SCM SAVIOUR

SUMMARY NOTES

CMA FINAL

WOW! BOOK

EXEMPTION GUARANTEED

CA Satish Jalan

CMA MOCK TEST SANGRAM

Attention CMA Students

Raise your Confidence level for upcoming CMA Exam
by availing our **MOCK TEST SERIES**

STOP GIVING ATTEMPTS
PASS CMA EXAM IN ONE SHOT

CA Satish Jalan

After identifying the root causes of exam failure and repeated attempts and having surveyed with over **25,000+ students**, and having implemented it with **500+ students**, we have devised a carefully planned system which is known among the CMA students as - **Mock Test Sangram Series.**

WHY CHOOSE US?

- Enhance your passing chance from 10% to 90%
- Get the confidence that the entire question paper seems like a normal class test.
- Say Goodbye to Repeated Attempts!

This is how MOCK TEST Sangram will help you:

- Revisions with Targets
- Remove Nervousness and Anxiety
- Time Management
- Understanding the Question Pattern
- Answer sheet with proper feedback
- Know your Strengths & weakness

Pass your CMA Exam in the next attempt itself

By registering with us ALL SUBJECTS TESTS, get a bonus of :

Three Revisions with targets will help you to increase your grip

Our Broad Progress Tracker is a Chart - delivered at your door step

Live Strategy Sessions to approach the exams with confidence

One-to-one preparation Assessment - To know where and why you are unable to move ahead, in spite of giving your best.

3 PART TEST (Phase 1) & 1 FULL TEST (Phase 2)

8100 11 2222

CONTACT US

www.sjcinstitute.com

SJC Institute

CMA FINAL

SCM - SFM COMBO

1.5 View for 2 years

SCM - ₹ 10,500/-

SFM - ₹ 10,500/-

Combo - ₹ 18,500/-

Save ₹2500/-

- Activate anytime
- With Hard Copy of Books

Enroll Now →

CA Satish Jalan

8100 11 2222

www.sjc.co.in

CMA FINAL GROUP 4

SPMBV

Mode - GD

Price 10000/-

Pre Booking at Rs 8000/-

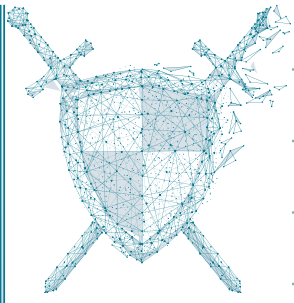
CA Satish Jalan

Call us : 8100-11-2222

sjcinstitute.com

Contents

Contents



Concepts of Strategic Cost Management in Different Stages of Value Chain

Strategy

A firm's strategy aims to match its own capabilities with the available opportunities. In other words, strategy defines as to how an organisation creates value for its customers while distinguishing itself from its competitors. In general, businesses follow one of two broad strategies, i.e., either **Cost Leadership** or **Product Differentiation. Low-Cost-Carriers (Airlines)** are known to provide quality products or services at low prices by toeing the cost leadership strategy. Electronic giants such as **Apple** are known to garner premium prices by following product differentiation strategy

Strategic Cost Management

Strategic Cost Management (SCM) may be stated as the process of identifying, accumulating, measuring, analysing, interpreting, and reporting cost information useful to both internal and external groups concerned with the way in which an organisation utilises its resources to achieve its strategic objectives.

As such, Strategic cost management needs to be perceived as the **application of cost management techniques** with a view **to enhance the strategic posture** of a firm and reduce the costs.

It is a process of **combining the decision-making structure** with the cost information, in order to reinforce the business strategy as a whole. It measures and manages costs to align the same with the company's business strategy.

4 Stages of Strategic Cost Management

Strategic Cost Management may be divided into four stages, viz.

(i) Formulation of Strategies

(ii) Communication of Strategies across the entire organisation.

(iii) Implementation of the tactics to execute the strategies.

(iv) Controlling the activities to track the achievement

Need for SCM

In Strategic Cost Management (SCM), primary importance is given to constant improvement in the product or service to deliver better quality to its target customers. SCM, therefore, encompasses every facet of the value chain of an organisation. The need for SCM may be summarised as:

(i) It is an **updated form of cost analysis**, in which the strategic elements are clearer and more formal.

(ii) It helps in **identifying the cost relationship** between value chain activities and its process of management to gain competitive advantage.

(iii) It is used to **analyse cost information** with a view to develop relevant tactics to garner a sustainable competitive advantage.

(iv) It provides a **better understanding of the overall cost structure** in the quest for gaining a sustainable competitive advantage.

(v) It uses cost information specifically **to govern the strategic management process** – formulation, communication, implementation and control.

3 Pillars of SCM

1. **Strategic Positioning Analysis:** It determines the company's comparative position in the industry in terms of performance.
2. **Cost Driver Analysis:** Cost is driven by different interrelated factors. In strategic cost management, the cost driver is divided into two categories, i.e.., structural cost drivers and executional cost drivers. It examines, measures and explains the financial impact of the cost driver concerned with the activity.
3. **Value Chain Analysis (VCA):** VCA is the process in which a firm recognizes and analyses, all the activities and functions that contribute to the final product. VCA depicts the manner in which customer-value accrues along the activity chain that results in the final product or service.

In a nutshell, strategic cost management is not just about controlling the costs but also using the information for strategic decision making. The fundamental objective of strategic cost management is to gain a sustainable competitive advantage by way of cost leadership and product differentiation.

Value Chain

Developed by Michael Porter in 1985 and used throughout the world, the value chain is a powerful tool for disaggregating a company into its strategically relevant activities in order to focus on the sources of competitive advantage, that is, the specific activities that result in lower costs or higher prices.

A company's value chain is **typically part of a larger value system** that includes companies either **upstream (suppliers) or downstream (distribution channels)**, or **both**. This perspective about how value is created forces managers to consider and see each activity not just as a cost, but as a step that has to add some increment of value to the finished product or service.

Value = The utility of a product that customer wants and is willing to pay for

Manufacturing companies create value by acquiring raw materials and using them to produce something useful. **Retailers** bring together a range of products and present them in a way that is convenient to customers, sometimes supported by services such as trial rooms or personal shopper advice and insurance companies offer policies to customers that are underwritten by larger re-insurance policies. Here, they are packaging these larger policies in a customer-friendly way, and distributing them to a mass audience.

In other words, the value that is created and captured by a company as reduced by the costs incurred is the profit margin. Expressed as a formula the equation would read as:

Value Created and Captured – Cost of Creating that Value = Profit Margin

The more value an organisation creates, the **more profitable** it is likely to be. As more and more value is provided to the customers, competitive advantage creeps in. Understanding how a company creates value, and looking for ways to add more value, are critical elements in developing a competitive strategy.

Thus, the **value chain is a set of activities that an organisation carries out to create value for its customers**. Porter proposed a general-purpose value chain that companies can use to examine all of their activities, and see how they are

connected. The way in which value chain activities are performed determines costs and affects profits.

Elements in Porter's Value Chain

Rather than looking at departments or accounting cost types, Porter's Value Chain focuses on systems, and how inputs are changed into the outputs purchased by consumers. Using this viewpoint, Porter described a chain of activities common to all businesses, and he divided them into primary and support activities, as shown below.

Primary Activities: Primary activities relate directly to the physical creation, sale, maintenance and support of a product or service. They consist of the following:

- **Inbound Logistics:** These are all the processes related to receiving, storing, and distributing the inputs internally. The supplier relationships are a key factor in creating value here.
- **Operations:** These are the transformation activities that change inputs into outputs that are sold to customers. Here, operational systems create value.
- **Outbound Logistics:** These activities deliver the product or service to the customer. These are the things like collection, storage, and distributing the outputs. They may be internal or external to the organisation.
- **Marketing and Sales:** These are the processes that are used to persuade clients to purchase from the firm instead of its competitors. The benefits being offered, and how well they are communicated to the customers, are sources of value here.
- **Service:** These are the activities related to maintaining the value of the product or service to customers, once it has been purchased.

Support Activities: Support activities support the primary functions stated above. Each support, or secondary, activity can play a role in each primary activity. For example, procurement supports operations with certain activities, but it also supports marketing and sales with other activities.

- **Procurement (Purchasing):** This is what the organisation does to get the resources it needs to operate. This includes finding vendors and negotiating best prices.
- **Human Resource Management:** This is how well a company recruits, hires, trains, motivates, rewards, and retains its workers. People are a significant source of value, so businesses can create a clear advantage with good HR practices.
- **Technological Development:** These activities relate to managing and processing information, as well as protecting a company's knowledge base. Minimizing information technology costs, staying current with technological advances, and maintaining technical excellence are sources of value creation.
- **Infrastructure:** These are a company's support systems, and the functions that allow it to maintain daily operations. Accounting, legal, administrative, and general management are examples of necessary infrastructure that businesses can use to their advantage.

Value chain analysis (VCA)

Value chain analysis (VCA) is a process where a firm identifies its primary and support activities that add value to its final product and then analyse these activities to reduce costs or increase differentiation.

Conducting a value chain analysis prompts a firm to consider how each step adds or subtracts value from its final product or service. This, in turn, can help it realize some form of competitive advantage, such as:

- **Cost reduction**, by making each activity in the value chain more efficient and, therefore, less expensive
- **Product differentiation**, by investing more time and resources into activities like research and development, design, or marketing that can help the product stand out.

Typically, increasing the performance of **one of the four secondary activities** can benefit **at least one of the primary activities**.

Five Steps to developing a value chain analysis (Illustrative)

Step 1: Identify all value chain activities – Primary/ Support

Identify each activity that plays a part in creating your company's finished product. For example, it is not enough to write down that you have a product design team. You need to dig deeper and ask:

E.g., **How** many designers are on that team?

How much time does each activity on that team require?

What raw materials are they using?

Once you've identified each primary activity in detail, you'll need to do the same for each support activity. This step will take a considerable amount of time and, if possible, shouldn't be a one-person task. Instead, encourage cross-collaboration internally so each department can outline its logistics, operational costs and services.

Step 2: Calculate the cost of each activity

Remember to calculate cost drivers such as rent, utilities and staff. By having an accurate picture of every single cost (and what activities increase or decrease costs), it's easier to see how much revenue you're actually generating. Once each activity has been mapped out, you can delineate which parts of your value chain are costing your business the most money.

Step 3: Look at what your customers perceive as value

Know that customers tie value directly to a product's price tag, in other words, **perception greatly impacts** product margins. Research shows that although branded and non-branded painkillers have the exact same health outcome, the former is better perceived by consumers.

Step 4: Look at your competitors' value chains

The best way to determine value is through market analysis. Although it's unlikely you will have access to your competitors' infrastructure and operational breakdowns, you can use benchmarks as a starting point. This process is called **competitive benchmarking**. We can choose to use competitive benchmarking in one of three main ways:

(i) **Process Benchmarking:** Comparing your process structure and operations against how your competitors carry out tasks.

(ii) **Strategic Benchmarking:** Comparing your high-level business strategy to your competitors' to determine what emulates success.

(iii) **Performance Benchmarking:** Comparing outcomes, such as revenue, organic traffic, social media performance, reviews and ratings and so on.

First, you need to determine your competitive benchmarking goals; then, you can **conduct research, make a comparison** and **determine value**.

Step 5: Decide on a competitive advantage (Choose your way – Cost Leadership or Product differntiation)

Any cost cuts you make in the chain can lower the cost of your final product. The more you can push your product prices down, the larger your cost advantage will be compared to competitors.

If you choose competitive differentiation, you must capitalize on increasing the value perception of those products that your customers and end users are most willing to pay for. You can cater to your customers' most basic desires and needs by recognizing their pain points and repositioning your products as the ultimate solution.

Value Innovation

Value innovation is a process in which a company **introduces new technologies** or upgrades that are designed to achieve **both product differentiation and low costs**. The changes implemented through value innovation create new or improved elements for the product or service, but also result in cost savings by eliminating or reducing unnecessary aspects during the product lifecycle. Value innovation places equal emphasis on 'Value' as also 'Innovation'. Value innovation, thus, can improve on existing services and lowers the costs of that service for both the company and their customers.

Value innovation was first outlined in a 1997 article in Harvard Business Review by W. Chan Kim and Renée Mauborgne, who would later write the book Blue Ocean Strategy in 2005. **Value innovation is a key principle of "blue ocean strategy"**, a business approach that **focuses on creating new market spaces instead of fighting**

competitors existing market share. Instead of competing for market share, value innovation is designed to create new markets. The **goal of value innovation is to create new demand** and **change the market enough to render** the competition irrelevant in that market.

Red Ocean vs Blue Ocean Strategy

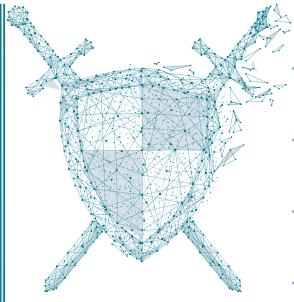
Red oceans are all the industries in existence today – the known market space, where industry boundaries are defined and companies try to outperform their rivals to grab a greater share of the existing market. Cutthroat competition turns the ocean bloody red. Hence, the term 'red' oceans.

Blue oceans denote all the industries not in existence today – the unknown market space, unexplored and untainted by competition. Like the 'blue' ocean, it is vast, deep and powerful –in terms of opportunity and profitable growth.

The creation of blue ocean enables driving costs down while simultaneously pushing value up.

Fundamental differences between Red Ocean Strategy and Blue Ocean Strategy

Red Ocean Strategy	Blue Ocean Strategy
Compete in existing market space	Create uncontested market space
Beat the competition	Make the competition irrelevant
Exploit existing demand	Create and capture new demand
Make the value-cost trade-off	Break the value-cost trade-off
Align the whole system of a firm's activities with its strategic choice of differentiation or low cost	Align the whole system of a firm's activities in pursuit of differentiation and low cost



Cost Control and Cost Reduction

I. COST CONTROL AND THE VARIOUS STEPS INVOLVED IN IT

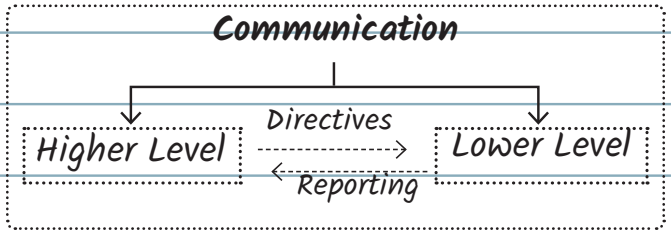
Cost Control *is defined as the regulation by executive action of the costs of operating an undertaking, particularly where such action is guided by cost accounting.*

Cost control involves the following steps and covers the various facets of the management:

(a) ***Planning:*** *First step in cost control is established plans/targets. The plan/ target may be in the form of budgets, standards, estimates and even past actual may be expressed in physical as well as monetary terms. These serves as yardsticks by which the planned objective can be assessed.*

Targets – Budgets/ Standards/ Estimates/ Past Actual

(b) ***Communication:*** *The plan and the policy laid down by the management are made known to all those responsible for carrying them out. Communication is established in two directions; directives are issued by higher level of management to the lower level for compliance and the lower level executives report performances to the higher level.*



(c) **Motivation:** The plan is given effect to and performances starts. The performance is evaluated, costs are ascertained and information about results achieved are collected and reported. The fact that costs are being complied for measuring performances acts as a motivating force and makes individuals endeavour to better their performances.

Motivation ⇒ Appraisal & Reporting

(d) **Appraisal and Reporting:** The actual performance is compared with the predetermined plan and variances, i.e deviations from the plan are analyzed as to their causes. The variances are reported to the proper level of management.

(e) **Decision Making:** The variances are reviewed and decisions taken. Corrective actions and remedial measures or revision of the target, as required, are taken.

Decision Making ⇒ Remedial Measures

2. ADVANTAGES OF COST CONTROL SYSTEM

The advantages of cost control are mainly as follows:

(a) Achieving the expected **return on capital employed** by maximising or optimizing profit

(b) Increase in **productivity** of the available resources

(c) Reasonable **price** of the customers

(d) Continued **employment** and job opportunity for the workers

(e) Economic use of **limited resources** of production

(f) Increased **credit worthiness**

(g) **Prosperity** and **economic** stability of the industry

3. COST REDUCTION

Cost reduction may be defined as the **real and permanent reduction in the unit costs of goods manufactured or services rendered without impairing their suitability for the use intended.**

Reductions due to windfalls, fortuities receipts, changes in government policy like reduction in taxes or duties, or due to temporary measures taken for tiding over the financial difficulties do not strictly come under the purview of cost reduction. At the same time a programmer of cost reduction should in **no way affect the quality of the products** nor should it lower the standards of performance of the business.

Broadly speaking reduction in cost per unit of production may be affected in two ways viz.,

1. By **reducing expenditure**, the volume of output remaining constant, and
2. By **increasing productivity**, i.e., by increasing volume of output and the level of expenditure remains unchanged.

These aspects of cost reduction are closely linked and they act together - there may be a reduction in the expenditure and the same time, an increase in productivity.

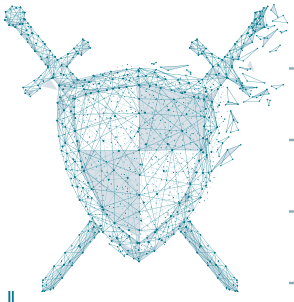
4. DIFFERENCES BETWEEN COST CONTROL AND COST REDUCTION. [MTP (JUN'17, DEC'18, JUN,20)]

Cost Control	Cost Reduction
(a) Cost Control represents efforts made towards achieving target or goal.	(a) Cost reduction represents the achievement in reduction of cost
(b) The process of cost control is to set up a target, ascertain the actual performance and compare it with the target, Investigate the variances, and take remedial measures.	(b) Cost reduction is not concern with maintenance of performance according to standard
(c) Cost control assumes the existence of standards or norms which are not challenged	(c) Cost reduction assumes the existence of concealed potential savings in standards or norms which are therefore subjected to a constant challenge with a view to improvement by bringing out savings
(d) Cost Control is a preventive function. Costs are optimized before they are incurred	(d) Cost reduction is a corrective function. It operates even when an efficient cost control system exists. There is room for reduction in the achieved costs under controlled conditions

(e) Cost control lacks dynamic approach	(e) Cost reduction is a continuous process of analysis by various methods of all the factors affecting costs, efforts and functions in an organization. The main stress is upon the why of a thing and the aim is to have continual economy in costs

5. Techniques of Cost Reduction

1. Productivity Increase
2. Optimum utilises of resources
3. VA/NE
4. BPR
5. Outsourcing
6. Kaizen
7. JIT/ Lean Manufacturing



Value Analysis & Value Engineering

I. VALUE ANALYSIS

Value Analysis (VA) or Value Engineering (VE) is a function-oriented, structured, multi-disciplinary team approach to solving problems or identifying improvements. The goal of any VA Study is to:

- **Improve value by** sustaining or improving performance attributes (of the project, product, and/or service being studied)
- while at the same time reducing overall cost (including life cycle operations and maintenance expenses).

Value Analysis can be defined as a process of systematic review that is applied to **existing product designs** in order to compare the **function of the product** required by a customer **to meet their requirements** at the lowest cost consistent with the specified performance and reliability needed.

This is a rather complicated definition and it is worth reducing the definition to key points and elements:

(i) **Value Analysis (and Value Engineering)** is a systematic, formal and organized process of analysis and evaluation. It is not haphazard or informal and it is a management activity that requires planning, control and co-ordination.

(ii) The analysis concerns the **function of a product** to meet the demands or application needed by a customer. To meet this functional requirement the

review process must include an understanding of the purpose to which the product is used.

(iii) **Understanding the use of a product** implies that specifications can be established to assess the level of fit between the product and the value derived by the customer or consumer.

(iv) To succeed, the **formal management process** must meet these functional specification and performance criteria consistently in order to give value to the customer.

(v) In order to yield a benefit to the company, the **formal review process** must result in a process of design improvements that serve to lower the production costs of that product whilst maintaining this level of value through function.

2. DEFINING COST AND VALUE

Any attempt to improve the value of a product must consider two elements, the first concerns the use of the product (known as **Use Value**) and the second source of value comes from ownership (**Esteem Value**). This can be shown as the difference between a luxury car and a basic small car that each has the same engine. From a use point of view both cars conduct the same function – they both offer safe economical travel (Use value) – but the luxury car has a greater esteem value.

