely to damage its service rendering reputation within a very short span of time. Further, the second level Pareto Analysis on motors has revealed a particular reference to the service problems related to motors. Adjustments and Lubrication issues cover up 83.33% of the total service problems exclusively connected to Motors. So, ABC Enterprise must direct its best efforts and develop specific expertise to solve these problems in the best interest of the customers.

Useful application of Pareto Analysis explained few pages back. (All 5 points)

EMA with ABC

Question 18: (ABC+EMA) (May 19, ICAI Question. 3) (Past paper)

Excel Ltd. is the leading manufacturer and exporter of high quality leather products - Product A and Product B.

Selling price per unit of Product A and Product B is Rs. 620 and Rs. 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 per unit	140	180	140	460
Direct Labour per unit	90	120	90	300
Cost allocation to Product A	70%	50%	70%	
Cost allocation to Product B	30%	50%	30%	

General overheads per unit of leather products manufactured are Rs. 230 which is allocated equally between Product A and Product B. 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 strategic decision making process . Pricing of products should also factor in environmental cost generated by each product.

General overheads per unit of leather products manufactured are Rs. 230 which includes :

Treatment cost of harmful gases ... Rs. 80

Wastewater treatment cost ..... Rs. 100

Cost of planting of trees..... Rs. 20

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

Particulars	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 A	70%	50%	70%	
Cost allocation to Product B	30%	50%	30%	

The remaining overheads cost and cost of planting trees can be allocated equally between Product A and Product B.

Required

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

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

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

(d) RECOMMEND and EXPLAIN the four management accounting techniques for the identification and allocation of environmental costs.

(e) STATE why the management of environmental costs is becoming increasingly important in organizations. Give reasons.

Solution:

(a) Product Wise Profitability as per Original Allocation Methodology

(Figures in per unit of leather produced)

Particulars	Product A	Product B	Total
Selling Price	620	420	1,040
Direct Material (Refer Table 1)	286	174	460
Direct Labour (Refer Table1)	186	114	300
Overheads (allocated equally)	115	115	230
Total Expenses	587	403	990
Profit	33	17	50
Profitability (%)	**5.32%**	**4.05%**	x

Workings

Table 1 Cost Allocation to the Products

(Figures in per unit of leather produced)

	Tanning			Dyeing			Finishing			Total		
	A	B	Total	A	B	Total	A	B	Total	A	B	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

(b) 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 (115x2)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 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, 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 point 2 thus allocated to the various processes, will be further allocated 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 A	Product B	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%	x

Workings: Table 2: Breakdown of General Overheads per unit (Rs.)

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 A and B
Other Overheads	30	Equally between Products A and B
Total General Overheads per unit	230	

Table 3: Allocation of Treatment Cost to various process

Process Wise Information

Overhead	Amount (Rs.)	Allocation Basis Between Products	Tanning (Rs.)	Dyeing (Rs.)	Finishing (Rs.)	Total (Rs.)
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 (Rs.)	Allocation Basis Between Products	Tanning (Rs.)	Dyeing (Rs.)	Finishing (Rs.)	Total (Rs.)
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: Allocation of Treatment Cost to Product A and B

Overhead	Tanning	Dyeing	Finishing	Total
Treatment Cost of Harmful Gases	Rs.40	Rs.30	Rs.10	Rs.80
Cost Allocation % to Product A	70%	50%	70%	x
Cost Allocation % to Product B	30%	50%	30%	x
Cost Allocation to Product A	28	15	7	50
Cost Allocation to Product B	12	15	3	30
Wastewater Treatment Cost	60	40	---	100
Cost Allocation % to Product A	70%	50%	70%	x
Cost Allocation % to Product B	30%	50%	30%	x
Cost Allocation to Product A	42	20	---	62
Cost Allocation to Product B	18	20	---	38

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

In the first method, general overhead costs are allocated to the products A and B, irrespective of the environment costs that each product incurs. General overhead costs are to each product equally. The resultant product profitability shows that Product A yields 5.32% and Product B yields 4.05% profitability. Therefore , the Excel Ltd. would conclude that Product A 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 A. 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 A yields 1. 77% and Product B yields 9. 29% profitability. The reason being, Product A generates more environment driven costs as compared to Product B.

Excel Ltd. would therefore increase the selling price of Product A 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 reduction of environment driven costs such as wastewater treatment and treatment of harmful gases. This would sustain profits in the long run.

(d) Four Techniques for the identification and allocation of Environmental Costs

Input-Output Analysis: This technique monitors the material input with the output that is produced. For example, if 100kg of material have been bought and input in the process resulting in 80kg output material, the 20kg must been accounted in some way. Some part of this may say 10% (2kgs) may have been sold as scrap while the remaining 90% (18kgs) of it may be waste. Possibly scrap can be reused therefore may have neutral environment impact. The company can then concentrate on minimizing waste generation.

Flow Cost Accounting: This technique uses not only material flows but also the organizational structure. Classic material flows are recorded as well as material losses incurred at various stages of production. Flow cost accounting makes material flows transparent. It tracks:

(i) quantities (physical data);
(ii) costs (monetary data) and
(iii) values = (quantities x costs)

Material flows are divided into three categories: material , system, and delivery/disposal.

(i) The **material values** and costs apply to the materials which are involved in the various processes.

(ii) The **system values** and costs are the in-house handling costs, which are incurred inside the company for the purpose of maintaining and supporting material throughput. Example personnel costs or depreciation.

(iii) The **delivery and disposal values** and costs refer to the costs of flows leaving the company for example transport costs or cost of disposing waste.

Tthe focus of flow cost accounting is on reducing the quantities of materials, which leads to increased ecological efficiency.

Life Cycle Costing: This technique 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. In order to reduce lifecycle costs, an organization may adopt a TQM approach . 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 provision of feedback of the organizational efforts in achieving such objectives.

Activity Based Costing (ABC): ABC allocates internal costs to cost centres and cost drivers on the basis of the activities that give rise to the costs . Environment-related costs can be attributed to joint cost centers and environment-driven costs are hidden on general overheads. Environment-driven costs are removed from general overheads and traced to products or services. The cost drivers are determined on environment impact that activities have and costs are charged accordingly. This should give a good attribution of environmental costs to individual products that should result in better control of costs.

(e) Reasons why environmental costs is becoming important in organizations

(i) "Carbon footprint" measures the total greenhouse gas emissions caused directly and indirectly by a person, organization, event or product. People are now becoming aware about the carbon footprint and recycling. Several companies have initiated CSR committees as they feel that portraying themselves as environmentally responsible makes them popular among their consumers.

(ii) Environmental costs are becoming huge for some companies particularly those operating in highly industrialized sectors such as oil production. Such significant costs need to be managed.