A shocking figure, that is often used as a general measure, is that typically 80% of the manufacturing costs of a product will be determined once the design drawing has been released for manufacturing.

The costs of production are therefore 'frozen' and determined at this point. These costs include the materials used, the technology employed, the time required to

manufacture the product and such like. Therefore, the design process creates many constraints for the business and fixes a high degree of the total product cost.

It is therefore a process that **demands periodic review** in order to recover any 'avoidable' costs that can be removed throughout the life of the product (by correcting weaknesses or exploiting new processes, materials or methods) and lowering the costs of production whilst maintaining its Use value to the customer.

Basically, there are **three key** costs of a product:

- **Cost of the parts purchased:** These are costs associated with the supply of parts and materials.
- **Cost of direct labour** used to convert products.
- **Cost of factory overheads** that recover the expenses of production.

Although there are three elements of total cost accumulation it is traditionally the case that cost reduction activities have focused on the labour element of a product.

Activities such as work-study, incentive payments and automation have compressed labour costs and as a result there is little to be gained, for most companies, in attempting to reduce this further. Instead, comparatively greater gains and opportunities lie in the redesign and review of the products themselves to remove unnecessary materials and overhead costs.

This approach to the 'total costs' of a product involves taking a much broader look at the way costs in the factory accumulate and the relationship between costs and value generation. These new sources of costs and evaluations would therefore include such sources as:

- Cost of manufacture

- Cost of assembly
- Cost of poor quality
- Cost of warranty

It is therefore preferable to take the **holistic approach** to understanding costs and losses in the '**entire system**' of design and conversion of value in order to determine how to achieve customer service 'functionality' at a minimal cost per unit.

3. THE FOCUS OF VALUE ANALYSIS

The key focus of the VA approach is therefore the management of '**functionality**' to yield value for the customer.

The switch from metal to plastic kettles does not impair this value and functionality with the customer – they still want to boil water - but it does result in a cost saving for the manufacturing company.

If a company seeks to reduce the costs of producing a product then it must seek out costs **that are unnecessary or items** of the product that provide **no functional value** to the customer.

The **rules governing the application of the VA** approach are therefore simple:

- No cost can be removed if it compromises the **quality** of the product or its reliability, as this would lower customer value, create complaints and inevitably lead to the withdrawal of the product or lost sales.
- **Saleability** is another issue that cannot be compromised, as this is an aspect of the product that makes it attractive to the market and gives it appeal value.
- Any activity that reduces the **maintainability** of the product increases the cost of ownership to the customer and can lower the value attached to the product.

4. TYPES OF VALUE ANALYSIS EXERCISES VA FOR EXISTING PRODUCTS

One of the best approaches to VA is simply to **select an existing product** that is **sold in relatively large volumes**. This product, or product family, will tend to have a great deal of the basic information, and documented history, which **can be used quickly as opposed to a newly introduced product** where such a history is not available. An existing product unites all the different managers in a business, each with an opinion and list of complaints concerning the ability to convert the design into a 'saleable' product.

These opinions regarding poor performance (and documented evidence of failures) are vital to the discussions and understanding of how the product attracts costs as it is converted from a drawing to a finished product. These discussions therefore allow learning to take place and allow all managers to understand the limitations to the scope of product redesign and re-engineering activities. These issues include:

- The **inability to change existing product designs** due to the need to redesign tooling and the expense of such an initiative.
- The project team may have a **finite duration** before the project is concluded and therefore time will dictate what can be achieved.
- The **high levels of purchased costs** may imply a need to engage with suppliers in the VA process. This initiative will be constrained by a number of issues such as the timing of the project, the availability of resources from the supplier, the location of the suppliers, and other constraints.

VA for New Products – Value Engineering

For **new products**, the team will need to modify the VA approach and will operate in an environment that is **less certain** and has **poor levels of available information** upon which to make decisions. In this case, the analysis and systematic process of review for new products is known as Value Engineering (VE). The VE approach is similar to that of Value Analysis but **requires a much greater level of investment** by the organization in terms of the skilled, experienced and proficient human resources seconded to the group.

VA for Product Families- Horizontal Deployment

Under conditions where the value analysis project team **finds commonalties** with many products manufactured by the company, then it is possible to extend the benefits to all these other products concurrently. In this manner, **all affected products can be changed quickly** to bring major commercial benefits and to introduce the improvement on a 'factory-wide basis'. This is particularly the case when supplying companies offer improvements that affect all the products to which their materials or parts are used. The horizontal deployment activity has many advantages both in terms of **financial savings** and also the relatively **short amount of time** required to introduce the required changes to the product design.

Competitive VA

VA techniques are not simply the prerogative of the business that designed the product. Instead VA is often used as a competitive weapon and applied to the **analysis of competitor products in order to calculate the costs of other company's products.** This is often termed **'strip down'** but is effectively **the reverse value analysis**. Here the VA team are applied to understanding the design and conversion

costs of a competitor product. The results of the analysis is to understand **how competitor products are made, what weaknesses exist,** and at **what costs of production together** with an understanding of what innovations have been incorporated by the competitor company.

5. HOW TO USE VALUE ANALYSIS

Keys to Success

a. One of the most important initial steps in developing the VA process is to **create a formal team** of individuals to conduct the exercise.

These individuals must be drawn from different parts of the business that affect the costs associated with design, manufacturing, supply and other relevant functions. In addition, the **team must be focused on a product or product family** in order to begin the exercise.

b. **Gain approval of senior management** to conduct a Value Analysis exercise. Senior management support, endorsement and mandate for the VA project provides legitimacy and importance to the project within the business. This approval process also removes many of the obstacles that can prevent progress from being made by the team.

c. **Enlist a senior manager as a champion** of the project to report back directly to the board of directors and also to act as the programme leader.

d. Once a programme team has been developed it is important to **select an operational leader** to co-ordinate the efforts, monitor progress and to support the project champion.

This leader will remain with the VA team throughout the life of the project and will be the central linking pin between the team and the senior management champion.

e. Establish the **reporting procedure** for the team and the timing of the project. This project plan needs to be formal and displayed as a means of controlling and evaluating achievements against time.

f. **Present the VA concept and objectives of the team** to all the middle and senior managers in the business. Widespread communication of the VA project is important so that other employees, particularly managers (who may not be involved directly with the process) understand the need to support the project either directly by assigning staff or indirectly through the provision of data.

g. **Maintain a list of those business functions that should receive a regular communication of progress** even though they may not be directly involved with the project. This process allows other individuals in the business to be informed about the progress and findings of the group. This form of promotion is important as it maintains a momentum and communicates the findings of the team as widely as possible.

h. **Provide an office space** and co-locate the team members where practical and possible to do so. The ability to locate a VA improvement group in one area of the business is important and assists the communication within the group. A convenient area can also be used to dismantle the product and also the walls of the area can be used to record, on paper charts, the issues that have been discovered by the team (and the associated actions that must be undertaken).

i. **Select the product for the first study. Ideally the existing product**, or family of products, will be one that is established, sells in volume and has a relatively long life expectancy.

As such any improvement in the cost performance of the product will provide a large financial saving to the business.

j. Write down **the objectives of the project** and the key project review points. Estimate the targets to be achieved by the project. These objectives provide a reference point and framework for the exercise. The objectives also focus attention on the outputs and achievements required by the company.

k. Select and **inform any personnel who will act in a part time or temporary role during the project**. This process is used to schedule the availability of key specialist human resources to support the team throughout the duration of the project.

l. **Train the team** in both the process of VA and also in basic team building activities. It is important that all members understand the nature of the project and its importance.

m. The **initial team building exercises** are also a good way of understanding the attitude of all members to the project – especially those with reservations or a negative attitude to what can be achieved. As with most team exercises there is a requirement to allow the team to build and bond as a unit. It is often difficult for individuals, drawn from throughout the factory, to understand the language that is used throughout the business and also to understand the 'design to market' process when their own role impacts on a small section of this large and complex process.

6. VALUE ENGINEERING [MTP DEC'17; MTP DEC'19; MTP DEC'21; DEC'17; JUN'18]

Value Engineering is an organized/systematic approach directed at analyzing the function of systems, equipment, facilities, services, and supplies for the purpose of achieving their essential functions at the lowest life-cycle cost consistent with required performance, reliability, quality, and safety. Society of Japanese Value Engineering defines VE as:

"A systematic approach to analyzing functional requirements of products or services for the purposes of achieving the essential functions at the lowest total cost".

7. WHAT ARE THE ISSUES CONSIDERED DURING A VE REVIEW?

The Issues are as follows :

- Elimination of unnecessary functions from the production process.
- Elimination of unnecessary product qualities
- Design minimisation
- Substitution of parts
- Search for better way of doing things.

8. WHAT ARE THE STEPS TO BE FOLLOWED FOR DOING VALUE ENGINEERING?

The following are the steps to be used for carrying out the Value Engineering exercise :

(i) Selection of the Product Plan.

(ii) Gathering Product Information

(iii) Functional Analysis

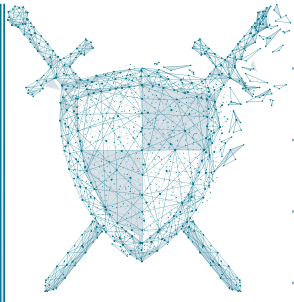
(iv) Creativity Phase and preparing the work-sheet

(v) Evaluation Sheet

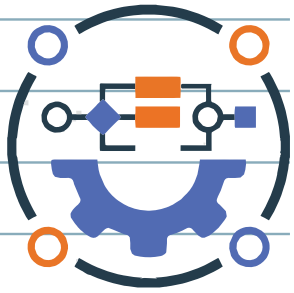
(vi) Cost Analysis

(vii) Result and Conclusion

(viii) Implementation.



Business Process Reengineering



1. MEANING OF BUSINESS PROCESS RE-ENGINEERING [DEC'18; MTP JUN'17; MTP JUN'18; MTP DEC'19]

Business Process Re-engineering (BPR) *refers to the* ***fundamental rethinking*** *and* ***redesign*** *of business processes to achieve* ***improvement in critical measures*** *of performance such as* ***cost, quality, service, speed*** *and* ***customer satisfaction****. In contrast the concept of Kaizen, which involves small, incremental steps towards gradual improvement, re-engineering involves a* ***giant leap****. It is the complete redesign of a process with an emphasis on finding* ***creative new way to accomplish an objective****. It has been described as taking a blank piece of paper and starting from scratch to redesign a business process. Rather than searching continually for minute improvement, re-engineering involves a* ***radical shift in thinking about how an objective should be met****. Re-engineering prescribes radical, quick and significant change. Admittedly, it can entail* ***high risks****, but it can also bring* ***big rewards****. These benefits are* ***most dramatic*** *when new models are discovered for conducting business.*

2. CHARACTERISTICS AND PRINCIPLES OF RE-ENGINEERING PROCESS

(i) Several jobs are combined into one

(ii) Often workers make decisions

(iii) The steps in the process are performed in a logical order

(iv) Work is performed, where it makes most sense

(v) Quality is built in.

(vi) Manager provides a single point of contact

(vii) Centralized and decentralized operations are combined.

3. SEVEN PRINCIPLES OF BPR [MTP JUN'19]

(a) Processes should be designed to achieve a desired outcome rather than focusing on existing tasks.

(b) Personnel who use the output from a process should perform the process

(c) Information processing should be included in the work, which produces the information

(d) Geographically disperesed resources should be treated, as if they are centralized

(e) Parallel activities should be linked rather than integrated

(f) Doers should be allowed to be self-managing

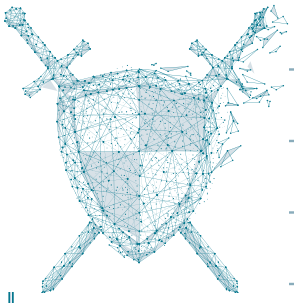
(g) Information should be captured once at source.

4. EIGHT STEPS OF BUSINESS PROCESS RE-ENGINEERING SUGGESTED BY VAKOLA ET AL. (1998). [MTP JUN'19]

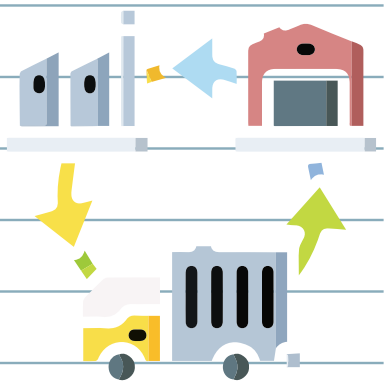
The eight proposed stages, as SUGGESTED BY Vakola et al. (1998) are as follows:

- Develop Vision and Objectives
- Understand existing processes
- Identify Process for Re-design
- Identify Change Levers
- Implement the new process

- Make new process operational
- Evaluate the new process
- Monitor ongoing continuous improvement.



Supply Chain Management



I. Supply Chain

Supply Chain refers to the **entire gambit of linkages** in manufacturing a product or rendering a service. For example, in relation to a manufacturing entity, it **encompasses all the activities** that commence **from the extraction of raw materials till the delivery of the finished product** to the ultimate consumer. Listed below are the generic links of a supply chain:

(i) Extraction of Raw Materials

(ii) Vendor

(iii) Manufacturer

(iv) Distributer

(v) Retailer

(vi) Consumer

In its simplest form a supply chain is the activities required by the organisation to deliver goods or services to the consumer. A supply chain is a focus on the core activities within the organisation required to convert raw materials or component parts through to finished products or services.

In its simplest **form the stages in a supply chain are as depicted within the Porters Value Chain** and this can be considered a good guide to a supply chain structure, viz.

- Inbound Logistics
- Operations
- Marketing and Sales
- Outbound Logistics
- Services

Supply Chain = Industry Value Chain = (Porter's Value Chain)

Thus, supply chains are made up of all the links that participate in the design, assembly, and delivery of a particular product.

Design → Assembly → Delivery

- Vendors supply raw materials
- Producers convert those raw materials into products
- Warehouses store that product until it's needed
- Distribution centers pick up and deliver that product
- Retailers, online and in-store, bring that product to you

Supply chains are the reason that the producer can provide customers **what they want, when** and **where** they want it, **at the price they need**. For example, in the electronics industry, the supply chain is the central nervous system that governs how products are created.

2. Supply Chain Management (SCM)

Supply chain management encompasses every activity involved in maintaining the supply chain. The goal of supply chain management is to look holistically at the entire supply chain from supplier through to the consumer, and **review three core areas of people, process and systems** in order to **maximise value from all activities**.

Behind every product one uses – electronics, coffee, clothing, lawn mowers – there lies SCM which makes it possible to get the products better, faster, and cheaper. In essence, supply chain management **integrates supply and demand management within and across companies**. Companies like Dell, Nokia, Proctor & Gamble, Toyota, and Walmart consider SCM to be a key factor in their overall success.

Not only is supply chain management important to the world's leading organisations, this fast-paced, global field offers tremendous employment opportunities. Nearly every size and type of organisation needs motivated, well- prepared individuals to become their supply chain leaders.

3. Supply Chain Strategy

Supply chain strategy follows the corporate strategy. Once the corporate strategy is defined, **this will cascade into the functional areas of the business where each function will set their strategy that is aligned to the corporate strategy**. The supply chain strategy may be set for example as **"We aspire to reduce waste in our supply chain activities to support the company's strategy to be a cost leader in our market"**.

Once this strategy is determined for the function it will **influence daily operational decisions**.

- **Procurement** may focus on driving cost out of the procurement activities by sourcing suppliers with **favourable** terms, negotiating quality improvements that reduce waste activities or stronger contractual terms
- **Operations** may look to remove the **7 wastes** from their existing processes.

- **Logistics** may look to invest in equipment to support removal of waste activities or review their operational processes.

There are **three core areas** to consider when developing the supply chain strategy and business case:

- **People** – Do you have the **right number of staff** with the **right skill** set?
- **Process** – **Are there waste activities** within your current operating processes?
- **Systems** – Are your **systems** enablers to the strategy or are legacy systems holding you back?

4. Importance of Supply Chain Management

1. Boosts Customer Service

- **Right Location:** Customers expect products to be available at the right location. (i.e., customer satisfaction diminishes if an auto repair shop does not have the necessary parts in stock and can't fix the car for an extra day or two).
- **Right Delivery Time:** Customers expect products to be delivered on time (i.e., customer satisfaction diminishes if pizza delivery is two hours late or Christmas presents are delivered on December 26).
- **Right After Sale Support:** Customers expect products to be serviced quickly. (i.e.., customer satisfaction diminishes when a home furnace stops operating in the winter and repairs can't be made for days)

2. Reduces Operating Costs

- **Decreases Purchasing Cost:** Retailers depend on supply chains to quickly deliver expensive products to avoid holding costly inventories in stores any longer than necessary. For example, electronics stores require fast delivery of

60" flat-panel plasma HDTV's to avoid high inventory costs to avoid holding cost of costly inventories.

- **Decreases Production Cost:** Manufacturers depend on supply chains to reliably deliver materials to assembly plants to **avoid material shortages** that would **shut-down production**. For example, an unexpected parts shipment delay that causes an auto assembly plant shutdown can cost ₹**20,000 per minute** and lakhs of rupees per day in lost wages.
- **Decreases Total Supply Chain Cost:** Manufacturers and retailers depend on supply chain managers to design networks that meet **customer service goals at the least total cost**. Efficient supply chains enable a firm to be more competitive in the market place. For example, **Dell's** revolutionary computer supply chain approach involved making each computer based on a specific customer order, then shipping the computer directly to the customer. As a result, **Dell was able to avoid having large computer inventories sitting in warehouses and retail stores which saved millions of dollars**. Also, Dell **avoided carrying computer inventories that could become technologically obsolete** as computer technology changed rapidly.

3. Improves Financial Position

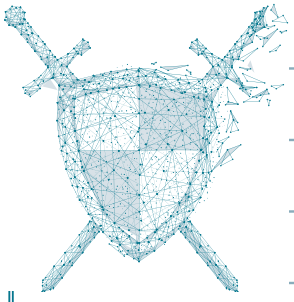
- **Increases Profit Leverage:** Firms value supply chain managers because they help control and reduce supply chain costs. This can result in dramatic increases in firm profits. For instance, **U.S. consumers eat 2.7 billion packages of cereal annually**, so decreasing U.S. cereal supply chain costs just **one cent per cereal** box would result in **$13 million dollars saved industry-wide as 13 billion boxes**

of cereal flowed through the improved supply chain over a five-year period.

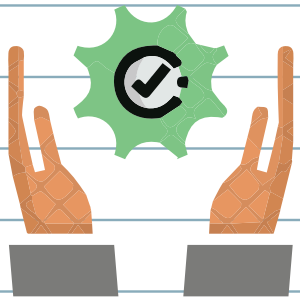
- **Decreases Fixed Assets:** Firms value supply chain managers because they decrease the use of large fixed assets such as plants, warehouses and transportation vehicles in the supply chain. If supply chain experts can redesign the network to properly serve customers from six warehouses rather than ten, the firm will avoid building four very expensive buildings- Reduce Machinery, Size of Building, Ware Houses.
- **Increases Cash Flow:** Firms value supply chain managers because they speed up product flows to customers. For example, if a firm can make and deliver a product to a customer in 10 days rather than 70 days, it can invoice the customer 60 days sooner.

4. Societal Benefits

- Lesser known, is how supply chain management also plays a critical role in society. SCM knowledge and capabilities can be used to support medical missions, conduct disaster relief operations, and handle other types of emergencies. Whether dealing with day-to-day product flows or dealing with an unexpected natural disaster, supply chain experts roll up their sleeves and get busy. They diagnose problems, creatively work around disruptions, and figure out how to move essential products to people in need as efficiently as possible.