(iii) Regulation is increasing worldwide at a rapid pace, with penalties for non-compliance also increasing accordingly.

Target Costing

Question 19: (ICAI Module Question)

Storewell Industries Ltd. manufactures standard heavy duty steel storage racks for industrial use. Each storage rack is sold for Rs.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 labor 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 Rs.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 Rs.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 Rs.675 if the profit per unit is maintained.

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

Solution:

(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 (Rs.)
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 Rs.615 p.u. while the profit is Rs.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 Rs.675 per unit. The profit per unit needs to be maintained at Rs.135 per unit. Hence, the

new target cost per unit = new selling price per unit – required profit per unit = Rs.675 - Rs.135 = Rs.540 per unit.

(iii) As explained above, current cost per unit is Rs.615 while the target cost per unit is Rs.540. Hence, the cost has to be reduced at least by Rs.75 per unit. Analysis of the cost data shows the variances between the budget and actual material usage and labor hours. It is given that the material procurement rate and labor hour rate is the same for budgets and actuals. Hence, the increment in cost of direct materials and labor is due to inefficient use of material and labor 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
= Rs.20,00,000 / 5,20,000 sq. ft. = Rs.3.85 per sq. ft.
Therefore, inefficiencies resulted in extra cost
= 20,000 sq. ft. × Rs.3.85 per sq. ft. =Rs.77,000.
If corrective action is taken, for 10,000 racks this translates to a saving of Rs.7.70 per unit. (Rs. 77,0000 / 10,000 racks)

(b) Inefficiencies resulted in extra 10,000 hrs. to be spent in production.
Labor cost per hr. = Actual cost / Actual labor hrs.
= Rs.10,00,000 / 100,000 hrs. = Rs.10 per hr.
Therefore, inefficiencies resulted in extra cost
= 10,000 hrs. × Rs.10 per hour =Rs.1,00,000.
If corrective action is taken, for 10,000 racks this translates to a saving of Rs.10 per unit. (Rs. 100,000 / 10,000 racks)

© 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.

Target Costing

Question 20: (Nov 2018 ICAI Question 2) (Module)

Zen Ltd., forms a Committee consisting of its Production, Marketing and Finance Directors to prepare a budget for the next year. The Committee submits a draft budget as detailed below:

Selling price per unit		50
Direct material cost per unit	Rs.9	
Direct labour cost per unit (3hrs @ Rs.3)	Rs.9	
Variable overhead (3hrs.@ Rs.2)	Rs.6	24
Contribution per unit		26
Budgeted Sales Quantity		25,000 units
Budgeted Contribution (25,000x 1"26)		6,50,000
Budgeted Fixed Cost		5,00,000
Budgeted Profit		1,50,000

The Management is not happy with the budgeted profit as it is almost equal to the previous year's profit. Therefore, it asks the Committee to prepare a budget to earn at least a profit of Rs. 3, 00, 000. To achieve the target profit , the Committee reports back with the following suggestions:

The unit selling price should be raised to Rs. 55.

The sales volume should be increased by 5,000 units.

To attain the above said increase in sales, the company should spend Rs.40,000 for advertising. The production time per unit should be reduced.

To win the acceptance of the workers in this regard the hourly rate should be increased by Rs. 3 per unit besides an annual group bonus of Rs. 30,000.

There is no change in the amount and rates of other expenses. The company has sufficient production capacity.

As the implementation of the above proposal needs the acceptance of the work force to increase the speed of work and to reduce the production time per unit, the Board wants to know the extent of reduction in per unit production time.

Required

(i) CALCULATE the target production time per unit and the time to be reduced per unit.

(ii) IDENTIFY the other problems that may arise in production due to decrease in unit production time and also suggest the remedial measures to be taken.

(iii) STATE the most suitable situation for the adoption of Target Costing.

Answer

Workings

Statement Showing Target Cost (Direct Labour and Variable Overhead)

Particulars	Amount (Rs.)
Target Sales (55 x 30,000Units)	16,50,000
Less:Target Profit	3,00,000
Less:Direct Material Cost (9x30,000Units)	2,70,000
Less: Budgeted Fixed Costs	5,00,000
Less:Proposed Advertising	40,000
Less: Proposed Annual Group Bonus	30,000
Target Cost (Variable Overhead and Direct Labour) for30,000 units	5,10,000

Target Production Time per unit and Time to be reduced per unit

Important Note:

As per the reading of the Question, there is ambiguity (confusion) in the line giving rise to the various interpretations and alternatives.

"To win acceptance of workers, hourly rate should be increased by Rs. 3 per unit."

Alternative 1: Increase in labour cost p.u. by Rs. 3 p.u. (Recommended)

Alternative 2: Increase in labour rate per hour by Rs. 3/hr. (Recommended)

Alternative 3: Increase in labour rate @ Rs. 3 and averaging it with 3 hrs /unit.

Alternative 1: Flat increase in labour cost p.u. by Rs. 3 p.u.

If labour cost is increased @ Rs. 3 p.u.

∴ Current Rate	Rs. 9 p.u.
Add: Increase p.u.	Rs. 3 p.u.
Labour Cost Rate	RS. 12 p.u.
No. of units	30,000
x Labour Cost Rate	Rs. 12 p.u.
? Labour Cost	Rs. 3,60,000
Target Cost Allowable for Labour & Variable Overheads	Rs. 5,10,000
∴ Cost Remaining for Variable Overheads (Rs. 5,10,000 – Rs. 3,60,000)	Rs. 1,50,000
∴Total Variable Overheads	Rs. 1,50,000
Rate per Variable Overheads	Rs. 2/hr
Total Hours Allowable (Rs. 1,50,000/Rs. 2/hr)	75,000 hrs
No. of units	30,000 units
∴ Hours allowable p.u. (75,000hrs./ 30,000 units)	2.5 hrs/unit
∴ Time to be reduced p.u. (3 hrs/unit -2.5 hrs/unit)	0.5 hours/unit

Alternative 2: Increase in labour rate p.u. by Rs. 3/hour

Current labour rate/hour	Rs. 3/hr
Add: Increase in labour rate @ Rs.3/labour	Rs. 3/hr
∴Variable Overheads rate/hr	Rs. 2/hr
∴ Total Cost of Labour + Variable Rate	Rs. 8/hr (3+3+2)
Total Cost of Labour + Variable	Rs. 5,10,000
∴ Total Allowable Hours (Rs. 5,10,000/ Rs. 8/hour)	63,750 hours
Total no. of units	30,000 units
∴ Hours per unit allowable (63,750 hours/ 30,000 units)	2.125 hours
∴ Time to be reduced per unit	0.875 hours

Alternative 3: Increase in labour rate @ Rs. 3 p.u. and averaging it with 3 hours/unit (Not recommended)

Current labour cost/unit	Rs. 9/unit
Add: Increase in Labour cost/unit	Rs. 3/unit
Total Labour Cost/unit	Rs. 12/unit
Total Hours/unit	3 hours/unit
Labour cost/hour (Rs.12/unit / 3hours/unit)	Rs.4/hour
Add: Variable Overhead Cost/Hour	Rs.2/hour
New (Labour + Variable O/H) rate/hour	Rs.6/hour
Total Cost of Labour and Variable O/H	Rs. 5,10,000
Total Allowable hours (Rs. 5,10,000 / Rs.6/hour)	85,000 hours
Total No. of Units	30,000 units
∴ Hours per unit allowable	2.83 hours
∴ Time to be reduced per unit (3hours - 2.83 hours)	0.17 hours

(ii) Problem

The target-costing method is applicable particularly for repetitive manufacturing. It should however be recognised that some products often bear a high degree of repetition and that there often are considerable repetitions where reduction targets could come into play as a framework for improving design. Working under pressure to finish new design assignments in a short time may take development resources away from efforts to optimise or re engineer production processes. If approaching product design as an activity to be optimised independently there is a risk that target costing may not succeed to satisfactorily addressing overall performance , so in short decrease in unit production time may lead to unwanted pressure on design and its implementation stage.

Remedial Measures

As a remedial action organisation should retain strong control over the design teams headed by a good team leader. This person must have an exceptional knowledge of the design process, good interpersonal skills and a commitment to staying within both time and cost budgets for a design project. If the time is too short even an organisation may reject a project for the time being. Later, it can be tried out with new cost reduction methods or less expensive materials to achieve target cost and control overall production activities.

(iii) Target costing is most useful in situations where the majority of product costs are locked in during the product design phase . This is the case for most manufactured products, but few services . In the services area, such as consulting , the bulk of all activities can be reconfigured for cost reduction during the "production" phase, which is 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 & JIT

Question 21 : [Nov 2019 ICAI Question 2(a)] (Module)

Pixel Limited is a toy manufacturing company. It sells toys through its own retail outlets. It purchases materials needed to manufacture toys from a number of different suppliers. Recently, due to the entity of few reputed foreign brands in the toy market and particularly in the segment in which Pixel Ltd. is doing business, it is facing a threat to operate profitably.

Each toy requires 4 kg. of materials at Rs. 19 per kg. and 5% of all materials supplied by the suppliers are found to be substandard. Labour hour requirement for each toy is 0.4 hour at Rs. 120 per hour.

Market research has determined that the selling price will be Rs. 240 per toy. The company requires a profit margin of 15% of the selling price. Expected demand for toy in the coming year will be 50,000 toys. Sales and variable overhead per unit for the four quarters of the year will be as follows :

	Q1	Q2	Q3 (Festive season)	Q4 (Festive season)
Sales (units)	7,500	9,000	15,500	18,000
Variable overhead per unit(Rs.)	22	22	24	25

Total fixed overheads are expected to be Rs. 6, 25,000 for each quarter.

The production manager has decided to produce 12, 500 units in each quarter. Inventory holding costs will be Rs. 18 per unit of average inventory per quarter. Inventory holding costs are not included in above.

Normal production capacity per quarter is 15,000 toys. The company can produce further up to 6,000 units per quarter by resorting to overtime working. Overtime wages will be at 150% of normal wage rate.

Assume zero opening inventory.

Required

(a) (i) CALCULATE the cost gap that exists between the total cost per toy as per the production plan and the target cost per toy.

(ii) DISCUSS how just-in-time purchasing and just-in-time production will remove the cost gap calculated in (i) above. Show calculations in support of your answer.

(b) EXPLAIN, how implementation of JIT production method can be a major source of competitive advantage and success of the company

Solution

(a) (i) Cost gap between Total Cost per toy as per the production plan and the Target Cost per toy

Target Cost per toy

Sr. No.	Particulars	per unit	For Annual Sales of 50,000 units
1	Selling Price per toy	240	1,20,00,000
2	Required Profit Margin (15% of selling price =15%x 240 per unit)	36	18,00,000
3	Target Cost per annum (Step 1- Step 2)		1,02,00,000
4	Target Cost per toy (Step 3 / 50,000 units)		**Rs. 204.00**

Therefore , Target Cost is **Rs. 204** per toy.

Total Cost as per production plan

Pixel Ltd. has an annual production requirement of 50,000 toys, which is also its annual sales . Given that opening inventory for the first quarter is nil. The production manager wants to produce 12,500 units per quarter irrespective of the sales demand for the quarter. This implies that during some quarters , there might be unsold inventory, for which inventory holding cost has to be borne. This type of production is called "produce to stock".

Production Schedule and Inventory Holding Cost for the year

Sr. No.	Particulars	Q1	Q2	Q3	Q4	Total for the year
1	Opening Stock (units)	-	5,000	8,500	5,500	
2	Production (units)	12,500	12,500	12,500	12,500	50,000
3	Sales (units)	7,500	9,000	15,500	18,000	50,000
4	Closing Stock (units) (Step1+2-3)	5,000	8,500	5,500	-	
5	Average Inventory =(Step1+Step4)/2	2,500	6,750	7,000	2,750	

6	Inventory Holding Cost (Average Inventory x 18 per unit of Average Inventory)	45 ,000	1,21,500	1,26,000	49,500	**3,42,000**

Total Cost of Production per toy as per production plan

Sr. No.	Particulars	Q1	Q2	Q3	Q4	Total for 50,000 units
1	Direct Material Cost per unit (Note 1)	Rs.80	Rs.80	Rs.80	Rs.80	40,00,000
2	Direct Labour Cost per unit (Note2)	Rs.48	Rs.48	Rs.48	Rs.48	24,00,000
3	Variable Overhead Cost per unit	Rs.22	Rs.22	Rs.24	Rs.25	11,62,500
4	Total Variable Cost per unit for the quarter (other than inventory holding cost) [Steps1+2+3]	Rs.150	Rs.150	Rs.152	Rs.153	
5	Production (units) for the quarter (refer production schedule above)	12,500	12,500	12,500	12,500	50,000
6	Total Variable Cost for the quarter (other than inventory holding cost) [Step 4 x Step5]	Rs.18,75,000	Rs.18,75,000	Rs.19,00,000	Rs.19,12,500	75,62,500

7	Inventory Holding Costforthe quarter (refer to the production schedule above)	Rs.45,000	Rs.1,21,500	Rs.1,26,000	Rs.49,500	**3,42,000**
8	Fixed Overheads	6,25,000	6,25,000	6,25,000	6,25000	25,00,000
9	Total Cost [Step 6 +Step 7 +Step 8]	25,45000	26,21,500	26,51,000	25,87,000	1,04,04,500
10	Total Cost per toy as per production schedule (Step 9/50,000 units)					**208.09**

Note 1

Each toy requires 4kg of material, 5% of all materials is substandard. Therefore , procurement should factor this substandard quality .