Cost Of Quality & Total Quality Management



1. What is TQM

TQM is a process of **increasing awareness** on quality in **all** resources and relationships **within the organization.**

Two Basic Principles

- Getting things right first time
- Continuous improvement

2. Cost of Quality

It is the difference between the actual cost of producing, selling and supporting products/services and the equivalent cost if there were no failures during production/ usage by customers = **Cost with no failures – Current Cost.**

3. Approaches Towards Quality

Inspection Approach

- Inspect the FG before delivery
- If defective
  (a) Rework/Rectify
  (b) Scrapped
  (c) Seconds Sale

Quality Control

- Operational techniques to fulfil the requirements of quality
- Control on operations
- Procedures
- Dependency on inspection

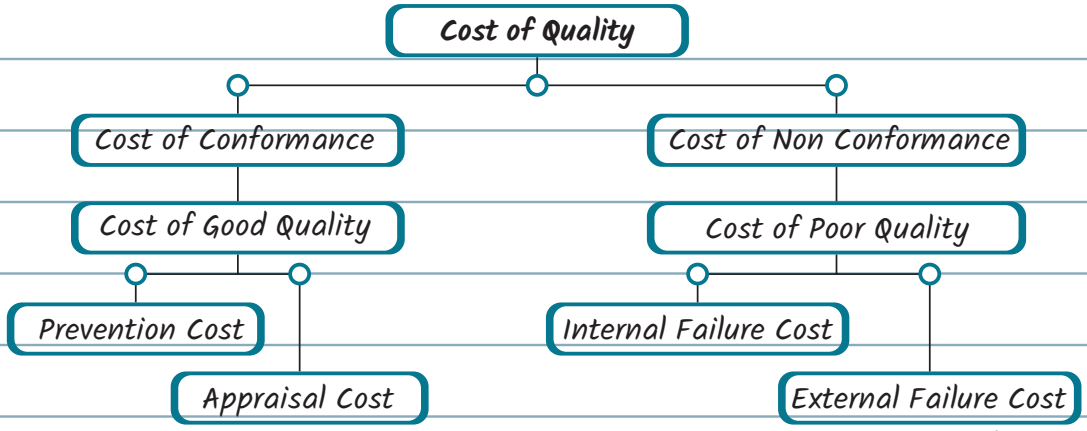
Quality Assurance

- Prevention Based
- Root Cause
- Design Improvement
  Training etc.

↓

TQM

4. Four types of Cost of Quality



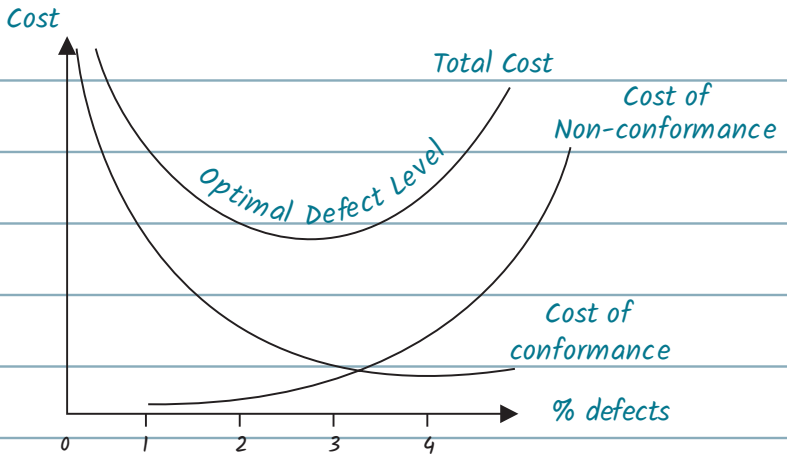
Types of Cost	Examples
Prevention Costs	Training, Quality Circles, Replacement of machines.
Appraisal Costs	Inspection Cost, Quality Review / Audit Cost.
Internal Failure Costs	Rework Cost, Scrap Cost.
External Failure Costs	After Sale Service, Warranty Replacement.

Quality Cost Report : TC in each category as a % of TQC or as a% of sales.

5. Optimal Cost of Quality

It is generally accepted that an increased expenditure in prevention and appraisal is likely to result in a substantial reduction in failure costs. Because of the trade off, there may be an **optimum operating level** in which the **combined costs are at a minimum**.

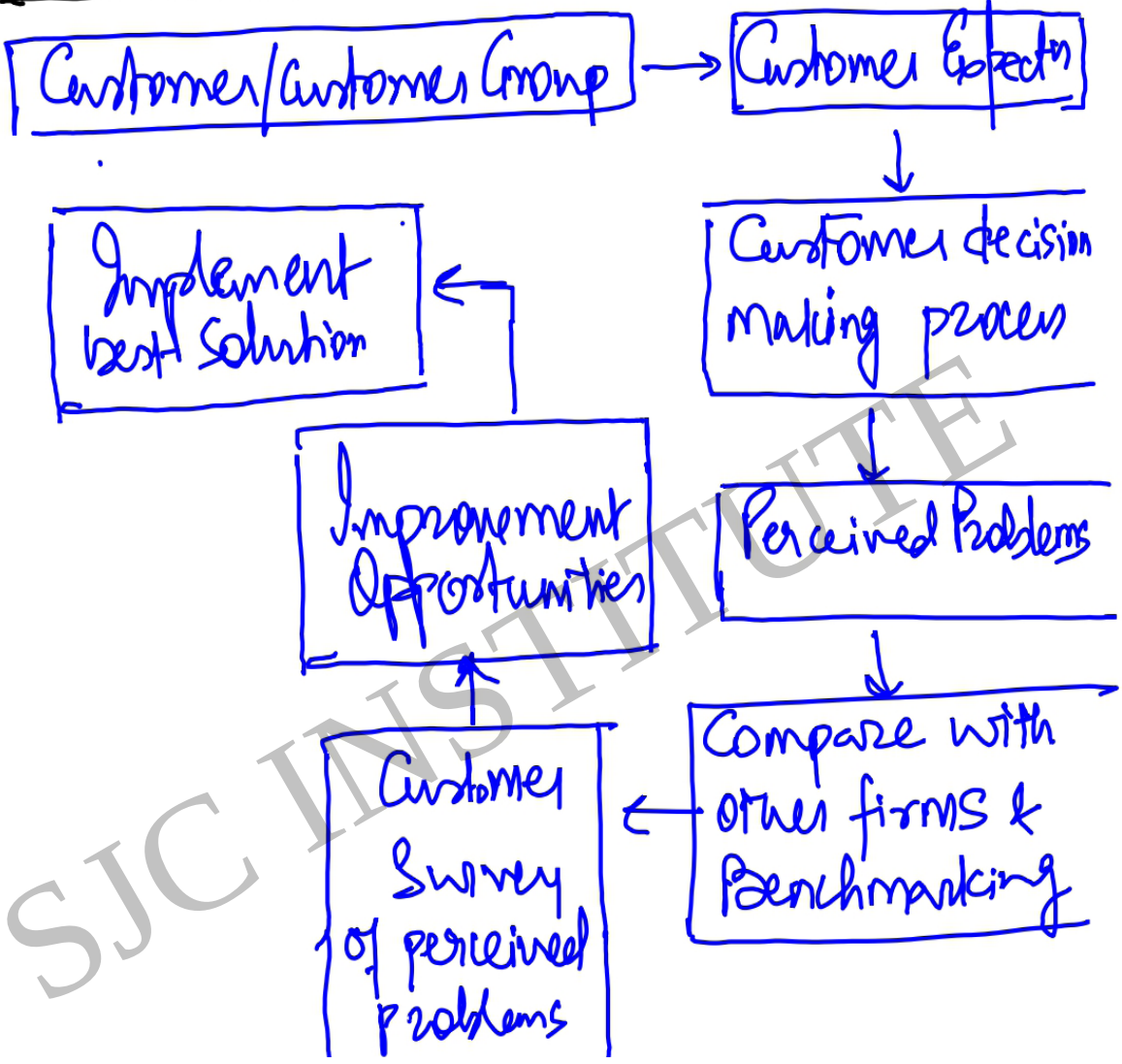
Hence it is further argued that striving for zero defects through a program of continuous improvements is not good for the economic interest of the company.



6. Principles of TQM

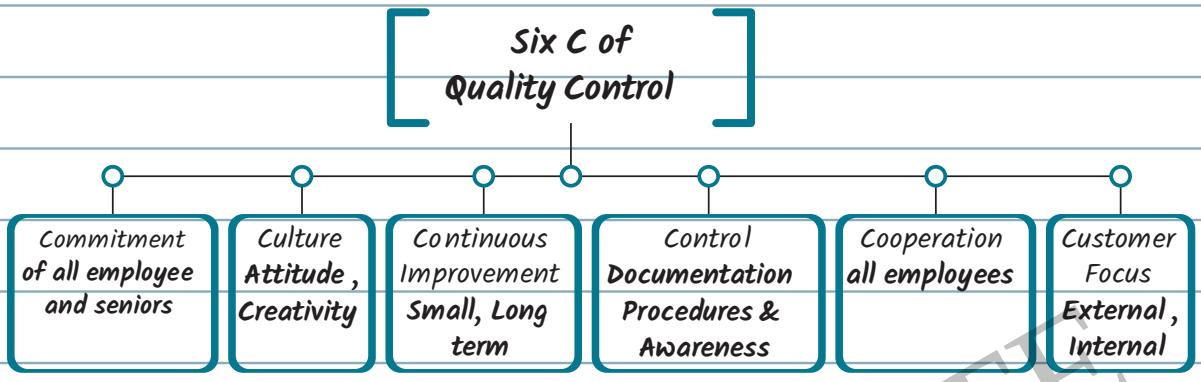
- Clear explanation of **benefits** of project
- Total employee **involvement**
- Process **measurement**
- Involvement of **customer** and **contributors**
- Elimination of a **irrelevant data**
- Understand the **need of whole process**
- **Graphical and pictorial techniques** to as if understanding
- **Use of errors** to prompt continuous improvement
- **Use of statistics** to tell people how they are doing
- Establishment of **performance targets**

7. Steps in TQM



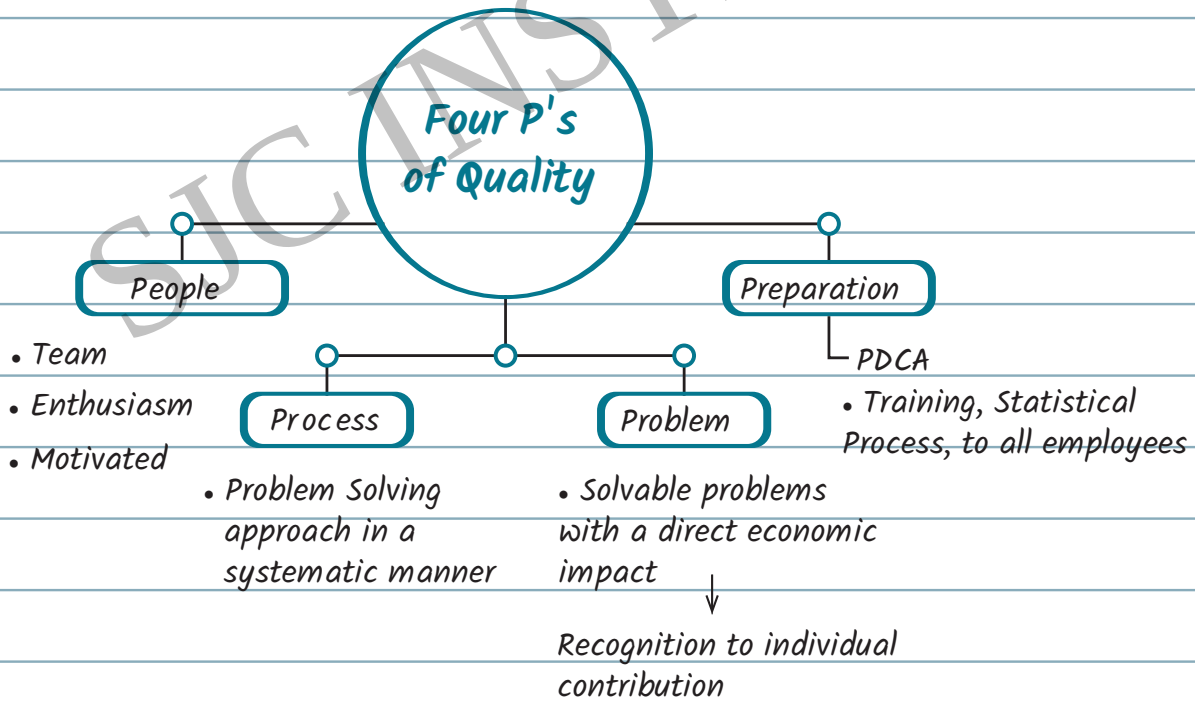
8. Six C of Quality Control

- Essential requirements for Implementation



9. Four P's of Quality

Essential Requirements of TQM



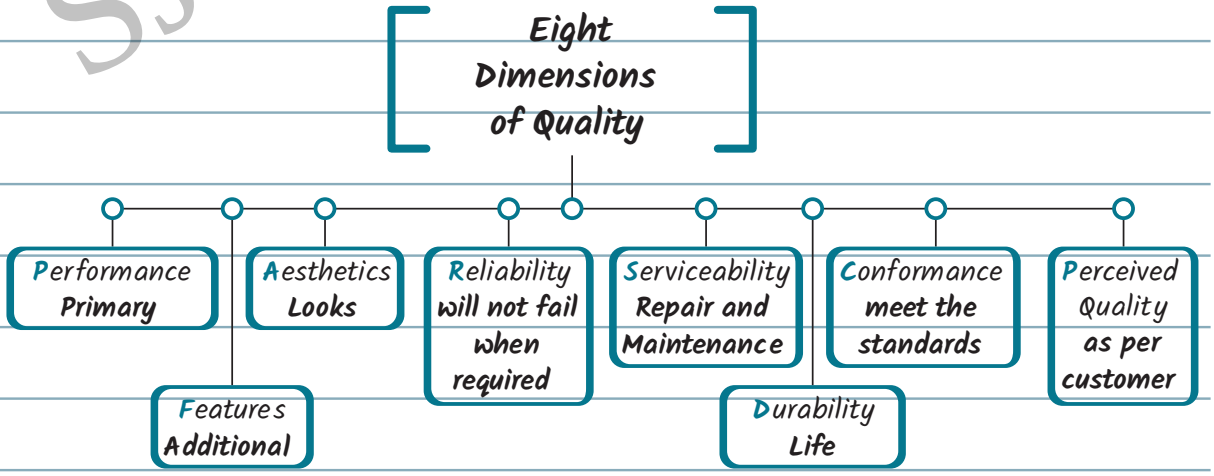
10. PRAISE

1. P = Problem Identification - involve everyone
2. R = Ranking of Problems - solve those that benefits Co. first
3. A = Analysis - Causes of Problems
4. I = Innovation - Identify various solutions
5. S = Solution - Effective implementation
6. E = Evaluation - Effective Control

Implementation of PRAISE - 3 point Action Plan

1. Small to Big Issues ⇒ Solve small problems first
2. Solvable Problem ⇒ Not trivial, with a potential impact & a clear improvement opportunity.
3. Recognition of Participants ⇒ Rewarded for their efforts through monetary/ non monetary means.

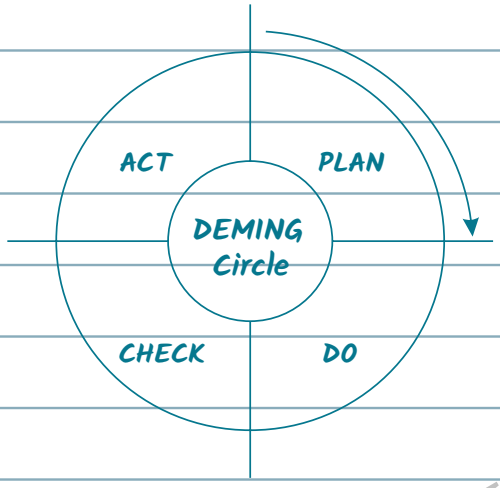
11. Eight Dimensions of Quality



[Mnemonics = SCRAP PDF]

12. PDCA Cycle

It consists of four steps - **Plan (P), Do (D), Check (C) and Act (A).**



To achieve sustained success, an organisation needs strong leadership and clear strategic direction. They need to develop and improve their people, partnerships and processes to deliver value-adding products and services to their customers. If the right approaches are effectively implemented, they will achieve the results they, and their stakeholders, expect.

The RADAR, logic assessment framework

The RADAR logic is a dynamic assessment framework and powerful management tool that provides astructured approach to questioning the performance of an organisation.

13. Production Schedule

Finished Goods Schedule

	Particulars	Before QMP	After QMP
	Gross FG Produced	**	**
Less:	Downgraded Units at Inspection Stage	**	**
	FG available for sale	**	**
Less:	Warranty replacement	**	**
	Net FG invoiced	**	**

Raw Material Schedule

	Particulars	Before QMP	After QMP
	Raw Material Purchased	**	**
Less:	Loss in transit	**	**
	Raw Material Received at Stores	**	**
Less:	Loss in storage	**	**
	Raw Material available for production	**	**
Less:	Loss in processing	**	**
	Raw Material consumed for Gross Production	**	**

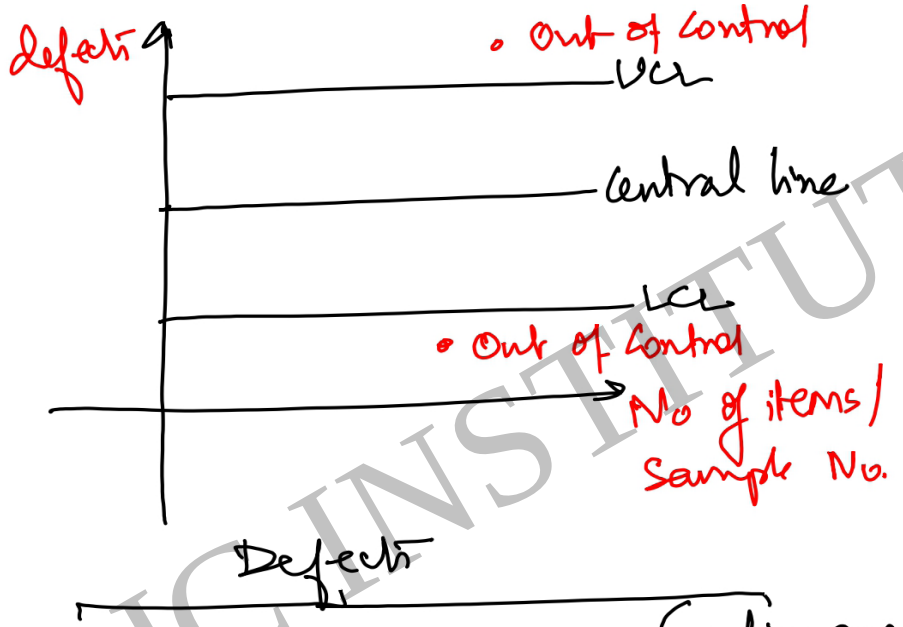
Machine Time Schedule

	Particulars	Before QMP	After QMP
	Gross Machine Hours	**	**
Less:	Downtime or Idle time	**	**
	Productive Machine Hours for Gross Production	**	**

The main concept is that a company **must implement the quality programme even if there is an extra cost due to it** as it will benefit a company in the long term by increasing its goodwill & competitiveness

14. Statistical Quality Control

1. Data of defects at inspection stage
2. Analysis of defects using SQC



Defects

Discrete or Attributes
↓
No. of defective unit
(Eg. No. of wrong Shipment)
or
No. of defects / unit
(Eg No. of errors in ITR)

- p chart
- c chart

Continuous or Variable
↓
Range of defects
(Eg Rod diameter ± 0.05 mm)

- R chart
- $\bar{x}$ chart
- x chart

99% Confidence, $z = 3$
95% Confidence, $z = 2$
68% Confidence, $z = 1$

P chart	C Chart	R chart	$\bar{x}$ chart	x Chart
Proportion defective	Multiple defects/unit	For process variability	For process variability	
			$\bar{R} = \Sigma R / n$	
$\bar{p}$ = Proportion defective	$\bar{c} = \frac{\Sigma \text{defects}}{\Sigma n}$	R = High-low	$\bar{x} = \frac{\Sigma x}{n}$ for each sample	$\bar{x}$
$\bar{q} = 1 - \bar{p}$		$\bar{R} = \frac{\Sigma R}{n}$	$\bar{\bar{x}} = \frac{\Sigma \bar{x}}{n}$	$\sigma = \sqrt{\frac{\Sigma (x - \bar{x})^2}{n}}$
$\sigma = \sqrt{\frac{p\bar{q}}{n}}$	$\sigma = \sqrt{\bar{c}}$	D_4 & D_3 value given	A_2 = Adj factor	$SE = \frac{\sigma}{\sqrt{n}}$
$CL = \bar{p}$	$CL = \bar{c}$	$CL = \bar{R}$	$CL = \bar{\bar{x}}$	
$UCL = \bar{p} + z\cdot\sigma$	$UCL = \bar{c} + z\cdot\sigma$	$UCL = \bar{R} \times D_4$	$UCL = \bar{\bar{x}} + A_2 \times \bar{R}$	$UCL = \bar{\bar{x}} + z \times SE$
$LCL = \bar{p} - z\cdot\sigma$	$LCL = \bar{c} - z\cdot\sigma$	$LCL = \bar{R} \times D_3$	$LCL = \bar{\bar{x}} - A_2 \times \bar{R}$	$LCL = \bar{\bar{x}} - z \times SE$
		If d_3, d_2 given		
		$D_3 = 1 - \frac{3d_3}{d_2}$		
		$D_4 = 1 + \frac{3d_3}{d_2}$	$A_2 = \frac{3}{d_2 \times \sqrt{n}}$	

Confidence level	Z
99%	3 (Refer)
96%	2
68%	1

15. Pareto Analysis or 80/20 Analysis

Founded by Mr. Vilfred Pareto, an Italian Economist in Milan.