Material required per unit = 4 kg / 95% = 4.21 kg

Material Cost per toy produced = 4 .21 kg x 19 per kg = 80 per unit

Note 2

Each toy requires 0.40 hours. Rate per hour is 120 per hour.

Therefore , Cost per toy = 0.40 x 120 = 48 per unit

Cost Gap

= Total Cost per toy as per production schedule - Target Cost per toy

= 208.09 - 204.00 per toy

= 4.09 per toy

JIT System

(ii) Just in Time Purchasing and Just in Time Production is aimed at eliminating inventory holding of raw material and finished goods respectively . Components are purchased only when there is a requirement in the production process. Similarly , finished goods are produced only when there is a demand for them. This type of production is called "produce to order". Hence, there is neither any opening inventory nor any closing inventory, thereby no inventory holding cost.

In the given problem, this savings is off-set by the extra payment to be made to labor for overtime. Production capacity is 15,000 toys per quarter. This can be increased by 6,000 toys per quarter by incurring additional overtime cost.

The Production Plan under the Just in Time System

Sr. No.	Particulars	Q1	Q2	Q3	Q4	Total for the year
1	Opening Stock (units)	-	-	-	-	
2	Production (units)	7,500	9,000	15,500	18,000	50,000
3	Sales (units)	7,500	9,000	15,500	18,000	50,000
4	Closing (units)	-	-	-	-	
5	Inventory Holding Cost	-	-	-	-	
6	Production Beyond Capacity of 15,000 Toys per quarter (units)	-	-	500	3,000	

Total Cost of Production under JIT System

Sr. No.	Particulars	Q1	Q2	Q3	Q4	Total for 50,000 units
1	Direct Material Cost per unit (Note 1)	Rs.76	Rs.76	Rs.76	Rs.76	38,00,000
2	Direct Labour Cost per unit	Rs.48	Rs.48	Rs.4B	Rs.48	24,00,000
3	Variable Overhead Cost per unit	Rs.22	Rs.22	Rs.24	Rs.25	11,85,000
4	Total Variable Cost per unit (Steps 1+ 2+3)	**146**	**146**	**148**	**149**	
5	Production (units) for the quarter (Refer JIT	7,500	9,000	15,500	18,000	50,000
6	Total Variable Cost for the quarter (Step 4 x Step 5)	10,95,000	13, 14,000	22,94,000	26,82,000	73 ,85,000

7	Production (units) for the quarter in excess of capacity (Refer JIT	-	-	500	3,000	3,500
8	Overtime Labour Cost for production in excess of capacity (Note 2) [Step 7 x 0.40 x 50% x 120 per hour]	Rs.o	Rs.o	Rs.12,000	Rs.72,000	**Rs.84,000**
9	Fixed Overheads	6,25,000	6,25,000	6.25,000	6.25,000	25,00,000
10	Total Cost for production under the JIT System (Step 6 + Step 8 + Step 9)	17,20,000	19,39,000	29,31,000	33,79,000	99,69,000
11	Total Cost per toy as per production schedule (Step 10 I 50,000 units)					**199.38**

Note 1

Carefully selected suppliers of delivering high quality materials in a timely manner directly at the shop floor, reducing the material receipt time and loss due to sub-standard material.

Note 2

Overtime wages are 150% of normal wage rate. Therefore, for every toy produced over the quarterly production capacity of 15,000 toys, 50% extra wage over and above the hourly rate has to be paid as overtime wages. Each toy needs 0.40 hours for production. Therefore , overtime cost for excess production = excess production units x 0.40x 50% x 120 per hour.

Cost Gap

The cost of production per toy under the JIT system is 199.38 per toy as compared to the target cost of 204 per toy and **save 4.62 per toy**.

The savings primarily comes from eliminating the inventory holding cost of Rs.3,42,000 per annum and sub- standard material cost of Rs.2,00,000 per annum under the previous production system. This is slightly offset by the additional cost of Rs. 84,000 per annum that has to be paid towards overtime labor charges and Rs. 22,500 towards additional variable overheads. However, by switching to the JIT system, Pixel Ltd. could reduce its production cost below the target cost per toy.

(b) JIT system aims at:

- Meeting customer demand in a timely manner.
- Providing high quality products and
- Providing products at the lowest possible price. The main features of the JIT production system are:

  Material handling cost is reduced - materials move from one machine to another in an organized sequence . The production process is grouped into to manufacturing cells. These can be managed with minimal labor. This reduces material handling costs as also any pile up of inventory in the form of work-in-progress. In JIT procurement process, the raw material is received only when needed. Due to significant reduction in inventory, inventory holding costs, normal wastage cost and spoilage can be avoided. Optimum arrangement of cells can lead to lesser floor space requirement, thereby reducing factory rental and overhead cost.

- **Multi-skilled labor:** Hire and retain multi-skilled workers who are capable of performing a variety in operations including repairs and maintenance. Therefore , a worker is not confined to only one process in the production process. He can contribute towards other processes as well. This reduces the workforce requirement and labor idle time . The company can have a more efficient workforce, with lesser number of workers. There is potential to reduce labor cost on account of this.
- **Minimizing defects rework and scrap:** Each stage of the production process is tightly linked in a sequential manner. Defective output from one stage will stop the work at the next stage. Due to this , workers can identify and correct errors or defects instantaneously. JIT creates urgency for eliminating defects as quickly as possible since the downstream work also stops due to error in any workstation . Production process efficiency improves and reduces rework or scrap. The overall quality of production improves. There are other benefits to streamlining production process: lesser need for inspection of final output and lesser sales returns due to defects. This would contribute to the product 's brand value.
- **Reduced set-up time:** Streamlined production process under JIT reduces set-up time at the workstations. When the production process has to change to make the product per the customer's demands , set-up time is incurred at the workstation. By streamlining operations , JIT system aims at reducing the set-up time, so that production can continue with the least possible interruption. This brings flexibility in the operations since the company can quickly change the production requirement, to make products to meet the customer's demand . Quick turnover improves productivity of the machine, thereby increasing the production capacity. Lesser time is spent on set-up which is not a value adding activity.

- **Reduces lead time for receiving materials** since the suppliers of raw material are capable of delivering high quality materials in a timely manner directly at the shop. Proper selection of such suppliers is imperative for the JIT system to be successful. If this can be achieved, then it is beneficial for the company since inventory holding of material is eliminated along with receiving better quality of raw material in a timely manner.

Eliminating inventory holding, scrap, material wastage, flexibility in operations by reducing set-up time, better response time to customer 's demands, better skilled workforce, better quality of production , lower workforce requirement , lower floor space requirement all of these contribute towards lowering working capital requirements. These contribute to a company 's competitive edge and success.

Theory Qn on EMA

Question 22: (ICAI Module Question) (RTP May 22)

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 focusing on environmental sustainability provides opportunity to KOA Limited for reducing costs?

Solution:

(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 . Environment 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 benefitted. This will also help Wasco Limited to improve their brand image among the stakeholder as corporate citizen.

(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 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 wastes 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 sell on the open market, thereby actually generating revenue.

EMA Classification of environment cost

Question 23: (RTP May 22) (Module)

SY Industries operates in two different lines of business first one is SY Paper Mart (SPM) and another is SY Glass Limited (SGL).

SPM is a paper manufacturer (deals in different sizes- A3, A4, and A5 and GSM) that obtained ISO 14001:2004 Environmental Management Systems (revised ISO 14001:2015) certification couple of year ago. Then CEO of SPM was committed to Environment Cost Management. At his superannuation, the new CEO replaced him, who believes apart from avoiding the legal consequences, there is no sensible reason for considering Environment Cost Management. SPM hardly practice the requirement contained in standard (of environment certifications) afterwards, it seems they obtained the certificate to fulfil the legal requirements (of different tenders and trade partnerships as well as improving image) only.

SGL, being the manufacturer of glasses, use (hence release) cadmium (as per WHO, Cadmium exerts toxic effects on the kidneys as well as the skeletal and respiratory systems. It is classified as a human carcinogen) in red ruby glass (A glass containing 0.03% of selenium, 0.06% of cadmium, and 0.03% of sulphur, to produce a ruby colour). At SGL only ruby red glass is responsible for all of its cadmium emissions but the cost accounting system allocated a portion of this cost to all products. The turnover of SGL during the immediate previous year was ` 248 crores, which was around 17% higher than what it was a year ago.

During the immediate previous year, at SGL the cost of disposing of the toxic material costs ` 82 Lacs. The cost of recycling products and scrap was ` 1.05 crores and ` 64 lacs respectively. Cost of committee (responsible for environmental certifications and formulating organisational policy on the environment) proceeding was ` 24 lacs which includes ` 2 lacs fees for renew the certification and ` 3 lacs for boarding (and other connected arrangements) of inspection team who made visit prior renewing the environment clearance certificate. Environment monitoring and employee training (regarding environmental safety) cost was ` 37 and ` 8 lacs respectively. Monitoring cost includes the Audit fees of ` 2 lacs. Inspection costs inside SGL to ensure compliance to environmental standards and their own policy matter is ` 7 lacs.

During the immediate previous year, a penalty order of ` 75 lacs passed by adjudicating authority against SGL for cadmium emission beyond the allowed limit by the regulator; against this order SGL made an appeal. Appellate authority upheld the order of adjudicating authority but reduce the penalty to 40%.

Required

(i) EVALUATE the belief of the new CEO of SPM.

(ii) COMMENT on the current pattern of allocation of environmental cost pertaining to cadmium emissions at SGL, in regard to cost of product produced by SGL. ADVISE the better approach which cost accounting system should adopt.

(iii) PREPARE the common-size environmental cost statement for the immediate previous year at SGL as per the classification suggested by 'Hanson and Mendoza', to equip the management for comparison over the periods.

(iv) Briefly ANALYSE the environment cost structure with a piece of ADVISE for management.

Note- State the assumptions clearly.

Solution:

3. The belief of the new CEO of SPM, that apart from avoiding the legal consequences, there is no sensible reason for considering Environment Cost Management is fallacious and unfounded.

Apart from regulatory requirements (legal requirements involving huge fines for noncompliance), Environmental Cost Management is becoming increasingly important due to the following reasons (which sensible and alarming too)–

Environmental costs can be large for some sectors – especially the businesses where natural resources are largely involved and used as the core of the value chain. Ranganathan and Ditz (1996) reported that Amoco's environmental costs at its Yorktown refinery were at least 22 per cent of non- operating costs against the estimates of only 3%.

Society in which business operates cares for the environment – hence expects businesses (as a corporate citizen) should focus on their environmental (triple bottom line) footprint and manage the same. Companies who behave in an environmentally responsible manner enjoy a better brand image and capable to sell more or high prices.

Hence the need for companies to develop a system of measuring, reporting, and monitoring environmental costs is inevitable.

(ii) It was clearly mentioned in the case that only ruby red glass is responsible for all of its cadmium emissions at SGL but still the cost accounting system allocated a portion of this cost to all products. This practice of allocating specifically traceable cost over all the product produced by SGL will surely result in under costing of ruby red glass, whereas the cost of other products being overstated.

The cost accounting system at SGL should adopt the ABC (activity-based costing) concept for the purpose of allocation of environmental costs. The environmental costs should be determined in full and accumulated as separate cost pools and traced to the products or processes that caused the costs using ABC concepts. Hence the environmental costs pertaining to cadmium emissions shall be charged to ruby red glass only (not all the product).

The use of ABC, apart from ascertaining correct costs also helpful in determining the scope of reducing environmental cost as well as emission in the environment.

(iii) Common-size **environmental cost** statement for the immediate previous year at SGL

Particulars	Turnover was Rs.248 crores	
	Amount (in Rs. lakhs)	% to turnover
Environmental Prevention Costs		
Employee Training	8	0.032
Cost of Committee (24 – 2 – 3)	19	0.077
Obtaining Certification (2 + 3)	5	0.020
Recycling products	105	0.423
Sub-Total (a)	**137**	**0.552**
Environmental Appraisal Costs		
Monitoring (37 – 2)	35	0.141
Inspection Cost	7	0.028
Environmental Audit	2	0.008
Sub-Total (b)	**44**	**0.177**
Environmental Internal Failure Costs		
Recycling Scrap	64	0.258
Disposing of Toxic Material	82	0.331
Sub-Total (c)	**146**	**0.589**
Environmental External Failure Costs		
Penalty	30	0.121
Sub-Total (d)	**30**	**0.121**
Total environment cost (a + b + c + d)	**357**	**1.439%**

(iv) The total environmental cost is `357 lacs, which is 1.439% of turnover. The composition of the environmental costs is very much balanced and near to optimality because the cost on prevention and detection is `181 lacs which is marginally over the total failure cost i.e., `176 lacs (environmental cost expects to be lowest where both these cut across).