He observed that 80% of wealth of Milan is distributed among 20% of its population and vice versa.

Basic principle is that a few items or activities are often core to the organisaton's fortune while the majority are only peripheral.

80% of something is accounted for by 20% of something else.

16. Applications of Pareto Analysis

A. Inventory Analysis

No. of Items	Value
80%	20%
20%	80%

B. Product Profitability Analysis

No. of Products	Profit
80%	20%
20%	80%

C. Customer Profitability Analysis

No. of Customers	Profit
80%	20%
20%	80%

D. Quality Control

No. of Defects	Causes
80%	20%
20%	80%

E. Activity Based Cost Analysis

Cost Driver	Overhead Costs
80%	20%
20%	80%

17. Management Actions using Pareto Analysis

- For low number of products/ customers yielding high revenue/profits

  Allocate maximum resources to the models.

- For high number of products/ customers yielding low revenue/profits

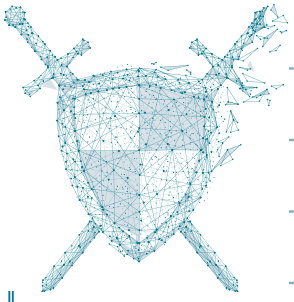
  Revision of pricing policy.

  Delegate to lower level.

  Discontinuation of certain products.

18. Limitations of Pareto Analysis

- Potential cost is involved
- Product & customer of low rank is neglected.



Lean Accounting

1. LEAN ACCOUNTING [DEC'17; MTP JUN'17; MTP JUN'18; MTP DEC'18; DEC'21]

What we now call **lean manufacturing** was developed by **Toyota** and other Japanese companies. Toyota executives claim that the famed Toyota Production System was inspired by what they learned during visits to the Ford Motor Company in the 1920s and developed by Toyota leaders such as Taiichi Ohno and consultant Shigeo Shingo after World War II. As pioneer American and European companies embraced lean manufacturing methods in the late 1980s, they discovered that lean thinking must be applied to every aspect of the company including the financial and management accounting processes.

Lean Accounting is the general term used **for the changes required to a company's account- ing, control, measurement, and management processes to support lean manufacturing and lean thinking**. Most companies embarking on lean manufac- turing soon find that their accounting processes and management methods are at odds with the lean changes they are making. The reason for this is that tradition- al accounting and management methods were designed to support traditional manufacturing; they are based upon mass production thinking. Lean manufactur- ing breaks the rules of mass production, and so the traditional account- ing and management methods are (at best) unsuitable and usually actively hostile to the lean changes the company is making.

2. PRINCIPLES, PRACTICES AND TOOLS OF LEAN ACCOUNTING

Principles		Practices		Tools of lean accounting	
A.	Lean & simple business accounting	1.	Continuously eliminate waste from the transactions processes, reports, and other accounting methods	(a)	Value stream mapping; current & future state
				(b)	Kaizen(leancontinuousim-provement)
				(c)	PDCA problem solving
B.	Accounting processes that support lean transformation	1.	Management control & continuous improvement	(a)	Performance Measure-ment Linkage Chart; linking metrics for cell/ process, value streams, plant & corporate reporting to the business strategy, target costs, and lean improvement
				(b)	Value stream performance boards containing break-through and continuous improvement projects
				(c)	Box scores showing value stream performance
		2.	Cost management	(a)	Value stream costing
				(b)	Value stream income statements
		3.	Customer & supplier value and cost management (to reduce the price)	(a)	Target costing
C.	Clear & timely communication of information	1.	Financial reporting	(a)	"Plain English" financial statements
				(b)	Simple, largely cash-based accounting

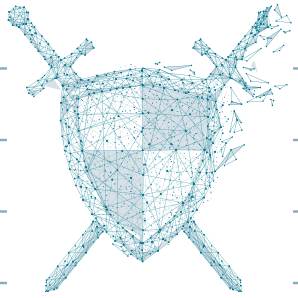
Principles		Practices		Tools of lean accounting	
		2.	Visual reporting of financial & nonfinancial performance measurements (Writing, on time delivery)	(a)	Primary reporting using visual performance boards; division, plant, value stream, cell/ process in production, product design, sales/ marketing, administration, etc.
		3.	Decision-making	(a)	Incremental cost & profitability analysis using value stream costing and box scores
D.	Planning from a lean perspective	1.	Planning & budgeting	(a)	Hoshin policy deployment
				(b)	Sales, operations, & financial planning (SOFP)
		2.	Impact of lean improvement	(a)	Value stream cost and capacity analysis
				(b)	Current state & future state value stream maps
				(c)	Box scores showing operational, financial, and capacity changes from lean improvement. Plan for financial benefit from the lean changes
		3.	Capital planning	(a)	Incremental impact of capital expenditure on value stream box-score. Often used with 3P approaches
		4.	Invest in people	(a)	Performance measure-ments tracking continuous improvement participation, employee satisfaction, & cross-training
				(b)	Profit sharing

Principles		Practices		Tools of lean accounting	
E.	Strengthen internal accounting control	1.	Internal control based on lean operational controls	(a)	Transaction elimination matrix
				(b)	Process maps showing controls and SOX risks
		2.	Inventory valuation	(a)	Simple methods to value inventory without the requirement for perpetual inventory records and product costs can be used when the inventory is low and under visual control.

3. CONTRASTING LEAN ACCOUNTING AND TRADITIONAL STANDARD COSTING

Lean Accounting	Standard Costing	Why is this important for Lean?
Quick, simple, and timely	Complex and wasteful processes	FLOW: Frequent and simple value stream income statements create much better control.
Clear and easy to understand	Difficult for people to understand	EMPOWERMENT: Information people can understand empowers those people for Lean improvement and growth.
Provides information for effective decisions.	Leads to bad decisions	VALUE: Readily understandable costs lead to better decisions and improved cash-flow and profits.
Supports value stream measurements and box scores	Supports measurements that undermine Lean endeavors	PURSUE PERFECTION: Measurements motivate people, Value Stream costs motivate lean improvement. Standard variance reports are anti-Lean.
Supports a value stream (total process) approach	Supports a departmental view of production	VALUE STREAMS: Focus on value streams lead to improved value, flow, and costs. Department focus opposes Lean.

Lean Accounting	Standard Costing	Why is this important for Lean?
Enables value stream financial control and improvement.	Narrows the focus of financial control and improvement.	PURSUE PERFECTION: Value Stream cost information creates better financial control and drives improvement.
Enables inventory valuation,	Enables inventory valuation,	FLOW: Standard costs were designed to value inventory. Lean accounting values inventory easier and better.
Enables value based pricing	Enables Cost+ Pricing	VALUE: Value streams focus on customer value leading to value pricing. Traditional companies use cost.



Six Sigma

1. SIX SIGMA

Six Sigma *is a set of practices developed by Motorola to systematically improve process by eliminating defects.* ***A defect is defined as non conformity of a product or service to its specifications.*** *The term six Sigma refers to the ability of highly capable processes to produce output with specifications. In particular, processes that operate with six sigma quality produce at defect levels below 3.4 defects per million opportunities (DPMO). Six Sigma's implicit goal is to improve all process to that level of quality or better.*

2. DMAIC [MTP DEC'17; MTP JUN'18]

Basic methodology consists of the following five (5) steps:

- ***Define*** *the process improvement goals that are consistent with customer demands and enterprise strategy.*
- ***Measure*** *the current process and collect relevant data for future comparison.*
- ***Analyze*** *to verify relationship and causality of factors. Determine what the relationship is, and attempt to ensure that all factors have been considered.*
- ***Improve*** *or optimize the process based upon the analysis using techniques like Design of Experiments.*
- ***Control*** *to ensure that any variances are corrected before they result in defects.*

Set up pilot runs to establish process capability, transition to production and thereafter continuously measure the process and institute control mechanisms.

3. DMIADV [MTP DEC'17; MTP JUN'18]

Basic methodology consists of the following five steps:

- **Define** the goals of the design activity that are consistent with customer demands and enterprise strategy.
- **Measure** and identify CTQs (critical to qualities), product capabilities, production process capability, and risk assessments.
- **Analyze** to develop and design alternatives, create high-level design and evaluate design capability to select the best design.
- **Design** details, optimize the design, and plan for design verification. This phase may require simulations.
- **Verify** the design, set up pilot runs, implement production process and handover to process owners.

Some people have used **DMAICR (Realize)**. Others content that focusing on the financial gains realized through Six Sigma is counter-productive and that said financial gains are simply by products of a good process improvement.

4. KEY ROLES REQUIRED FOR SUCCESSFUL IMPLEMENTATION OF SIX SIGMA

Six Sigma identifies several key roles for its successful implementation:

1. **Executive Leadership** includes CEO and other key top management team members. They are responsible for setting up a vision for Six Sigma implementation. They also empower the other role holders with the freedom

and resources to explore new ideas for breakthrough improvements.

2. **Champions** are responsible for the Six Sigma implementation across the organization in an integrated manner. The Executive Leadership draws them from the upper management. Champions also act as mentors to Black Belts. At GE this level of certification is now called **"Quality Leader"**.
3. **Master Black Belts**, identified by champions, act as in-house expert coaches for the organization on Six Sigma. They devote 100% of their time to Six Sigma. They assist champions and guide Black Belts and Green Belts. Apart from the usual rigour of statistics, their time is spent on ensuring integrated deployment of Six Sigma across various functions and departments.
4. **Experts** this level of skill is used primarily within Aerospace and Defense Business Sectors. Experts work across company boundaries, improving services, processes, and products for their suppliers, their entire campuses, and for their customers. Raytheon Incorporated was one of the first companies to introduce Experts to their organizations. At Raytheon, Experts work not only across multiple sites, but across business divisions, incorporating lessons learned throughout the company.
5. **Black Belts** operate under Master Black Belts to apply Six Sigma methodology to specific projects. They devote 100% of their time to Six Sigma. They primarily focus on Six Sigma project execution, whereas Champions and Master Black Belts focus on identifying projects/ functions for Six Sigma.
6. **Green Belts** are the employees who take up Six Sigma implementation along with their other job responsibilities. They operate under the guidance of Black Belts and support them in achieving the overall results.

7. **Yellow Belts** are employees who have been trained in Six Sigma techniques as part of a corporate-wide initiative, but have not completed a Six Sigma project and are not expected to actively engage in quality improvement activities.

5. SIX SIGMA PROCESS IN QUALITY CONTROL PROCESS. [MTP DEC'19; MTP JUN'17; MTP DEC'17; MTP JUN'18; MTP DEC'18; MTP JUN'20; DEC'19; RTP JUN'18]

Six Sigma is a set of practices originally developed by Motorola to systematically improve processes by eliminating defects. A defect is defined as non-conformity of a product or service to its specifications.

While the particulars of the methodology were originally formulated by Bill Smith at Motorola in 1986, Six Sigma was heavily inspired by six preceding decades of quality improvement methodologies such as quality control, TQM, and Zero Defects. Like its predecessors, Six Sigma

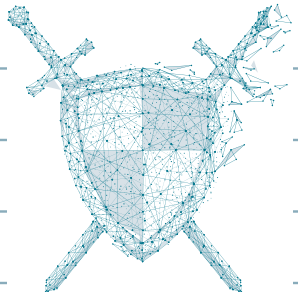
asserts the following:

(a) **Continuous efforts to reduce variation** in process outputs is key to business success

(b) Manufacturing and business processes can be **measured, analyzed, improved** and **controlled**

(c) **Succeeding at achieving sustained** quality improvement requires commitment from the entire organization, particularly from top-level management.

The term **"Six Sigma"** refers to the ability of highly capable processes to produce output within specification. In particular, processes that operate with six sigma quality produce at defect levels below 3.4 defects per (one) million opportunities (DPMO). Six Sigma's implicit goal is to improve all processes to that level of quality or better.



CVP Analysis

1. Breakup of total cost

$$VC \text{ ut or } MC = \frac{\Delta TC}{\Delta uts}$$

(assume no change in FC) Since, $\Delta FC = 0$, MC = Incremental cost = ΔTC

2. Contribution

Sales - VC = FC + Profit

Total Contribution = Quantity sold × Contribution /unit

3. Profit-Volume Ratio or Contribution Sales Ratio

$$\frac{\text{Contribution / ut}}{\text{SP / ut}} = \frac{\text{Total Contribution}}{\text{Total Sales}} = \frac{\Delta \text{ Profit}}{\Delta \text{ Sales}}$$

$$\text{or, Sales} = \frac{\text{TFC + Profit (before tax)}}{\text{Total Sales}}$$

4. Important Assumptions

• TFC remains constant.	If any of the assumption do not hold good, do not use formulas. Follow these steps :
• VC/unit remains constant.	(a) Contribution earned from initial volume
• SP/ unit remains constant.	(b) Desired contribution
	(c) Shortfall from desired contribution
	(d) Additional volume to be sold to recover the shortfall contribution as per new cost or price

5. BEP

$$\text{BEP uts} = \frac{FC}{\text{Contribution pu}} \quad \& \quad \text{BEP (₹)} = \frac{FC}{PVR}$$

At BEP,

- Total Contribution = Total Fixed Cost
- No profit, No loss

6. Cash BEP

$$\text{Cash in BEP (uts)} = \frac{\text{Cash FC}}{\text{Contribution pu}} \quad \& \quad \text{Cash BEP (₹)} = \frac{\text{Cash FC}}{PVR}$$

At Cash BEP,

- Total Contribution = Total Cash FC
- Total Cash FC = TFC - Non Cash exp (depreciation)

BEP ≥ Cash BEP

7. Margin of Safety

- Excess of sales over BES
- MOS (units) = Total Sales (uts) - BES (units) = $\frac{\text{Profit}}{\text{Contribution pu}}$
- MOS (₹) = MOS (Units) × SP/Unit = $\frac{\text{Profit}}{\text{PV Ratio}}$

8. Jugalbandi Jodis

(a) BES Ratio + MOS Ratio = 1

$$\text{BES Ratio} = \frac{FC}{\text{Contribution}}$$

$$\text{MOS Ratio} = \frac{\text{Profit}}{\text{Contribution}}$$

(b) VC Ratio + Contribution Ratio = 1

9. BEP of Merged Company

- Find PV Ratio of the merged company at 100% capacity utilisation of merging companies.
- BEP of the Merged Co. = $\frac{\text{TFC of the Merged Co.}}{\text{PV Ratio assuming 100\% capacity}}$

10. BEP with Multiple Products

Total Contribution

- **Contribution / unit × Unit sold** – sales mix is in units

  Solve using x Method

Total Contribution

- **(Sales – TVC) or (Sales × PVR)** – sales mix is in Value

  Solve using Weighted Average Method

  Overall BEP = $\frac{\text{TFC}}{\text{Weighted Average Contribution/ut or Weighted Average PVR}}$

11. BEP with Opportunity Cost

BEP = $\frac{\text{TFC}}{\text{Contribution/ unit}}$

Where,

TFC = Normal FC + Opportunity FC

Contribution / Unit = SP – VC – Opportunity VC/Unit

12. BEP for Perishable Product

- Product with shelf life upto 1 yr.
- Opening stock is sold first
- **BEP** = Op stock + Additional uts of current production
- **Potential BEP** = (Opening stock is discarded)

$$= \frac{\text{Total Fixed Cost}}{\text{Contribution/unit from New Production}}$$

13. BEP with Step FC

- Before real BEP - No profits
- BEP exists in real terms when the calculated BEP units lies within the range of its FC
- After Ist BEP - Company starts making profit.
- When real BEP is on the upper limit of its slab, there has to be a 2nd Real BEP in the immediate next slab.
- Solve using algebric equation or columnar approach.

A. Algebric Equation :

When slab range are equal

Step 1 : Find the slab number for Ist Real BEP

Step 2 : Find the first Real BEP

Step 3 : Find the 2nd Real BEP, if applicable.

B. Columnar Approach :

When slab range are unequal

Step 1: Make columns for each slab

Step 2: Find BEP in each slab

Step 3: Comment whether it is real or imaginary.

14. Indifference Point

Indifference Point = To choose between two mutually exclusive options

$$= \frac{TFC}{\Delta \text{ VC/ut}} \text{ or } \frac{TFC}{\Delta \text{ Contribution/ ut}} \text{ (When SP constant)}$$

Expected Level	Recommendation
> Indifference point	High FC option
< Indifference point	Low FC option
= Indifference point	Any option

Indifference between 3 Option :

- I/D_{AB}
- I/D_{BC}
- I/D_{CA}

- **Range of Sales**
- **Justify the new machine**
- **BE between 2 options**

14. Indifference Point

To choose between **Temporary Shutdown or Continue the operations** (during business distress or off season)

- **Non-financial factors :** Labour availability, Relation with suppliers, Accumulated inventor Goodwill, Customer loyalty, Security , Competition pressure, Reopening hassles, Difficulty in regularisation.
- **Shutdown point** $= \frac{TFC_{Continue} - TFC_{Shutdown}}{Contribution/ut_{continue} - Contribution/ut_{Shutdown}}$

$= \frac{Avoidable\ FC - Extra\ Shut\ Down\ Cost}{Contribution/ut}$

Expected Level	Recommendation
> Shutdown point	Continue
< Shutdown point	Shut down
= Shutdown point	Any option

16. BE with Probability Effect

(a) Probability of BE or of sales to earn a profit = Sum of Probability of Sales ≥ Computed Sales

(b) Probability of Sales to make a loss = Sum of Probability of Sales ≤ Computed Sales

17. Minimum units for BE

- Sell the product with the highest contribution per unit first.
- If batch size is applicable, plan to produce only 1 batch and see the BEP. [E.g. ABC – BEP Sum]

18. BE with Optimum Mix under Key Factor

- Key factor exists
- Optimum product mix has been obtained
- Use optimum mix ratio as the sales mix to find BEP
- Combined PVR = $\frac{\text{Total contribution as per optimum mix}}{\text{Total sales as per optimum mix}}$
- Overall BEP = $\frac{\text{TFC}}{\text{Combined PVR}}$

19. Absorption Costing Vs Marginal Costing

Particulars ①		Particulars ②	
DM	✓	Sales	✓
DL	✓	Less: VCOS	
Prime Cost	✓	DM	✓
Factory OH		DL	✓
- Variable FOH	✓	VOH	✓
- Fixed FOH (Absorbed)	✓	VCOP	✓
Factory Cost/COP	✓	(+) OP Fg	✓
(+) Op Fg	✓	(-) Cl Fg	(✓)
(-) Cl Fg	(✓)	VCOGS	✓
COGS	✓	VA&SOH	✓
Admin & Selling OH			✓
- variable (actual)	✓	Contribution	✓
- fixed (actual)	✓	(-) FC	
COS	✓	Fixed POH	✓
		Fixed A&SOH	✓
			✓
		Profit	✓

(+) Under recovery of fixed FOH	✓
(-) Over recovery of fixed FOH	(✓)
Net Cos	✓
Profit	✓
Sales	✓

The main reason of difference in profit is difference in stock valuation.