Penalty cost can be completely avoided by minor increment in inspection, hence SGL must look forward in that area, apart from this management also need to focus on modifying the process in order to reduce the scrap (recycling cost of scrap is approximately 18% of the total environmental cost). Management also needs to look into nature of toxic material and possible substitute if any. Must increase expenditure on employee training (this will reduce all other environmental costs).

Concept Insight

- Hansen and Mendoza in the year 1999 point out that environmental costs are incurred because of poor quality controls. They classify the environmental cost into the following four categories–

Environment Costs

- **Enviromental Prevention Costs** are the costs of activities undertaken to prevent the adverse environmental impacts.
- **Environmental Apprisal Costs** incurred to ensure that the organisation complies with regulations and voluntary standards.
- **Environmental Internal Failure Costs** incurred from performing activities that have produced contaminants and waste that have not been discharged into environment.
- **Environmental External Failure Costs** incurred on activities performed after discharging waste into the environment.

- Environment prevention costs are the costs of activities performed to prevent the production of waste that could cause damage to the environment. Examples include the costs of recycling products, training staff, and carrying out environmental studies.
- Environmental internal failure costs are the costs of activities that must be undertaken when contaminants and wastes have been created by a business but not released into environment this includes recycling of scrap.
- Instead of turnover, operating cost can also be used for preparing common size environment cost statement (capable of making the comparison over the period).
- Any external inspection shall be added to head for the purpose it was conducted e.g., inspection by the surveyor of court prior to impose penalty will be added to penalty, similarly cost to meet the lodging expenses of the inspection team, visiting prior to renewing certification shall be added to cost of obtaining certification. The cost incurred on inspection staff and connected matters to ensure compliance to the environmental standards and organisational policy on the environment shall be included under the head environment detection (appraisal) cost.

Life cycle cost

Question 24: (ICAI Exam Module Question)

P & G International Ltd. (PGIL) has developed a new product ' a^3 ' which is about to be launched into the market. Company has spent Rs 30,00,000 on R&D of product ' a^3 '. It has also bought a machine to produce the product ' a^3 ' costing Rs 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 ' a^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 (Rs)	750	600	525
Variable Cost per unit (Rs)	375	300	300
Contribution per unit (Rs)	375	300	225
Total Contribution (Rs)	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 ' a^3 '.

(iii) Find possible reasons for the changes in cost during the life cycle of the product ' a^3 '. 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**
Numbers of units produced and sold	22,000	22,000	22,000
Selling price per unit (Rs)	450	450	300
Less: Unit variable cost (Rs)	225	188	225
Unit contribution (Rs)	225	262	75
Total contribution (Rs)	49,50,000	57,64,000	16,50,000

(ii) Pricing Strategy for Product a^3

PGIL is following the skimming price strategy that's why it has planned to launch the product a^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 a^3 is decreasing gradually stage by stage. This is happening because PGIL wants to tap the mass market by lowering the price.

(iii) Possible Reasons for the changes in cost during the life cycle of the product ' a^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 a^3 over the life of product as a consequence of economies of scale and learning / experience curves.

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

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

Product a^3 has the least variable cost Rs 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 a^3 jumps to Rs 225 in decline stage. As soon as the product reaches its decline stage, the need or demand for the product disappear and quantity discount may not be available. Even PGIL may have to incur heavy marketing expenses for stock clearance.

Q.	Concept	Resource	Pg
25	Relevant cost	CA Student Journal	83-87
26	Shut down point	Module	88
27	Decision making	Module	89-91
28	Relevant cost + COQ + TP	Module Case	92-96
29	Ethical & Non Financial Consideration	Module	97-101
30	Make or buy	CA Student Journal	102-105

CHAPTER 5 REVISION VIDEO

SCAN QR OR CLICK HERE

Relevant cost

Question 25: (ICAI: CA Student Journal)

B Ltd. is a company that has, in stock, materials of type XY that cost Rs. 75,000, but that are now obsolete and have a scrap value of only Rs. 21,000. Other than selling the material for scrap, there are only two alternative uses for them.

Alternative 1 – Converting the obsolete materials into a specialized product, which would require the following additional work and materials:

Material A	600 units
Material B	1,000 units
Direct Labour:	
5,000 hours unskilled	
5,000 hours semi skilled	
5,000 hours highly skilled	
Extra selling and delivery expenses	Rs. 27,000
Extra advertising	Rs. 18,000

The conversion would produce 900 units of saleable product and these could be sold for Rs. 300 per unit.

Material A is already in stock and is widely used within the firm. Although present stocks together with orders already planned, will be sufficient to facilitate normal activity and extra material used by adopting this alternative will necessitate such material being replaced immediately. Material B is also in stock, but is unlikely that any additional supplies can be obtained for some considerable time, because of an industrial dispute. At the present time material B is normally used in the production of the product Z, which sells at Rs. 390 per unit and incurs total variable cost (excluding Material B) is Rs. 210. per unit. Each unit of product Z uses four units of Material B. The details of Materials A and B are as follows:

	Material A (Rs.)	*Material B (Rs.)*
Acquisition cost at the time of purchase	100 per unit	10 per unit
Net realizable value	85 per unit	18 per unit
Replacement cost	90 per unit	-

Alternative 2 – Adopting the obsolete materials for use as a substitute for a sub-assembly that is regularly used within the firm. Details of the extra work and materials required are as follows:

Material C	1,000 units
Direct Labour:	
4,000 hours unskilled	
1,000 hours semi-skilled	
4,000 hours highly skilled	

1,200 units of the sub-assembly are regularly used per quarter at a cost of Rs. 900 per unit. The adaption of material XY would reduce the quantity of the sub-assembly purchased from outside the firm to 900 units for the next quarter only. However, since the volume purchased would be reduced, some discount would be lost and the price of those purchased from outside would increase to Rs. 1,050 per unit for that quarter.

Material C is not available externally thought 1,000 units required would be available from stocks, it would be produced as extra production. The standard cost per unit of Material C would be as follows:

	Rs.
Direct labour, 6 hours unskilled labour	18
Raw material	13
Variable overhead: 6 hours at Re. 1	06
Fixed overhead: 6 hours at Rs. 3	18
	55

The wage rate and overhead recover rates for B Ltd. are:

Variable overhead	Re. 1 per direct labour hour
Fixed overhead	Re. 2 per direct labour hour
Unskilled labour	Re. 3 per direct labour hour
Semi-skilled labour	Re. 4 per direct labour hour
Highly skilled labour	Re. 5 per direct labour hour

The unskilled labour is employed on a casual basis and sufficient labour can be acquired to exactly meet the production requirements. Semi-skilled labour is part of the permanent labour force, but the company has temporary excess supply of this type of labour at the present time. Highly skilled labour is in short supply and cannot be increased significantly in

the short-term. This labour is presently engaged in meeting the, demand for product L, which requires 4 hours of highly skilled labour. The contribution from the sale of one unit of product L is Rs. 24.