Profit Reconciliation Statement

Particulars	Amt
Pft as per Abs Costing	✓
Less: Cl. St Overvalued	(✓)
Add: Op St Overvalued	✓
Pft as per Marginal Costing	✓

SJC Institute

Under/Over Absorption of fixed OH

Fixed OH Absorbed ✓

Actual OH ✓

Under/Over Abs ✓

Profit at BE under Marginal Costing

- BEP = TFC/Contn/ut
- Now, show a profit statement on above units. where profit will come zero.

Reconciliation of Actual P/L & BE P/L

Particulars	₹
Profit as per Break Even	✓
(+) MOS Contribution	✓
(−) Addl labs cost due to inefficiency	(✓)
(−) Scrap at variable Mfg cost	(✓)
(−) Cl. stock at cost	(✓)
Profit as per Actual P/L	✓

20. Evaluation of Proposals or Alternatives

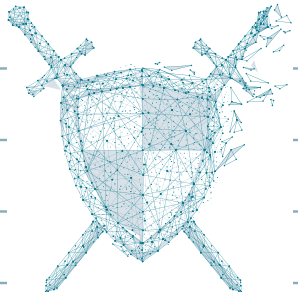
Find profitability under different proposals and select the one with highest profit

Or

Find the incremental profit from each situation & select the highest one.

21. Factors before decision making

1. Overtime is not viable in longterm as it decreases the efficiency of workers. For long term growth, expansion is preferred.
2. When growth is steady, price decrease is not viable.
3. For expansion, sources of financing should be explored.



Export Offer

- **Export offers are one time / non repetitive offers.**
- **The main business of the company is to sell in domestic market.**

A. Export offer is to be evaluated on the basis of

Incremental Cost or Change in Total Cost

= Total Cost With Export Offer - Total Cost Without Export Offer

Net benefit from Export = Export Revenue - Incremental Cost

B. Minimum Price of Export Offer

= Cost to be incurred + Contribution lost - Benefits achieved

C. Under Incremental Revenue and Differential Cost Approach

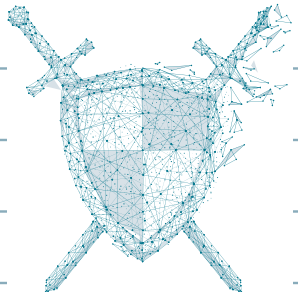
- The profit is maximum where Incremental Profit is close to zero or next higher positive than zero.
- If due to export, any level of incremental profit needs to be foregone, then include such incremental profit in the minimum price of the export offer.

E.g. Let us say that profit for regular business will be maximum at 90% capacity level. The incremental profit for 80% to 90% level is ‘ 600. If the export occupies 20% of the capacity, then there will be a loss of ‘ 600 as the capacity of regular business will be reduced to 80%. This amount of ‘ 600 is to be added to the minimum price of export.

D. Multiple Export Offers to be accepted or not

It is evaluated by making several combinations of different export offers.

E.g. 3 Export offers, viz, A,B and C, to be evaluated together. Make combination as - A, B, C, AB, BC, CA, ABC.



Key Factor

- **Key factor/ Critical Factor/ Limiting Factor/ Principle Budgeting Factor/ Constaint**

What is a Key Factor ?

It refers to the resource whose requirement is move than its availability

↓

Ways to deal with Key Factor?

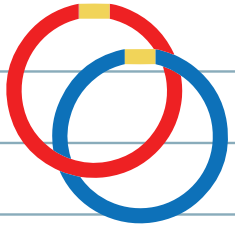
1. **Traditional Approach** - Make best use of what isavailable.
2. **Modern Approach** - Increase the availability Different situations to deal with Key Factor

↓

Different situations to deal with Key Factor

No of Products	No of Key Factors	How to deal with it
ONE	Multiple	Theory of Bottleneck
		Utilise the available for best products **Step 1:** Ranking of Products based on Contribution per unit of Key Factor or Relative Profitability **Step 2:** AllocationBasedonRank
Multiple	Multiple	• Use Combinations • Use Linear Programming • Use Simultaneous Equations • Use Throughput Accounting

I. Special Situations



A. Tie between Contribution per hour of two products

Select any of the products first.

B. Fractional Production quantity of a product using the limited resource

Prefer to not to round off the quantity. E.g. 550.70 units not to be rounded off to 551 units as the resource for 0.30 units may not be available.

C. Specific Fixed Cost of a Product

Deduct the specific fixed cost per unit from the contribution of the product to derive the net contribution per unit. Rank the products based on net contribution per unit of key factor.

When both Specific FC and General FC are given, do not use ranking. Prefer to prepare optimum mix by allocating resources to each product one by one & check profits from each option

D. Incremental Ranking

When the demand of the product varies with the price, we calculate the contribution per unit of key factor for each value of demand and price in an incremental manner and then rank and allocate.

Step 1: Incremental Contribution

Step 2: Incremental Hours

Step 3: Incremental Contribution per Incremental Hour

Step 4: Rank the demand level

Step 5: Allocate the available resource in order of ranks.

E. Minimum commitment for a product

It should be produced in highest priority, even before the first rank.

F. Shadow Price or Marginal Value or Opportunity Cost of a resource

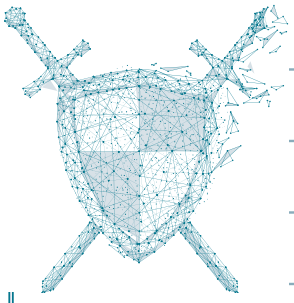
It means the income lost if one unit of a resource becomes unavailable. It is computed only for the limited resource.

A product should be produced from the limited resource only if its **contribution is equal to or greater than the shadow prices** of resources used in it.

G. If a product is sold with discount & without discount simultaneously, consider them as two separate products.

H. BEP when Minimum Commitments are there

- Sell minimum commitments first to check how much contribution has been earned.
- Then sell additional units of the products in optimum sales mix.



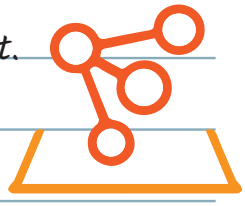
Make or Buy

1. Applicability

Here, we decide whether to make or buy the **raw materials or components or packing materials** required in normal course of operation.

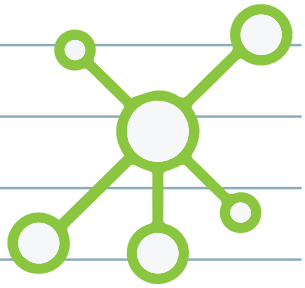
2. Non Financial Factors

Quantity, Quality, Time, Uniqueness, High skills, Huge Investment, Focus, Peer co-operation, Reliability, Employee morale, Resources, Time to Market.



3. Financial Factors

Financial factors helps to compare the cost of manufacture with cost of purchase using relevant costing approach.



4. Evaluation with Key Factors

Type I: Make or Buy decision with Single Key Factor

Step 1: Rank for manufacture on basis of **Savings in Manufacturing per unit of Key Factor**.

Step 2: On the basis of above ranking, develop an **Optimum Mix**.

Stpe 3: Find Relevant cost of manufacture of materials that could be manufactured and **purchase those materials which cannot be manufactured**.

Type II: Make or Buy Decision with a condition that only one component can be bought from outside

Step 1:	First, rank on the basis of savings per unit of key factor.
Step 2:	Select the component with least rank to purchase
Step 3:	Check whether hours released are sufficient to produce additional requirement of other components.
Step 4:	If step 3 is feasible, conclude, if not, try with next higher rank.

5. Make or Buy Decision with Indifference Point Analysis

A. Between Two Options

$$\text{Indifference Point} = \frac{\Delta FC}{\Delta VE \text{ per unit}}$$

E.g.

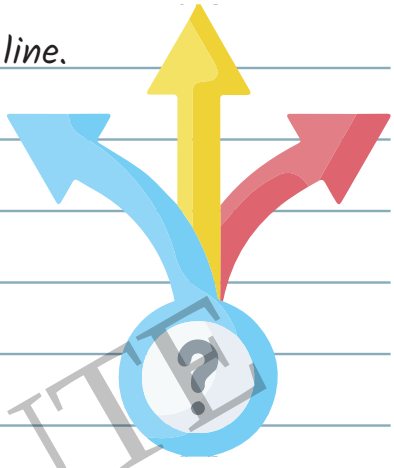
	Make	Buy
FC	50,000	–
VC/ut	20	30

Level of Operation	Suggestion
< Indifference Point	Buy
> Indifference Point	Make
= Indifference Point	Any Option

B. Between Three Options

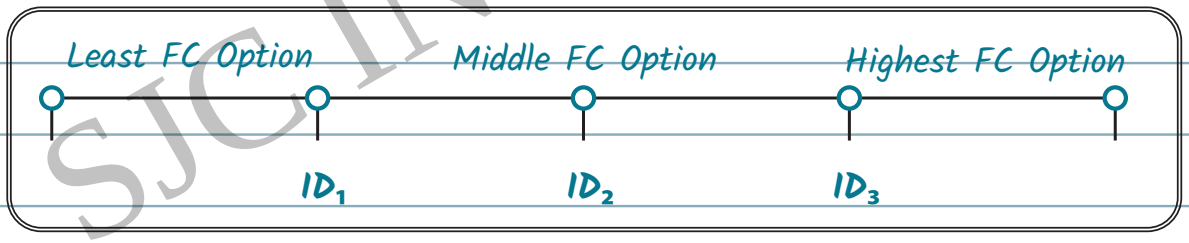
Step 1: First, identify indifference point between: (a) Option 1 & 2; (b) Option 2 & 3; (c) Option 3 & 1.

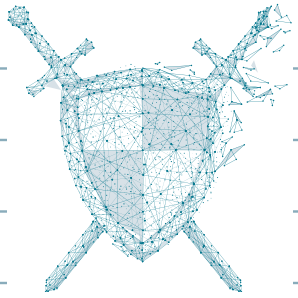
Step 2: Plot them in ascending order on a straight line.



Let us assume that the three Indifference Points are ID 1, ID 2 and ID 3 and are arranged in ascending order.

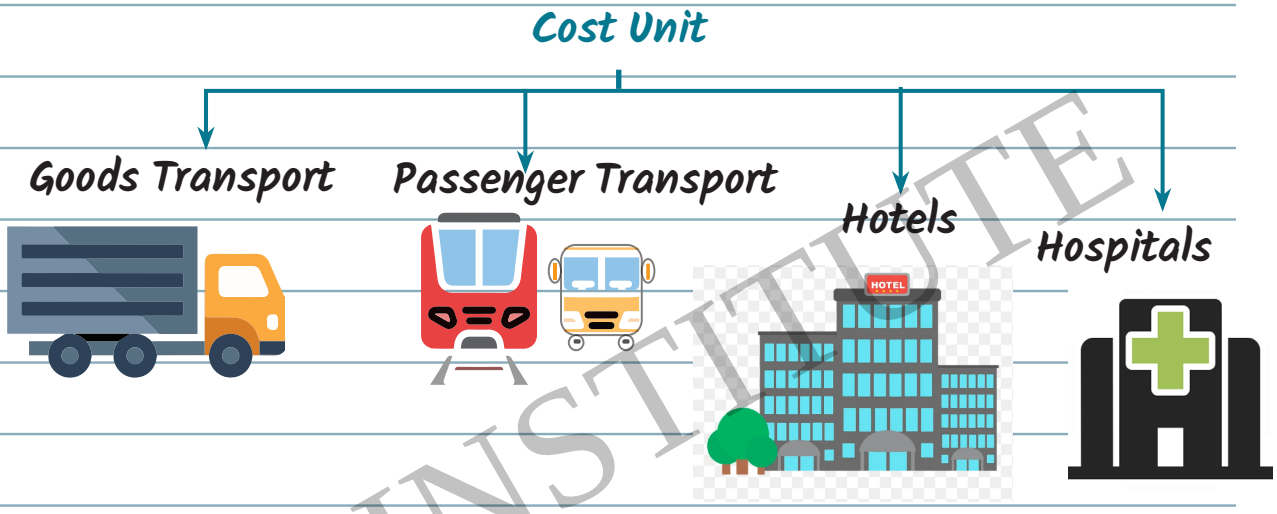
Level of Operation :





Service Costing

1. Cost Unit



2. BE Patient days with Slab FC

Step 1 : Assume that BE will be within the present range of operation

- TFC
- Contribution/ Patient day = Average Contribution/ Patient day
- $BEP = \frac{TFC}{\text{Contribution/ Patient day}}$
- Match above BEP with the slab range. If within the range, accept the solution. If not within the range, Revise BEP. (Step 2)

Step 2 : Revised BEP

- Revised FC as per the value of BEP in step I
- Revised BEP = $\frac{\text{Revised FC}}{\text{Revised Contribution/ ut}}$

When Cost of Capital is given

Find PV of Cash flows to arrive at a decision.

Sub Contracting (Outsourcing)

1. Non Financial Factors

Quality, Quantity, Time, Secrecy, Capital Investments, Skills, Peer Co-Operation,- Know how, Focus, Reliability, Resources, Employee Morale, Loss of Control.

2. Outsourcing- Advantages and Disadvantages

A business practice to reduce costs or improve efficiency by shifting jobs or processes to another party or purchase few of products or parts from outside for a span of time. It is an integral part of downsizing or reengineering.

Advantages

- Cost savings
- Frees up resources - to focus on core activities
- Flexibility to scale up or down
- Fulfill market demand to prevent competition

Disadvantages

- Risk of loosing sensitive data
- Control of operations is lost
- Quality issues
- Time of delivery
- Right quantity

- Retrenchment of workforce may create strikes. Preventions measures for disadvantages - Proper terms and conditions with supplier.

3. Comparative Study of Decision Making

	Make or Buy Decisions	Key Factor Decisions	Sub Contracting
1.	For Raw Materials	For Finished Goods	For Finished Goods
2.	One Time Decision	Regular Decision	One Time Decision
3.	Purchase is primary	Produce is primary	Purchase is primary
4.			
Step 1	Compare Relevant Cost of Manufacture with Purchase	N/A	Compare Relevant Cost of Manufacture with Purchase
Step 2	Decide Make or Buy	N/A	Decide Make or Buy
Step 3	Find Savings in manufacturing per unit for components to be produced	Find Contribution per unit for products to be produced	Find Savings in manufacturing per unit for components to be produced
Step 4	Find Savings in Manufacturing per hour	Find Contribution per hour	Find Savings in Manufacturing per hour
Step 5	Rank the Components	Rank the Products	Rank the Products
Step 6	Allocate the limited resource in the order of rank to produce	Allocate the limited resource in the order of rank to produce	Allocate the limited resource in the order of rank to produce
Step 7	Purchase that could not be produced to meet the requirement of production	Purchase that could not be produced to meet the market demand if Purchase price < Selling Price	Purchase that could not be produced to meet the market demand if Purchase price < Selling Price

 # Sub Contracting with 2 Products and 2 Key Factors

Option 1 : Linear Programming

Option 2: Ranking

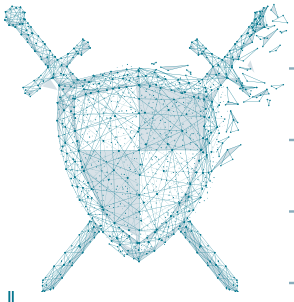
Step 1 : Rank using Savings/ut of K/F in Dept 1

and Rank using Savings/ut of K/F in Dept 2

If rank is same, then proceed for Step 2

Step 2: Statement of optimum mix for manufacture

Step 3 : Purchase when could not be manufactured.



Pricing Decisions

1. Concept of Pricing

Price must be sufficient to cover the costs and profit. Pricing strategy should achieve maximum profits.

Knowing the market and customer base are key element choosing the right pricing strategy.

2. Key Pricing Strategies

a. Profit orientation - to maximise profit

b. Competition based - based on what competitors are charging

c. Demand based - Yield management

d. Cost plus - Traditional pricing

e. Mark up - Eg - Retailer's price = Distributor's price plus markup

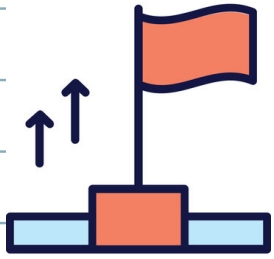
3. Effective Pricing

It is one that satisfies all the stakeholders viz the producer, distributor and consumer. It may be called a long run calibrator of price equilibrium over a business cycle. It is the price set by the producer and accepted by all. It is what all stakeholders can bear.

Steps Involved:

1. Analysis of Financial Statements
2. Analysis of Cost behaviour
3. Analysis of profit gap
4. Evolvg cost reduction strategies
5. Determination of feasible prices for different capacity levels
6. Determination of effective price
7. Establishing the cost controls
8. Review, Revise and Reset

4. Three Important Approaches



a. Product Differentiation

b. Cost Leadership

c. Yield Management

5. Product Differentiation

i. Process of distinguishing a product or service from others, to make it more attractive to a particular target market.

ii. To build up - Specific competitive advantage - Quality, Features, Availability

iii. Objective - Develop a position that potential customers see as unique Uniqueness create a perception of esteem value, which goes beyond pricing considerations.

6. Cost Leadership

a. Able to operate at a lower cost than its rivals.

b. It has 3 dimensions

i. Optimum utilisation of assets

ii. Cost conscious culture

iii. Concurrent value chain control

Yield Management

Process of understanding, anticipating and influencing consumer behavior in order to **maximize revenue and profit** from fixed and **perishable resources** such as airline seats, hotel rooms, hospital beds, etc.

A set of revenue maximization strategies and tactics meant to improve the business profitability.

It is a technique that determines the **best pricing policy for optimizing profits**.

It combines - operations research, statistics and customer relationship management. Categorises customers into price bands.

To sell the right resources to the **right customer** at the **right time** for the **right price**.

May lead to price discrimination.

Features of Industries that can use Yield Management

1. Fixed Capacity - e.g seats in a flight and rooms in a hotel or beds in a hospital
2. Perishable products
3. Low marginal costs
4. Price elastic demand
5. Advance booking

The Process of Yield Management

1. Identification of market segments
2. Forecasting and Pricing
3. Segment wise allocation
4. Overbooking

Complexities of Yield Management

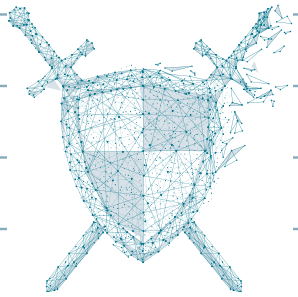
1. **Customer Loyalty** - customers resist the discriminating prices
2. **Employee motivations** - their decision making is reduced, not suitable for group bookings
3. **Customer response** - needs to managed properly as they resist demand based pricing
4. **Capacity optimisation** - implies predicting potential capacity

Yield competencies

A matrix may be drawn by answering these questions:

1. Is the unit of product or service governed by the principle of fixed capacity?
2. Is the unit of product or service perishable?
3. Does the product or service warrant low marginal costs?
4. Is the unit of product or service prone to price elastic demand?
5. Is the unit of product or service poised for a segmented market?
6. Can the unit of product or service be offered by means of advance booking?

   If the answer is yes, one must move towards yield management



Pricing Strategies

1. Pricing

The technique or strategies of determination of price.

The theme of pricing is that it may be independent of costing. A company may fix a price irrespective of its cost i.e. based on what customers are willing to pay.

2. Price

The consideration at which goods or services are transferred from the seller to the buyer.

3. Different Forms of Price

Transfer Price	Market Price	Fair Price	Selling Price
Price for internal transfer	Price prevailing in the market for goods or services in the industry.	Price at which a buyer is willing to buy a good or service from the seller in an open market.	Price at which goods or services are sold to external customers.

4. Price vs Value

Price	Value
Price is the amount that **a company charges** from its customers for its goods or services.	Value is what the **customer willingly demand** and is **ready to pay** for as per the relative importance of goods or services at the given point of time.

5. Pricing Strategies

Pricing strategies refer to **broad plan of action to make a product marketable** such that it maximizes the organization profit.

6. Pricing under different market conditions

A. Monopoly

The seller/ producer can fix any price but it will go for the price where demand for the product and consequent profit will be maximum

B. Monopolistic competition

Under monopolistic condition, consumers may buy more at a lower price than at higher price. The profit can be maximised by equating marginal revenue with marginal cost.

C. Oligopoly

To fix the price, not only the demand for the product is considered but also the reactions of the other firms in the industry to any action or decision it may take.

(1) Pricing strategies by oligopolists :

- **Predatory Pricing:** Keeping price artificially low, and often below the full cost of production.
- **Limit-Pricing Strategy:** They may also operate a very low pricing strategy to discourage new entrants, which is also called entry forestalling price.
- **Colluded pricing or Uniform pricing:** Oligopolists may collude with rivals and raise price together, but this may attract new entrants.
- **Cost-Plus Pricing:** Average production costs plus a fixed mark-up to achieve a desired profit level.

(2) Non-Price Strategies by oligopolists :

- Improve Quality & After Sales Servicing
- Advertising, Sponsorship, Sales promotion and Product Placement
- Loyalty Schemes

D. Perfect competition

No pricing policy of its own as the sellers are price takers (i.e. it has to accept the price determined by the market) and sell as much as they are capable of selling at the prevailing market price.

7. Skimming the Cream Pricing

It is a policy of high price during the early period of a product's existence and in the later years the prices can be gradually reduced.

Key points

- Inelastic Demand
- High Profit at initial stage

- Demand not known
- Financing High Cost of Capital

8. Penetration Pricing

It is a policy to enter into a competitive market by keeping price at very low level, even below the variable cost. The prices are **regularised by** companies after gaining a market share.

Key points

- Demand is elastic to price
- Large-scale or mass production
- Long term demand
- Threat of competition / competitive market

9. Competitive Pricing

Where a company sets its price mainly on the consideration of what its competitors are charging, its pricing under such situation is called competitive pricing.

- **Going rate pricing:** for food, textiles, etc
- **Sealed bid pricing:** for tenders - defence contracts
- **Cost plus pricing:** for infrastructure contracts

10. Loss Leader

Where a product can be enriched by a series of optional extras, which a customers of the main product are at liberty to add on for additional advantages, the **main product may be offered at a relatively low price**. If the price is set below cost, the

product becomes a loss leader. **E.g** Gillette, Aircrafts

11. Price Discrimination / Customisation

Pricing of a product is some time customised keeping taste, preference and perceived value of a consumer into consideration.

a) **Based on product line: E.g.** Smartphone with 16 GB over 32 GB.

b) **Based on customer's past behaviour: E.g.** A customer with good payment record may be given more discounts then the others.

c) **Based on demographics: E.g.** Railway fare concession for senior citizen and concessional price tickets for military personnel.

d) **Based on time differential: E.g.** Discounted price for data usage provided by a broadband service provider if subscription paid for six months at a time.

12. Geographic Pricing

(a) **Point of production pricing:** Price not including freight charges.

(b) **Uniform delivered pricing:** Uniform price at all locations including delivery charges. Zone delivered pricing: Different prices for different geographical zones depending on uniform fright charges to that zone.

(c) **Freight absorption pricing:** Prices are inclusive of freight that a competitor located near the client would charge.

13. Psychological pricing

(Charm pricing) is a pricing and marketing strategy based on the theory that certain prices have a psychological impact. **E.g.** Bata Shoes sold at ₹ 999 or

withdraw a product from the market and relaunch it at a higher price (customers perceiving lower price = lower quality)

14. Bundled Pricing/ Package Pricing

To sell several products/services as a package at a price lower than the sum of their individual prices. **E.g.** Hotel Package, Hospital Package

15. Pricing based on Products

Category	Nature	Pricing Strategy
Revolutionary Product	New to the market, Innovative Product. **E.g.** Pen like CPU	Premium pricing
Evolutionary Product	Upgraded version of an existing product. **E.g** Smartphone	Priced taking cost-benefit, competitor, and demand for the product into account.
Me too product	Similar to existing revolutionary/ evolutionary products **E.g.** Chairs	Market price or Going rate pricing

16. Pricing during Recession

Price **less than the total cost** but **above the marginal cost** for a limited period.

17. Pricing below Marginal Cost

- Perishable nature.
- Stocks have been accumulated in large quantities and the market prices have fallen.
- Popularize a new product.
- Enables the firm to boost the sales of other products having high profit margin.

18. Value Based Pricing – True Economic Value and Perceived Value

There is an increasing trend to price the product on the basis of customer's perception of its value. This method helps the firm in reducing the threat of price wars.

(a) Objective Value or True Economic Value

= Price of next best alternative + Net benefits from performance of the product

(b) Perceived Value

The price of a product that a consumer is willing to spend to have that product. At the time of fixing price, it is to be kept in the mind that any price which is set below the perceived value but above the cost of goods sold give incentives to both buyers and the seller.

19. Pricing using Calculus

Used by monopolists or monopolistic competition firms.

As per economic theory of pricing, Profit is Maximum at a level of output where Marginal Revenue (MR) is equal to Marginal Cost (MC) i.e.

Marginal Revenue (MR) = Marginal Cost (MC)

This model determines the level of production up to which production can be continued.

Step 1: The Basic Price equation, which is used to determine the Price where Profit is Maximum. The equation is written as:

P = a – bQ

Where

a = Price where demand is zero

b = Change is price / change in demand

E.g. Demand is sensitive to selling price such that with every decrease of ₹ 10 the demand increases by 100 units

Current SP = ₹ 150 and demand is 800 units.

∴ a = 150 + (10 × 8) = ₹ 230 and

b = 10/100 = 0.1

Step 2: The Marginal Revenue equation is written as

Marginal Revenue (MR) = P = a – 2bQ

20. Pricing Techniques

- **Absorption Costing / Full Cost Plus Pricing – For Well established products**

  Price = VC + FC(absorbed) + Markup

- **Marginal Costing – For new products**

  Price = VC + Contribution

- **Relevant Costing – For non – repetitive special offers**

  Price = Cost to be incurred + Contribution lost

- **Return on Capital Employed Based Pricing**

  Price = Total Cost + Profit as a percentage of capital employed or

  = Variable Cost + Contribution as a percentage of capital employed

where,

Capital employed = Fixed Assets + Working Capital

While computing price, Profit is **profit before tax**

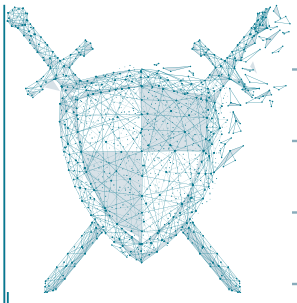
Whenever tax rate is given, do not use any shortcut like 20% of

SP = 25% of Cost

Assume desired profit is profit after tax.

Find Profit before tax (PBT) = $\frac{PAT}{1 - \text{tax rate}}$

Use PBT in the Price equation.



Divisional Transfer Pricing

I. Organisation Structure

A. Centralised or Functional System

(1) Advantages

- **Control** over divisions
- **Low cost** by consolidating common acitivites
- **No diversion** from overall strategy

(2) Disadvantages

- Involves top management in **operations - limited growth**
- Divisional managers **restraints** from group policies
- **Delayed** decisons at division level if fast action required.
- **Divisional profitability** cannot be ascertained, though performance measures can be created.
- Transfer between divisions are at cost.

B. Decentralised or Divisional System

(1) Advantages

- Improved decision-making process - **quality and speed**.
- **Motivational** - delegation of decision-making.
- **Autonomy** for divisional managers.

- Allow top management to **focus on strategic** rather than operational matters.
- **Reduce** head office **bureaucracy**.
- Good **training ground** for junior and middle management.
- **Divisional profitability** can be ascertained.

(2) Disadvantages

- **Dysfunctional or sub optimal decision-making**, where divisions make decisions in their own best interests which may not be good from the company's viewpoint.
- **Costs of activities** that are common to all divisions may be greater for a decentralized organization rather than a centralized one.
- **Loss of control by** top management as decision-making is delegated to the divisional managers.

Some of those in favour and against are linked. **For example**, the ability of decentralized operations managers to make speedy decisions will increase the lack of control in circumstances in which the head office cannot be informed of these decisions in a timely manner.

2. Income Tax Perspective

IT authority considers **TP = Fair Price or Arm's Length Price.**

Methods followed by IT Authority :

(a) Comparable Uncontrolled Price Method

(b) Transactional Net Margin Method

(c) Resale Price Method

(d) Cost Plus Method

(e) Profit Split Method

3. Divisional Profitability Statement

When divisions are **cost centres** - Transfer price = Total Cost

When divisions are **profit centres** - Transfer price = Cost Plus Price

Particulars	Transferor Division	Transferee Division	Group /Total
Sales Revenue / Transfer Revenue			
Less:			
Transferred Input / Purchase Cost			
Own Cost			
Profit			

 # Group's Profit is not affected from Transfer Price but it is affected from transfer

 # Divisions maximum profitability level may not match with Group's maximum profitability level. At the end, the Group's maximum profit level should be chosen.

4. Divisional Performance Measures

 # Three Basic Rules of a Performance Measure

(1) That considers **only controllable factors**

(2) That **provides incentive** to the managers who make **decisions in the best interest of the group**.

(3) That considers **both financial** and **non - financial** aspects.

The popular financial performance measures to evaluate a division's performance are :

A. ROI

ROI = Controllable Profit / Investments

Advantages -

- Easy to comprehend.
- Ties in directly with the accounting process.
- Measures the performance of a division as a whole.

Disadvantages -

- Expressed in percentage form rather than absolute measure.
- Not for different activities.
- Encourages short term or suboptimal decisions. (**e.g.** a manager might reject a project with ROI of 20% as it may cause its ROI to fall from 38% to 35%

B. RESIDUAL INCOME

Residual Income = Controllable Profit – (Capital × Ko)

Advantages -

- Expressed in absolute form
- Can compare different activities performance by assigning different cost of capital to each.

Disadvantages -

- Does not facilitate comparison between investment centres
- Does not relate the size of a centre's income to the size of the investment.

(This remedy can be removed by giving different targets to different divisions as per their size and market scenario).

C. Economic Value Added (EVA) – (Stern Stewart and Co.)

It is RI with defined Profit and Investment.

EVA = NOPAT – (Opening Capital employed × Ko)

5. Methods of Transfer Pricing

A. As given in the question

B. Return on Capital Employed Based

Transfer Price = Cost of Transfer + Return on Capital Employed

This is used in case the transferor is a monopolist or a price setter.

C. Shared Profit Method

Step 1 – Find Group Profit

Step 2 – Share of Group Profit in the divisions in Total Cost Ratio

Step 3 – Transfer Price = Total Cost + Share of Profit

If the transferring division has received the goods from another division, then its total cost will be (Transferred Input + Own Cost)

Under **Shared Contribution method**, the total contribution of the group is shared among the divisions in their total variable cost ratio and the transfer price will be Total Variable Cost + Share of Contribution

D. TP Under Goal Congruency Concept

Under goal congruency, divisions need to act in the best interest of the group.

Situation in Transferor Division	Minimum Transfer Price	Maximum Transfer Price
I. Idle Capacity	Cost to be incurred due to transfer = VC + Specific FC (VC may not be same as external sales)	Lower of - 1. External Purchase Price - Cost to be incurred on units transferred 2. Net Incremental Profit from Transferred units (SP of FG - Own Cost)
II. Fully busy with external sales	Cost to be incurred due to transfer + Contribution Lost from external sales	Same as above
III. Partly idle capacity & partly sacrifice of external sales		
IV. Capacity Shortage to meet the External Demand	Cost to be incurred due to transfer + Contribution Lost from release of time in order of least profitability.	Same as above

Evaluation of Transfer from the group's view point

Particulars	Amount
Transferor Division	
Cost to be incurred	✓
(+) Contribution Lost	✓
Minimum Price = Net Cost	×
Transferee Division	
Savings in Purchase Cost	✓
(–) Additional Cost on Transferred units	(×)
Maximum Price = Net Savings	✓
Net Overall benefit (Savings – Cost)	✓

E. Dual Rate Transfer Pricing

- Transferor charges transferee at its Cost Plus Price.
- Transferee records the transfer at Variable Cost of the transferor.
- H.O. needs to do adjustment to the extent of difference in amount of transfer recorded, to find its net consolidated profit.

Advantage

Transferee makes optimal decision to sell its goods, if it is facing uncertainties.

F. Two Part Transfer Pricing

Transferor charges transferee a Fixed Lump Sum over a period to recover its fixed cost and profit and standard variable cost per unit for every unit transferred.

Advantage

Transferor is able to get its assured profit and transferee is receiving units at variable cost of the transferor, which will be far lesser than the external price.

Due to fixed lump sum payment, transferor and transferee are bound to honor each other commitments.

J. Negotiated Transfer Price

Transfer Price determined through negotiations may be a mix of accounting calculations and compromise.

Head office intervention may be required.

Several ways of negotiating are -

(1) Dual tariff based pricing method

(2) Two part transfer pricing method

(3) Shared profit method

(4) Setting a range of bargain (Minimum Price and Maximum Price)

(5) **Range of Negotiation for transferor :** Consider transferor's relevant cost.

6. Best Strategies for Divisions & the Group

Best Strategies for Transferor :

- Calculate total profit and defence situations of external sells and transfer available with the transferor.
- If transferee price is not given assume maximum transfer price will be pay by the transferred division. Maximum TP = Net external purchase price (PP + Modification Cost).

To create an incentive for transfer d maximum TP can be just the external purchase price also ignoring the modification cost.

Best Strategy for Transferee

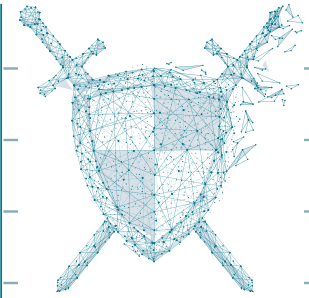
If it is dependent on transfer the transfer price and volume should be considered to calculate its best profitability.

Best Strategy by Company

(a) Evaluate whether companies benefiting by transfer all requirements of transferee.

(b) If benefited, all units required must be transferred, respective of transfer price.

(c) The combined net profit obtained thereafter is the best profit of the company.



Relevant Costing

1. Relevant Cost

Future cost influencing a decision. Varies from situation to situation. Applicable only for short term. In opportunity approach, opportunity cost is also considered as relevant cost. **Future Variable Cost, Avoidable FC & Opportunity cost are always relevant.**

There is always an incremental amount (positive or negative) in any relevant cost.

2. Irrelevant Cost

Cost which are not influenced by any decision and thus have no impact on any decision. **Sunk / Historical Cost, Committed FC are always irrelevant.**

The incremental amount of all irrelevant costs are always zero.

3. Approaches for Decision Making

(a) Total Cost Approach (Considers Relevant as well as Irrelevant Costs)

(b) Differential/ Incremental Cost Approach (Considers only Relevant Costs, Irrelevant Costs are eliminated by default)

(c) Opportunity Cost Approach (Considers Relevant Costs only along with Opportunity Costs)

4. Three Important Factors for Decision Making

(a) **Suitability** - Vision , Ethics

(b) **Acceptability** - Financials

(c) **Feasibility** - Resources & Processes

5. Relevant Cost under Opportunity Approach

Particulars	₹
Cost to be Incurred for an offer	***
Add: Benefit Lost/Opp. Cost due to the offer	***
Less: Benefit Achieved/Opp. Gain due to the offer	***
Relevant /Incremental Cost	***

Compare the above Relevant cost with the offer Revenue to evaluate the offer

6. Uses of Relevant Costing

(a) Evaluation of offers.

(b) Minimum price of an offer.

(c) Maximum price of an offer.

7. Evaluation of Offers

Accept an offer if Offer Revenue > Relevant cost of the offer

However, importance to be given to **other non financial factors**.

8. Minimum Price of an Offer

Minimum Price = Relevant Cost = Cost to be incurred + Opportunity Cost

- The price at which the net position with and without offer will be same.
- The price where there will be an indifference to accept or reject an offer.

9. Maximum Price of an Offer

Maximum Price = Relevant Gain = Additional income due to the offer.

- The price at which the net position with and without offer will be same.
- The price where there will be an indifference to accept or reject an offer.

If there is a regular market for the item/service to be bought then the maximum price will be - lower of - (a) incremental profit (b) external market price

10. Opportunity Cost

A. Meaning

It refers to the **highest amount of benefits sacrificed or income foregone** from the next best alternative **while selecting a particular course of action.**

Income foregone is the contribution lost or **relevant income only** (excluding irrelevant costs)

Next best alternative implies that when there are multiple alternatives, we select the **alternative with highest income.**

Opportunity cost can be understood only with respect to an alternative. While thinking of it, **do not consider the cash flows of the alternative whose opportunity cost is being computed.**

If no alternative is specified, we find the opportunity cost of resource being idle. i.e. highest of income foregone from all the available alternatives.

B. Why to consider opportunity cost at all

To **prevent ourselves from guilt** of not considering other alternatives after a decision has been taken.

C. Shadow Price or Opportunity Cost or Marginal Value of a Resource

Opportunity cost or shadow price is applicable **for limited resource only**. i.e. supply is less than demand or availability or requirement.

Shadow price means the **additional income** that can be generated **from 1 unit** of a resource (employed in regular work)

If the resource is **in abundant supply** or is idle, the shadow price or opportunity cost will be nil, as there will be no sacrifice of income if the resource is used an offer.

If the resource is being used for a product and is **in short supply**, the shadow price will be – the **contribution lost from 1 unit of resource** which is being earned from the product.

If the limited resource is being used in multiple products, and if we have to find the minimum price of an offer where resource will be used, **we release the resource in order of least contribution per unit of resource**.

A product should be produced only if its **contribution is able to recover its shadow price** of the resource used in it.

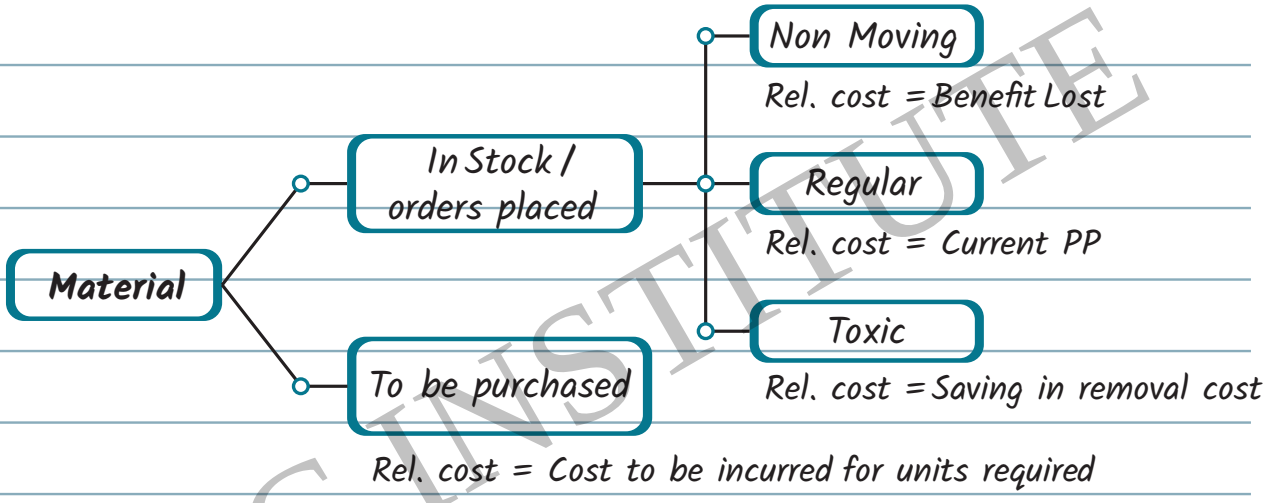
11. Opportunity Gain

Cost saved or benefits achieved from the next best alternative while selecting a course of action.

Next best alternative is the alternative with **the least cost**.