Given the above information, you are required to present cost information advising whether the stocks of Material XY should be sold, converted into a specialized product (Alternative 1) or adopted for use as a substitute for a sub-assembly (Alternative 2).

Solution

Alternative – I

Statement of Net Benefit

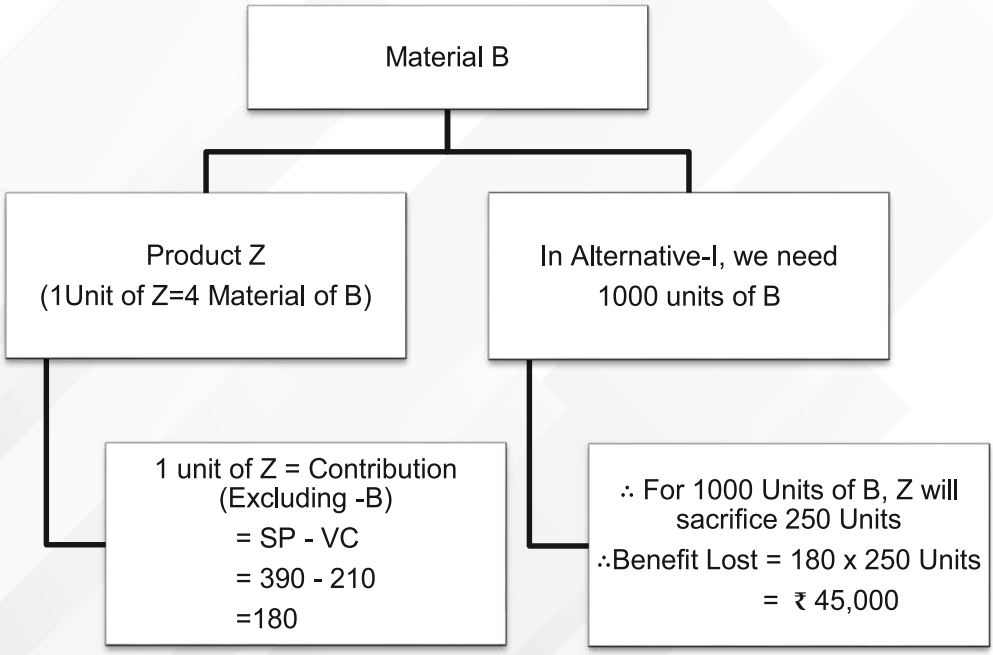
Particulars			Rs.
1. Relevant Revenue	(900x300)		270,000
Less: Relevant Cost			
2. Opportunity cost of selling XY			(21,000)
3. Material			
- Material A	(600ux90)	54000	
(In stock & Regularly used ∴ RC = Replacement cost)			
- Material B (W.N:1)		45000	(99,000)
4. Labour			
- Unskilled	(500 hrs. x 3/hr.)	15,000	
- Semi-skilled	(500 hrs.)	-	
- Highly skilled (WN:2)	(500 hrs. x 11/hr.)	55,000	(70,000)
5. External selling			(27,000)
6. Advertisement expenses			(18,000)
7. Variable overheads	(15000hrs x 1/hr.)		(15,000)
NET BENEFIT			20,000

Alternative – II
Statement of Net Benefit

Particulars		Rs.
1. Relevant Revenue (WN:3)		1,35,000
Less: Relevant Cost		
2. Opportunity cost of selling XY		(21,000)
3. Material C (1000 units x Rs. 37/unit)		(37,000)
4. Labour		
- Unskilled (4000 hrs x 3/hr)	12,000	
- Semi skilled (1000 hrs x 0hr)	-	
- Highly skilled (4000 hrs x 11/hr) (WN:2)	44,000	(56,000)
5. Variable overheads (4000+1000+4000hrs x Rs.1/hr)		(9,000)
NET BENEFIT		12,000

Recommendation
Since Net Benefit of Alternative – I is More than Alternative II & It recovers the Opportunity cost of selling Material XY. Therefore we will go ahead with Alternative I.

WN:1 Material B
In case of Material B, acceptance of Alternative I will mean Diversion of Material B from production of Product Z,
The excess of relevant revenue over relevant cost for Product Z is Rs. 180/- (390-210) & each unit of Mat B. The last contribution (Excluding cost of Mat B which is incurred for both alternatives) will therefore be Rs. 45 for each unit of B



WN:2 Highly skilled Labour

Highly Skilled Labour is short in supply & can only be obtained by reducing the Production of Product L resulting in loss of contribution of Rs. 24. L Uses 4 hrs. of highly skilled labour.

Accordingly, for Casual Labour, Relevant Cost will Contribution Lost per Labour hour

Accordingly, RC for casual Labour which is Busy will be

= COST TO BE INCURRED + BENEFIT COST

= 5+6

= Rs 11 .

WN:3 Relevant Revenue for Alternative – 2

As a result of XY, the total material required for sub assembly will be reduced from 1200 units to 900 units However on account of reduction, there will be loss in discount, the total impact of which will be –

1200 units @900 Rs. /unit	10,80,000
900 units @1050 Rs. /unit	(9,45,000)
NET SAVING / RELEVANT REVENUE	**1, 35,000**

WN:4 Material C

Material C is not available outside & therefore its production will have to done in house.

The total production cost (Excluding fixed cost as it is only on absorbed basis) will become the relevant cost for Material C

Shut down point

Question 26: (ICAI Module Question)

Rabi Ltd. is considering the discontinuance of Division C. The following information is given:

Particulars	Division A & B	Division C	Total
Sales (Maximum achievable)	41,40,000	5,17,500	46,57,500
Less: Variable cost	20,70,000	2,76,000	23,46,000
Contribution	20,70,000	2,41,500	23,11,500
Less: Specific Avoidable Fixed Cost	14,49,000	4,14,000	18,63,000
Divisional Income	6,21,000	(1,72,500)	4,48,500

The rates of variable costs are 90% of the normal rates due to the current volume of operation. There is adequate market demand.
For any lower volume of operation, the rates would go back to the normal rates.
Facilities released by discounting Division C cannot be used for any other purpose.

Required

Evaluate the decision to discontinue Division C using relevant cost approach.

Solution:

Statement showing discontinuance of Product C

Sales	41, 40,000
(-) Variable C	(23, 00,000)

(∵ C is discontinued Variable Cost will reach to its normal level)

[20,70,000 : 90%

? : 100% i.e. 23,00,000]

Contribution	18,40,000
(-) Fixed Cost	14,49,000
Revised Net Profit	3,91,000
(-) Original Net Profit (when C was there)	4,48,500
Decrease in net profit	(57,500)

Hence C should not be discontinued.