Opportunity gain can be understood **as negative opportunity cost**.

12. Relevant Cost of Materials



If materials are to be purchased in lots then

(a) **No use of extra materials** - Rel Cost = Cost to be incurred for the lot purchased - Scrap value of extra quantity.

(b) **Regular use of extra materials** - Rel Cost = Cost to be incurred for the quantity required for the offer.

13. Relevant Cost of Labour

- **Labour**
  - Direct Labour
    - Not Busy/ Abundant Supply
      - Rel. Cost = cost to be incurred
    - Busy in Regular work
      - Rel. Cost = cost to be incurred + Benft Lost
    - Treat As Indirect Worker if not retrenched
  - Indirect Labour
    - Not Busy
      - Rel.cost =Nil
    - Busy in Regular work
      - Rel.cost = Benefits lost
    - Additional Time/ Over time
      - Rel. cost = Extra cost to be incurred

14. Relevant Cost of Overheads

- **Overhead**
  - Variable Overhead
    - Already incurred — Irrelevant
    - To be incurred — Relevant
  - Fixed Overhead
    - Avoidable or Discretionary — Relevant
    - Unavoidable or committed — Irrelevant

#1. **VOH Varying with LHrs or Labour Cost**

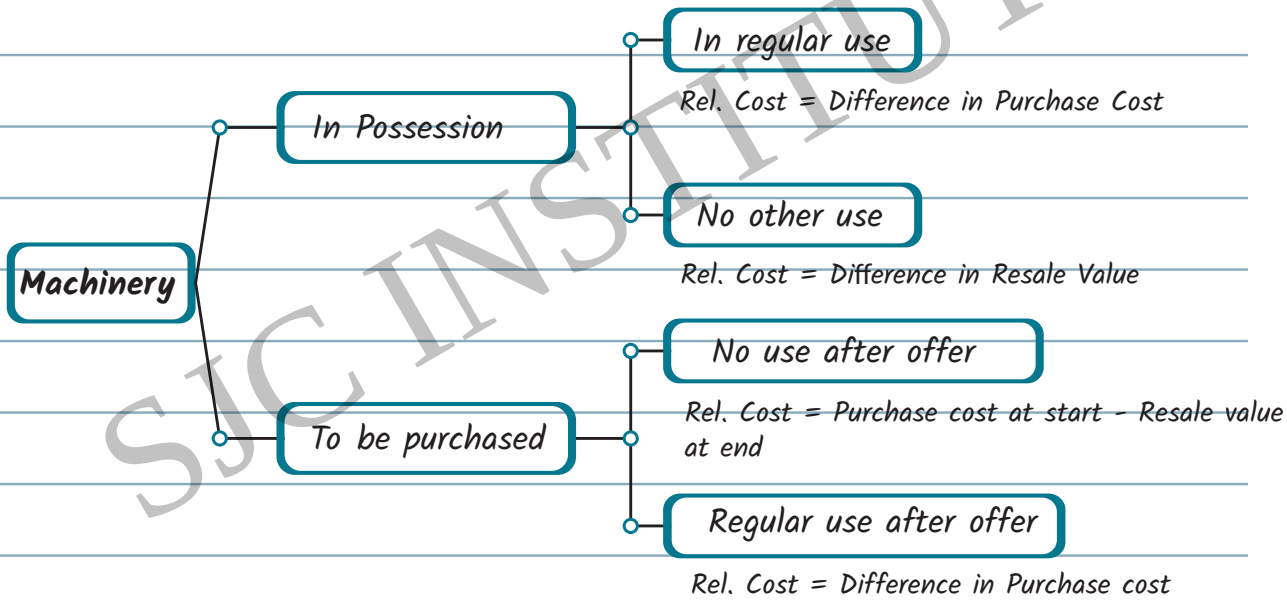
Apply the given rate on actual labour hours or actual labour cost & not on the relevant labour cost.

#2. **Keywords to identify the Committed Fixed OH**

Charged, Added, Recovered, Applied, Absorbed, Apportioned or Given as a Rate in % form or Rate per unit or Rate per LHR.

#3. **Actual OH =OH Recovered + Under Recovery**

15. Relevant Cost of Depreciation



16. Non Financial Factors / Ethical Considerations

(a) Environmental factors

(b) Staff Motivation

(c) Government regulation

(d) Availability of resources

(e) Availability of Project Sites

(f) Corporate Social Responsibility

(g) Moral duties towards the stakeholders

(h) Good Governance and Compliances

17. Sensitivity Analysis

If any variable is uncertain, we must conduct sensitivity analysis. E.g., Fuel Price.

E.g., Sensitivity of life of acid on PV of cash flow by reducing Life by 1 year.

18. Continue / Discontinue Decision

Incremental Benefit of Continue

Implemental Revenue	✓
Incremental Cost	
VC	✓
AFC	✓
Incremental Benefit	✓

If implemental benefit is positive the decision must be continued

If any division is discontinued its entire FC may not be avoided.

Normally a product with least profitability is short to be this continued so that the company may focus upon more profitable production or being in new products.

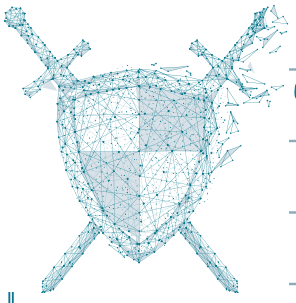
Other Factors –

- Laws of clients → loss of future business.
- Identify may be lost.
- May improve efficiency and quality to enhance profit.

19. Cost of capital is given

- Find PP of cash flows to evaluate
- If life is different then calculate

$$EAC = \frac{PV \text{ of } CFAT}{AF\ (ry, n \text{ years})}$$



Target Costing

SJC Institute

1. Steps in Target Costing

1. Mkt Research → Requirements/ Specification
2. Avg Mkt Price
3. Volume
4. Target Profit = desired profit = ROCE
5. Target Cost : Target SP - Target Profit
6. Actual Cost = Current Cost (ABC is preferred)
7. Cost Gap = Cost v/s target

= Current Cost - Target Cost

8. Cost Redn opportunities

(a) VA (b) VE Make/Buy

↳ • modify the design
• Substitute the parts
• Reduce the durability

Analysis of Activities involved in prodn

VA | NVA

↓ eliminate

Functional Analysis

↓

Remove "good to have" features

9. Launch the product

10. Continuous improvement (Kai) (Zen)

SJC Institute

2. Advantages of Target Costing

1. Innovn – to meet the mkt requirement
2. Competitive advantage – matching the price with competitors, doing something additional for customers = differentiation
3. Market-driven mgmt – as per competitors / mkt requirements
4. Real cost red^n – to achieve the best value.

3. Success of Target Costing

Depend on a dynamic Project team leader who understands designing, cost structure & has ability to complete within time.

SJC Institute

4. Suitability of Target Costing –

Where a product requires designing & majority of its cost gets committed during the design phase itself.

5. Role of Cost & Mgmt Acctant in Target Costing

(1) Cost of designs

(2) Capital Budgeting decision

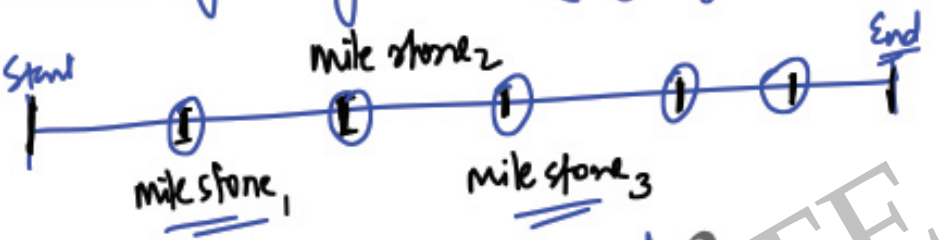
(3) Cost benefit analysis of diff designs

(4) Compare Act Cost with target cost after the designs are calculated.

SJC Institute

6. Control Procm in Target Costing

1. Identification of control points over the course of target costing programme.



2. Point of go or no go decision
   when to abandon

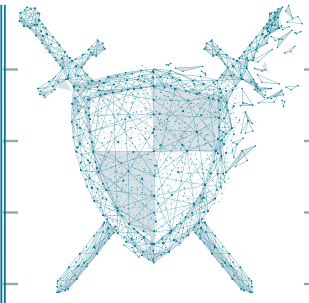
3. Milestone can be in terms of points or it can be in forms of times. (e.g no. of days)

1. Target Costing vs Traditional Costing

Traditional Costing	Target Costing
A company builds a product, determines its cost, adds a profit and then does not understand why its high price does not attract buyers.	A company places the product in the market at its attractive price by cutting down the cost of producing it continuously.
Focuses on Cost Control	Focuses on Cost Reduction

2. Target Costing vs Standard Costing

Standard Costing	Target Costing
Controls cost by keeping the actual cost within the predetermined cost.	Continuously challenges the standard cost.
First determines the design, then cost and at last the price.	First determines the design, then target price, then target profit and then the target cost.
Standards are revised annually.	Standard are revised frequently.
Short term cost control approach	Medium term profit planning approach.



Kaizen Costing

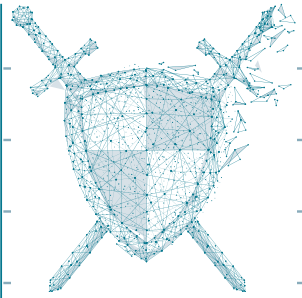
I. Kaizen Costing

A. Meaning

Small incremental changes routinely applied and sustained over a long period result in significant improvements.

B. Principles

- Gradual improvements in the existing situation, at an acceptable cost.
- Collective decision making and application of knowledge.
- No limits to the level of improvements that can be implemented.
- Setting small and frequent standards and continually improving these standards to achieve long-term sustainable improvements.
- Eliminating waste, improving systems, and improving productivity.
- Involves all employees and all areas of the business.
- Define roles and responsibilities of employees clearly.



Life Cycle Costing

1. Meaning

It means involves identifying the costs and revenue over a product's life. As a product progresses through its life cycle, it faces different challenges and opportunities which require changes in the strategies.

2. Objective

It aims to maximize the profit generated by a product over its life.

It helps to suggest which strategies the organisation needs to order to complete successfully.

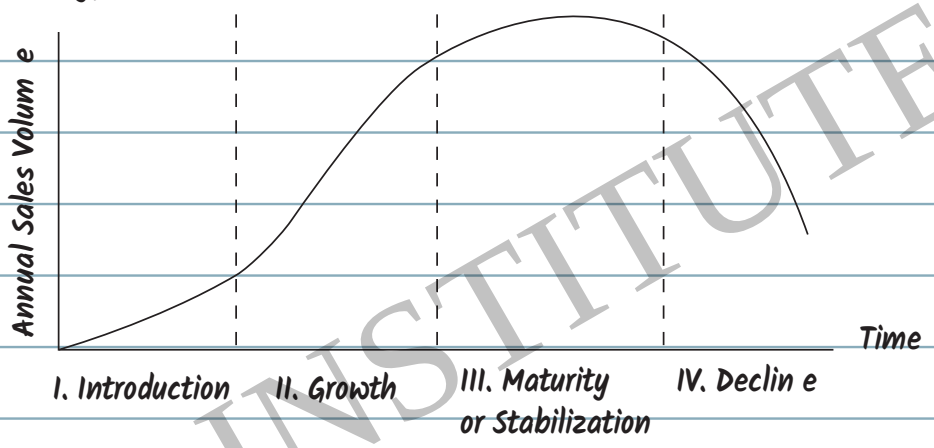
3. Traditional Accounting System vs Life Cycle Costing

Traditional	Life Cycle
Profitability assessed on annual basis. Life of a product is comprised of a series of annual periods.	Profitability assessed over the entire life of the product.
Treats all non - production costs as period costs.	Traces non production costs to individual products over complete life cycle.
Write offs R & D expenses against revenue from existing products so that existing products seem less profitable.	Traces R & D expenses to specific product so that the product profitability are well distinguished.

4. Product Life Cycle Phases – Characteristics and Strategies

Each product has a life cycle. The life cycle of a product varies from a few months to several years. Product life cycle is thus a pattern of expenditure, sales level, revenue and profit over the period from new idea generation to the deletion of product from product range.

The life cycle of a product consists of four phases / stages viz., Introduction; Growth; Maturity; Saturation and Decline.



Phases	Characteristics	Strategies
Introduction	• Product identity / awareness • High distribution Cost • Pricing – Skimming • Competitors start copying	• Strengthen Supply chain • Make product more visible • Set price as per market • Induce customer to try
Growth	• High volume • Increased competition • Price reduction to grow • New channels to handle growth • New features	• Induce customer to buy • Make product available • Long term relationship with customer/partners • Promote differentiation features

Maturity	• Fierce competition • Overcapacity in industry • Selling Price further reduces • No new channels left • Customers move to another product	• Strong marketing effort • Reduce price to attract price sensitive customers • Huge inncentive to channel partners • Start R&D to increase life
Decline	• Sales may drop significantly • Competitors drop out • Consumer's taste changed completely	• Revive / discontinue the product • Use this product to launch a new product

5. Benefits of Product Life Cycle Costing

(a) Understanding of **individual product profitability**

(b) Accurate feedback information

(c) Cost reduction and revenue expansion **opportunities** are more apparent

(d) Increased **visibility** of non - production costs.

(e) Promote **long-term rewarding** in contrast to short-term.

6. Uses/Importance of Product Life Cycle

(a) As a **Planning tool**, it characteristics the marketing challenges in each stage and posses major alternative marketing strategies.

(b) As a **Control tool**, the launched PLC concept allows the company to measure product performance against similar products launched in the post.

(c) As a **Forecasting tool**, it is less useful because sales histories exhibit diverse patterns and the stages vary in duration

(d) Life Cycle Costing involves identifying the costs and revenue over a product's life i.e. from inception to decline. Life cycle costing aims to maximize the

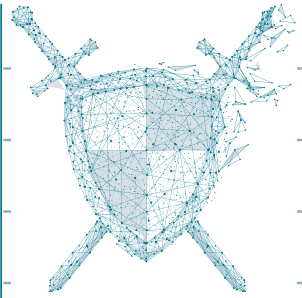
profit generated from a product over its total life cycle. Understanding this can be a useful **analysis tool** and can help to suggest which strategies the organisation needs to adopt in order to compete successfully.

7. Impact on Selling Price and Cost per unit at Different Stages

	Introduction	Growth	Maturity	Decline
Selling price	Very High	High	Moderate	Low
	To cater to esteem value customers and skimming through premium pricing.	To capture market share, price is reduced.	To match with competitors	Product is obsolete or no more desirable for change of customer tastes or preferences.
Cost per unit	High	Low	Very low	High
	To cover the high initial costs of funds, research and development costs and high promotional expenses.	Due to benefits from learning curve effect and economies of scale.	Due to larger benefits from economies of scale, efficien-cy and reduced promotion expenses.	Due to lost benefits from scale, high promotional spending.

7. Customer Life Cycle – An emerging concept

- Aims to extend the life cycle of a particular customer so that they become more profitable.
- Does this by encouraging loyalty (e.g. loyalty cards).



Decision Making Using Probability

1. Expected Value using probability

Expected Value = Average Value = E(x) = px

2. Probability for achieving the desired sales

Type 1 – Based on Probability Distribution of Sales

Pb of achieving BES

Step 1: BES

Step 2: Pb of BES =sum of probabilities of sales which are greater than or equal to above Sales

Pb of incurring a loss

Step 1: Sales units for incurring loss

Step 2: Pb of loss =sum of probabilities of sales which are less than or equal to above Sales

Type 2 – Based on Probability Distribution of Fixed Cost

Pb that company will achieve a profit

Step 1: FC to achieve a profit

Step 2: Pb to achieve a profit = sum of probabilities of fixed costs which are less than or equal to above fixed cost

Type 3 – Joint probability based

Dependency between two variables.

Create a table of all the possible combinations

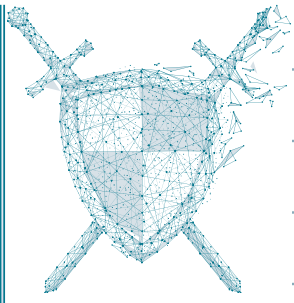
Add a column for joint probabilities = P1 x P2

Find required Expected Values = Contribution x Jt Pb

3. Attitude towards Risk

Sl	Approach	Risk Level	Pb of BE
1	Risk Averse	No Risk	100%
2	Risk Aggressive	High Risk	0%
3	Risk Neutral	Moderate Risk	0% to 100%

If a company's policy is to take pto 20% risk of not meeting the breakeven or 80% chance is required to break even, it indicates that the group is Risk Neutral.



Activity Based Cost Management

1. Traditional vs Modern Business Environment

Sl	Traditional	Modern
1.	Single Product	Multiple Product
2.	Narrow range of products	Wide variety of products
3.	Labour intensive	Capital intensive
4.	No competition	Fierce Competition
5.	No facilities	High facilities
6.	Direct Cost : Indirect Cost = 100:20	Direct Cost : Indirect Cost = 100:800
7.	Production Department : Service Department = 3:1	Production Department : Service Department = 3:8

2. Product Cost Statement under Absorption Costing

Particulars		Amount (₹)
Direct Materials		**
Direct Labour		**
Prime Cost		**
Factory Overheads (absorbed)		
(OH Absorption Rate x Actual Basis)		
- Department A	**	
- Department B	**	**
Total Cost		**

NOTE

1. **Overhead Absorption Rate (separate for each department)**

$$= \frac{\text{Budgeted Overhead}}{\text{Budgeted Basis}}$$

2. **Budgeted Basis** - It can be any of six types

Quantity Produced - for single product companies

Labour Hours - for multiple products - labour intensive

Machine Hours - for multiple products - machine intensive

Direct Labour Cost - for workers employed at same wage rate

Direct Material Cost - for products where material dominates the overheads.

Prime Cost - for standard products

Limitations :

1. **Absorption costing principle is volume based overhead allocation that tend to allocate -**

   (a) Too great a proportion of overheads to high volume products which cause little diversity and hence use fewer support services.

   (b) Too small a proportion of overheads to low volume products which cause greater diversity and therefore use more support services.

2. Inaccurate Costing & Pricing.
3. Pricing challenges with Competitions.
4. Blanket OH Rates are acceptable for valuing stock but not for product strategies.

5. Not helpful for performance measurement.

6. Splitting Cost into fixed & variable is complies & unrealistic.

3. Product Cost Statement under Activity Based Costing

ABC is based on principle that the support activities tend to vary in the long term according to the range and complexity of the products, rather than the volume of output.

It is the process of identifying the costs of the support activities (Cost Pool) and the factors that drive the cost of each activity (Cost Drivers).

Support overheads are charged to products by absorbing costs on the basis of the product's usage of the cost drivers.

Particulars		Amount (₹)
Direct Materials		**
Direct Labour		**
Factory Overheads (absorbed)		
- Activity 1 (Activity Rate /driver and Actual driver)	**	
- Activity 2	**	
- Activity 3	**	
- Activity 4	**	**
Total Cost		**

4. Steps of Implementing ABC

(a) Identifying an organisation's major **activities**.

(b) Find **Cost Pool** - the accumulated cost of each activities

(c) Identify **Cost Drivers** - that determine the size of the costs of an activity.

(d) Calculate **absorption rate** for each activity

(e) Charge **overhead costs to products** for each activity on the basis of their usage of each activity.

5. Classification of Activities

Classification Level	Cause of Cost	Types of Cost	Cost Driver
Unit Level	Production of a single unit of product or delivery of single unit of service	Direct Materials, Direct Labour	Units produced
Batch Level	A batch of things being made, handled, processed	Purchasing Cost, Set up Cost, Inspection Cost	Batches produced
Product Level	Development, production or acquisition of different products	Product development cost, Die cost, Product specific advertisement	No of products
Facility Level	Not relatable to any specific product hence excluded from ABC.	Building Rent, Organisational advertisement	None

6. Types of Cost Driver

In traditional costing, the cost driver used to allocate overhead costs to cost objects related to quantity of output.

With changes in business structures, technology and related cost structures, output quantity is not the only cost driver.

In general, the cost driver **for short-term overhead costs** may be the volume of output or activity.