Decision making

Question 27: (Module)

Golden Pacific Airlines Ltd. operates its services under the brand 'Golden Pacific'. The 'Golden Pacific' route network spans prominent business metropolis as well as key leisure destinations across the Indian subcontinent. 'Golden Pacific', a low-fare carrier launched with the objective of commoditizing air travel, offers airline seats at marginal premium to train fares across India.

Profits of the 'Golden Pacific' have been decreasing for several years. In an effort to improve the company's performance, consideration is being given to dropping several flights that appear to be unprofitable.

Income statement for one such flight from 'New Delhi' to 'Leh' (GP - 022) is given below (per flight):

	Rs.	Rs.
Ticket Revenue (175 seats x 60% Occupancy x Rs. 7,000 ticket price)		7,35,000
Less: Variable Expenses (Rs.1,400 per person)		1,47,000
Contribution Margin		5,88,000
Less: Flight Expenses:		
Salaries, Flight Crew	1,70,000	
Salaries, Flight Assistants	31,500	
Baggage Loading and Flight Preparation	63,000	
Overnight Costs for Flight Crew and Assistants at destination	12,600	
Fuel for Aircraft	2,38,000	
Depreciation on Aircraft	49,000*	
Liability Insurance	1,47,000	
Flight Promotion	28,000	
Hanger Parking Fee for Aircraft at destination	7,000	7,46,100
Net Gain / (Loss)		(1,58,100)

* Based on obsolescence

The following additional information is available about flight GP-022.

1. Members of the flight crew are paid fixed annual salaries, whereas the flight assistants are paid by the flight.
2. The baggage loading and flight preparation expense is an allocation of ground crew's salaries and depreciation of ground equipment.

3. One third of the liability insurance is a special charge assessed against flight GP-022 because in the opinion of insurance company, the destination of the flight is in a "high - risk" area.
4. The hanger parking fee is a standard fee charged for aircraft at all airports.
5. If flight GP-022 is dropped, 'Golden Pacific' Airlines has no authorization at present to replace it with another flight.

Required

Using the data available, prepare an ANALYSIS showing what impact dropping flight GP-022 would have on the airline's profit.

Solution:

As per the statement given in the problem, FlightGP-022 incurs a net (loss) of Rs.158,100. This is the net result of revenue less costs. Revenue is entirely variable depending upon passenger occupancy. Costs are both variable and fixed nature. To analyze the impact of dropping flight GP-022, we need to re-compute net gain/ (loss) that Golden Pacific earns when it operates the flight based on relevant costing principles.

Net Gain/ (Loss) = Revenue earned from flight operations less Variable costs of operation.

Revenue earned is the ticket revenue earned from flight operations of GP-022, this is entirely variable. Variable costs of flight operations are those expenses that would be incurred only when the flight is operated. These include variable expenses per pas senger, salaries flight assistants, overnight costs for flight crew and assistants, fuel for aircraft, a third portion of flight insurance that is specifically related to this flight sector and flight promotion expense. These are expenses that will not be incurred if the flight is not operated. Hence, relevant for decision making.

Other expenses like salaries of flight crew and hanger parking fees for aircraft are fixed expenses that will be incurred even if the flight does not operate. Loading and flight preparation expense is an allocated cost that will continue to be incurred even if flight GP-022 does not operate. Depreciation of aircraft and liability insurance expense (2/3rd portion not related to a specific flight sector) are sunk costs. These expenses have already been incurred and hence are irrelevant to decision making. Therefore, these fixed, allocated and sunk expenses are ignored while analyzing the decision whether to continue operating flight GP- 022.

Flight GP-022
Statement Showing Net Gain/ (Loss)

	Rs.	Rs.
Contribution Margin if the flight is continued		5,88,000
Less: Flight Costs		
Flight Promotion	28,000	
Fuel for Aircraft	2,38,000	
Liability Insurance (1/3 × Rs.1,47,000)	49,000	
Salaries, Flight Assistants	31,500	
Overnight Costs for Flight Crew and Assistants	12,600	3,59,100
Net Gain/ (Loss)		2,28,900

If Golden Pacific Airlines Ltd. discontinues flight GP-022, profits will reduce by Rs. 2,28,900. The statement showing loss in operations of Rs.158,100 is misleading for decision making purpose because it accounts for costs that are fixed and irrelevant. However, since flight GP-022 yields a net gain of Rs.2,28,900, flight operatinue.ions should cont

Relevant cost + COQ + TP

Question 28 (Case Study on Relevant Cost +COQ + Transfer Pricing) (Module Case)

Aditya Group was established in 1975, manufactures and sells electronic personal grooming and beauty products. The group has two 100% subsidiaries AUS Ltd. and ANZ Ltd. AUS Ltd. manufactures luxury products that cater to niche customers who prefer specialized personal grooming and beauty care. ANZ Ltd. caters to regular daily beauty and grooming requirements that has a wide reach within the market. Factories of both companies are located within India. The products are sold to wholesalers, who supply these products to the retail market.

Aditya Group purchases its raw material requirements from both domestic and overseas markets. Additionally, certain products manufactured by AUS Ltd. can be enhanced based on the products manufactured by ANZ Ltd. Therefore, as per production requirements, AUS Ltd. sources some product components from ANZ Ltd.

Aditya Group has a centralized decision making set-up. Basic policy decisions for functions such as production planning, sales and client relationship, finance and human resources are handled at the group level. Individual units AUS Ltd. and ANZ Ltd. concentrate on the manufacturing alone.

About You

You are an Assistant Manager in Finance and Accounts department of Aditya Group, headed by Director- Finance Ms. Elsea. You assist and report to Ms. Fiona, Manager of your department. Sometime you also assist Director Finance in analysing financial and non financial information, drafting reports for board meetings, preparation of presentation and staff trainings.

Business Situation-

You got an email from Ms. Elsea, with Cc to Ms. Fiona. Ms. Elsea, asked you to prepare a cost statement for making a quotation to a new customer. She has also informed you that the customer can also maintain a long- term business relation with us. You have been requested to gather information related to the specification from Sales Manager.

Yesterday, 5.25 P.M.

You have been called by Ms. Fiona, and provided the product specification received from Sales- Manager for which quotation has to be quoted. Ms. Fiona has also requested you to gather relevant information to prepare cost statement. Due to the expected long term business relationship that AUS Ltd. wants to have with the customer, the sales manager wants to quote the lowest possible price. AUS Ltd. currently has some spare capacity that can be utilized to cater to this entire order . Therefore, only the relevant cost to AUS Ltd. has to be considered to arrive at the quote.