For long-term overhead costs, the cost drivers will not be related to volume of output or activity.

A. Resource Cost Driver

It is used to assign the cost of a resource to an activity cost or cost pool.

Example - Electricity cost's resource cost driver is Machine hours

B. Activity Cost Driver

It is used to assign activity cost to products.

Activity drivers can be classified as :

(A) Organisational Drivers

(i) Structural Cost Drivers

Relate to business strategic choices about an organization's underlying economic structure, such as scale and scope of operations, use of technology and complexity of products.

Example:

Structural Activities	Structural Cost Drivers
Plant Construction	Number of plants, Scale, Degree of work centralisation
Multiple Products	Number of products scheduling

* An activity cost may be influenced by multiple cost drivers.

(ii) Executional Cost Drivers

relate to the execution of the business activities, such as utilization of employees, provision of quality service, and product design and manufacturing.

Example:

Executional Activities	Executional Cost Drivers
Employee Utilisation	Degree of involvement
Operation of Plant Layout	Plant, Layout Efficiency

(B) Operational Drivers –

That drives unit, batch & product level activities.

Operational Activities	Operational Cost Drivers
Unit Level : Grinding	Grinding Machine Hours
Batch Level : Equipment Setup	No. of Setup
Product Level : Product Design	No. of Requisition

6. Merits of ABC

1. Accuracy in Costing/ Pricing
2. Cost Reduction Opportunities - Value adding / Non Value adding activities
3. Cost Relationships - Using Cost Drivers
4. Budgeting and Performance Measurement

8. Criticism of Activity Based Costing

(a) Difficulties in understanding and **identifying activities**.

(b) Difficulties in **tracing cost** to activities.

(c) Difficulties in **identifying drivers** of each activity.

(d) Difficulties in determining the **consumption of driver** in each product.

(e) A **single cost driver** may not explain the cost behavior of all items in the cost pool.

(f) The **cost of implementing & maintaining** ABC may exceed the benefits.

(g) Not for **short term decisions**.

(h) Not for **single or small range of products**.

(i) Management **must have a purpose** of using the extra information provided by ABC.

Is Activity Based Cost a Variable Cost or Relevant Cost?

It is **not a variable cost** like traditional variable cost that varies directly with the production volume, though cost driver may influence the total cost of an activity. It is **not a relevant cost** as the overheads are not avoidable.

9. Activity Based Budgeting (ABB)

(a) It provides a framework for **estimating** the amount of resources required for an activity.

(b) Actual results can be compared with budgeted results to highlight both in financial and non-financial terms those activities with major discrepancies from budget for potential reduction in supply of resources.

(c) It seeks to support the objectives of continuous improvement.

(d) The **three key elements** of activity based budgeting are as follows:

(1) Type of work to be done - Identifying the Cost Drivers

(2) Quantity of work to be done - Projecting the number of units required within each cost driver

(3) Cost of work to be done - Cost per unit of cost driver

10. Activity Based Management (ABM)

Set of actions that management can take based on information from an ABC system to imrove profitability. It implies the use of ABC as a costing **tool to manage** costs at activity level.

It involves :

(a) Cost Driver Analysis

(b) Activity Analysis

(c) Performance Analysis

A. Operational ABM

Indentifying and improving value added and removing non value added activities to reduce cost without distorting product value.

B. Strategic ABM

Determining which products to be manufactured or which coustomers are most profitable.

C. Benefits of ABM

(1) Cost Reduction

(2) Activity Analysis - Value adding and Non Value Adding

(3) Design Decisions

(4) Cost Driver Analysis

(5) Continuous improvement

(6) Performance Evaluation

(7) Benchmarking

(8) Appropriate Pricing

D. Limitations of ABM

Does not consider non financial value of a cost .E.g Good working environment.

E. Difference between ABC and ABM

(1) ABC is a technique to distribute overhead cost logically. ABM is a broader concept, that focusses on management and rationalization of activities to improve the value received by the customers.

(2) ABC supplies the information whereas ABM uses the information in various analysis to yield continuous improvement.

12. Break Even Analysis under ABC

Total Fixed Cost = Activity wise fixed costs

+ Un-analysed fixed costs

$$\text{Break Even Point} = \frac{\text{Total Fixed Cost}}{\text{Contribution per unit}}$$

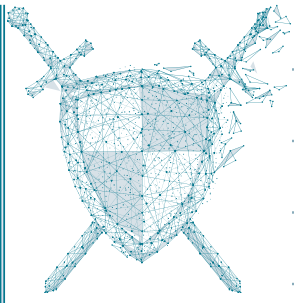
If the unanalysed fixed cost mainly consists of depreciation, further analysis under ABC is not recommended.

13. Variance Analysis under ABC

Activity costs are treated like variable overhead costs varying with their cost drivers.

Standard Cost for AO			Actual Cost		
Standard Drivers for AO	Rate per unit of Driver	Amount	Actual Drivers	Rate per unit of Driver	Amount
****	**	*****	****	**	*****

Sl No.	Particulars	Workings	Amount
1.	Total Activity Cost Variance	Standard Cost for AO - Actual Cost	**
2.	Activity Cost Expenditure Variance	(Standard Rate per unit of Driver – Actual Rate per unit of Driver) × Actual Drivers	**
3.	Activity Cost Efficiency Variance	(Standard Drivers for AO - Actual Drivers) x Standard Rate per unit of Driver	**



Just in time & Back Flush Accounting

A. Meaning

A pull system for production or purchase whose objective is to produce or to procure products or components as they are required by a customer or for use, rather than for stock.

B. JIT Production

Each component on a production line is produced only when needed for the next stage and production is equivalent to sales demand.

C. JIT Purchasing

Material purchase is as per the requirement of production.

D. Principles

Principles	Features
*Reduces the amount of **raw materials** inventory and improves the quality of received parts*	• ***Long term contracts** with single suppliers in nearby*
	• *Spare Parts/ Materials from suppliers on the **exact date** and at the **exact time** when they are needed*
	• ***Straight delivery to the production floor** for immediate use in manufactured products*

Principles	Features
	• **Visit** of engineering staff **at supplier sites** to examine supplier's processes
	• Installation of **EDI system** that tells suppliers exactly how much of which parts are to be sent
	• **Dropping off** products at the specific machines
Reduces the amount of **work-in-process**, while also shrinking the number of products that can be produced before defects are identified and fixed, thereby reducing scrap costs	**Shorten the setup times**
	Eliminating the need for **long production** runs **Streamlined flow** of parts from machine to machine
	Training to employees how to operate a multitude of different machines, perform limited **maintenance**
Alters supporting **accounting system**	Single **consolidated monthly payment** to each supplier.
	No need for suppliers to send invoices.

E. Backflush Costing

Accounting system under JIT :

- No **data entry of any kind until a finished product** is completed. Trigger entries at the end of production.
- The total amount of finished goods is entered into the computer system, which multiplies it by all the components listed in the bill of materials for each item produced.

  Qty Consumed = Qty produced × Material required/ut

- This yields a lengthy list of components that should have been used in the production process and which are subtracted from the beginning inventory

balance to arrive at the quantity of purchases.

Qty Purchased = Qty Consumed – Opening Inventory

Limitations:

(1) Dependent on production report

(2) Scrap not reported

(3) Lot tracing not possible

(4) Inaccurate inventory reported

The success of a back-flushing system is directly related to a **company's willingness to invest in a well-paid**, experienced well-educated **production staff** that undergoes little turnover.

F. Pre requisites for JIT

- Low variety of goods
- Vendor reliability
- Good communication
- Demand stability
- TQM
- Defect free materials
- Preventive maintenance

G. Performance Measurements

- Labour Efficiency
- Inventory Turnover Ratios
- Quantity of scraps

- Cost of quality
- Customer Services
- Ideas generated by employees

H. Time analysis under JIT

Manufacturing Lead time or Process Cycle Time = Setup time + Movement Time + Process Time + Waiting Time + Inspection Time.

Except process time, all other time are regarded as non value adding under JIT.

I. Cycle Time Efficiency or Manufacturing Cycle Efficiency

$$= \frac{\text{Value added time}}{\text{Cycle time}}$$

Where cycle time = Value added time + Non value added time

J. 5 S under JIT

Japanese philosophy to organize work space for efficiency and effectiveness

Sort (Seiri)

Make work easier by eliminating obstacles and evaluate necessary items.

Set in Order (Seiton)

Arrange all necessary items into their most efficient and accessible arrangements.

Shine (Seiso)

Clean your workplace on daily basis completely or set cleaning frequency.

Standardize (Seiketsu)

Standardize the best practices in the work area.

Sustain (Shitsuke)

Not harmful to anyone, training and discipline, to maintain proper order.

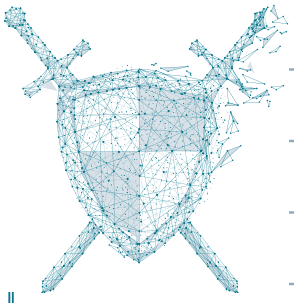
I. Kaizen Costing

A. Meaning

Small incremental changes routinely applied and sustained over a long period result in significant improvements.

B. Principles

- Gradual improvements in the existing situation, at an acceptable cost.
- Collective decision making and application of knowledge.
- No limits to the level of improvements that can be implemented.
- Setting small and frequent standards and continually improving these standards to achieve long-term sustainable improvements.
- Eliminating waste, improving systems, and improving productivity.
- Involves all employees and all areas of the business.
- Define roles and responsibilities of employees clearly.



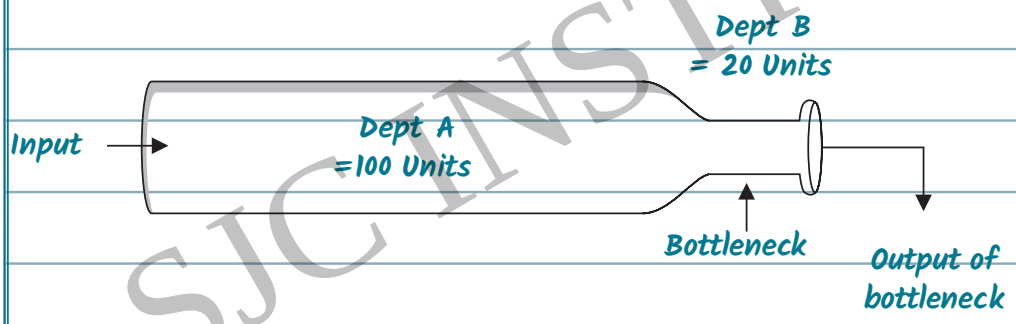
Theory of Constraints or Throughput Accounting

1. What is TOC or Theory of Bottleneck

It is a technique that emphasizes on identifying the constraint in the system, exploiting it and elevating it until it is no longer a constraint.

2. What is a Constraint or Bottleneck

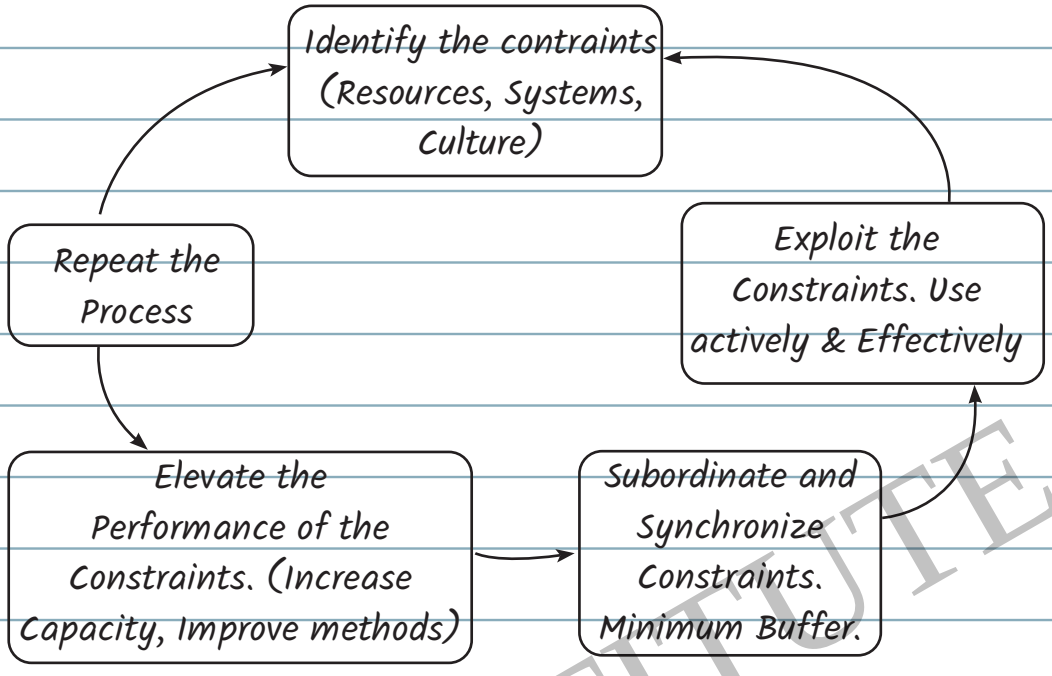
The resource that limits the system output. It can be tangible or intangible.



3. Objective of TOC

Elevating a constraint

4. Five Steps of TOC



If desired result is achived, then search for next bottleneck. If not achieved then correct the bottleneck.

5. Throughput vs Absorption Costing

In Absorption Costing, Manager produce move to drive down the Cost/ unit.

6. Problems with Throughput Accounting

- Less profitable orders not fulfilled
- Dependency on Production Scheduling staff
- All costs are variable in long run

7. Reporting under Throughput Accounting

1. Income statement format
2. Inventory valuation
3. No Over production
4. Can be used for internal purpose only

8. Systematic changes required for Acceptance of Throughput Accounting

1. Inventory Valuation - T.A. not accepted by GAAP
2. Inventory Investment Analysis - T.A is better as it forces one to analyse all inventory reduction projects.

3. Capital Investment Analysis

TA recommends capital expenditure only if it increases bottleneck capacity

4. Product Costing

Throughput is simple but not for Cost plus Contracts or tenders or Complex work

5. Production Scheduling

TA use software to produce where highest profit will come.

6. Long term planning

T.A is best as there is no consideration for existing customers.

7. Price Setting - TA is easy & speedy

9. Three Measures of Performance

Throughput Contribution	**Sales – Materials** • All other costs are fixed costs • Measures incoming money
Investments	Facilities, Equipment, Building, Research and Development Cost. • Money tied up in the system
Operating Expense	Direct Labour, Rent, Utilities, Depreciation, etc. • Money leaving the system

10. Profit Statement

	Particulars	Amount
	Sales	**
Less:	Materials (only variable cost) (on Actual Sales uts)	**
	Throughput Contribution	**
Less:	Operating Expenses (all are fixed) (on Planned Capacity)	**
	Profit	**

11. Performance Ratios

(a) ROI = Profit / Investments

(b) Productivity Ratio or Throughput Accounting Ratio of Products

= Throughput contribution per time period of bottleneck / Conversion cost per time period of bottleneck,

- A product is viable only if its TAR>1

(c) Product Return per time period

= Throughput contribution per time period of bottleneck

- Best Product is where throughput contribution/ time period is highest.

12. Dealing with Multiple Key Factors and Multiple Products

Step 1:

Throughput Accounting Ratio or Key Factor Ratio or Critical Ratio = Requirement / Availability

A resource is a key factor only if its TAR is > 1

Step 2:

Select the resource with highest TAR

Step 3:

Assume the resource with highest TAR as the only key factor or the bottleneck. Now the situation has reduced to single key factor and multiple products.

Step 4:

Rank the products in relation to Throughput Contribution per unit of bottleneck

Step 5:

Allocate the available resource to the products in order of rank.

Some other Calculations :

1. Total factory Cost = Op Exp ⇒ All factory cost excluding D/M

2. Throughput Cost for the period [factory Cost absorbed]
= Factory Cost/minute of bottleneck × Bottleneck time utilised during the period

3. Throughput Efficiency Ratio
= $\frac{\text{Throughput Cost (absorbed)}}{\text{Actual factory Cost}}$

5. Capital Expenditure is viable only if it increases the capacity of bottleneck as well as yields a positive profitability.

6. Product Cost – only DM cost

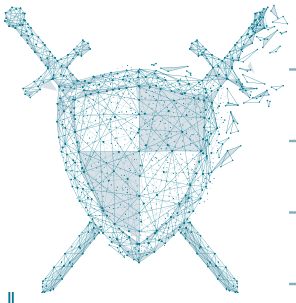
7. Throughput time ratio or Manufacturing Cycle Efficiency

$$\frac{\text{Value added time}}{\text{Total cycle time}} = \frac{\text{Process time}}{\text{Throughput Cycle time}}$$

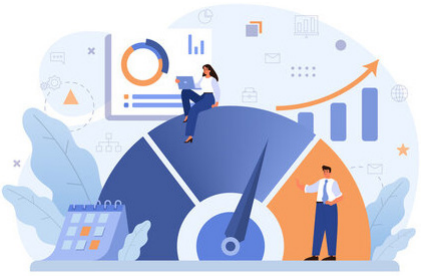
8. Profit = $\frac{1}{\text{Manufacturing Response Time}}$

For Decision Making or Selection of Best alternative

Always think whether a new proposal is elevating the bottleneck capacity or not



Benchmarking



1. Meaning

*It is a technique for **continuous improvement** in performance by **comparing** against the **best performing organisation**.*

2. Types of Benchmarking

Type	Description
Competitive Benchmarking	Comparing with competitive firms' products, processes and business results.
Strategic Benchmarking	Comparing strategic vision with other companies – e.g. developing new products, core competencies.
Global Benchmarking	Comparing with global best practices – international culture, business processes.
Process Benchmarking	Comparing the process – e.g. order processing
Functional Benchmarking	Involving experts from different functional areas. This may lead to innovation.
Internal Benchmarking	With internal divisions or group companies e.g. business units located in different areas
External Benchmarking	With external companies that are leading in the industry.
Intra group Benchmarking	Within the same companies of the group
Inter group Benchmarking	With the groups in the same industry
Inter Industry Benchmarking	With the companies in different industries

3. Process of Benchmarking

(a) Planning

(b) Collection of data

(c) Analyzing the findings

(d) Recommendations

(e) Monitoring and reviewing

4. Principles of Benchmarking or Code of Conduct

(a) Legality

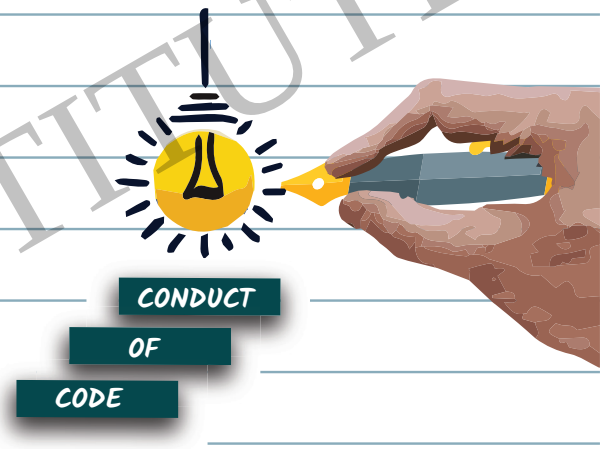
(b) Confidentiality

(c) Exchange

(d) Use

(e) First party contact

(f) Third party contact



5. Goals for Benchmarking

(a) Significant **performance improvements** based on efficiency, cost savings and new revenue.

(b) Targets – cycle time, productivity, customer service, quality and production costs.

6. Prerequisites for Benchmarking

(a) Senior management support

(b) Clearly defined objectives

(c) Appropriate scope of work

(d) Sufficient resources

(e) Clear picture of organisation performance

(f) Right skills and competence

(g) Stakeholders and staff are well informed

7. Difficulties in Benchmarking

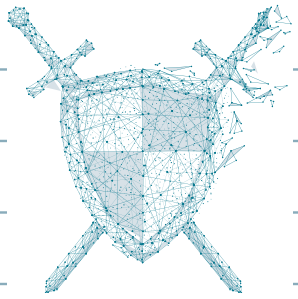
(a) Time consuming and difficult

(b) Cannot be delegated

(c) Resistance from employees

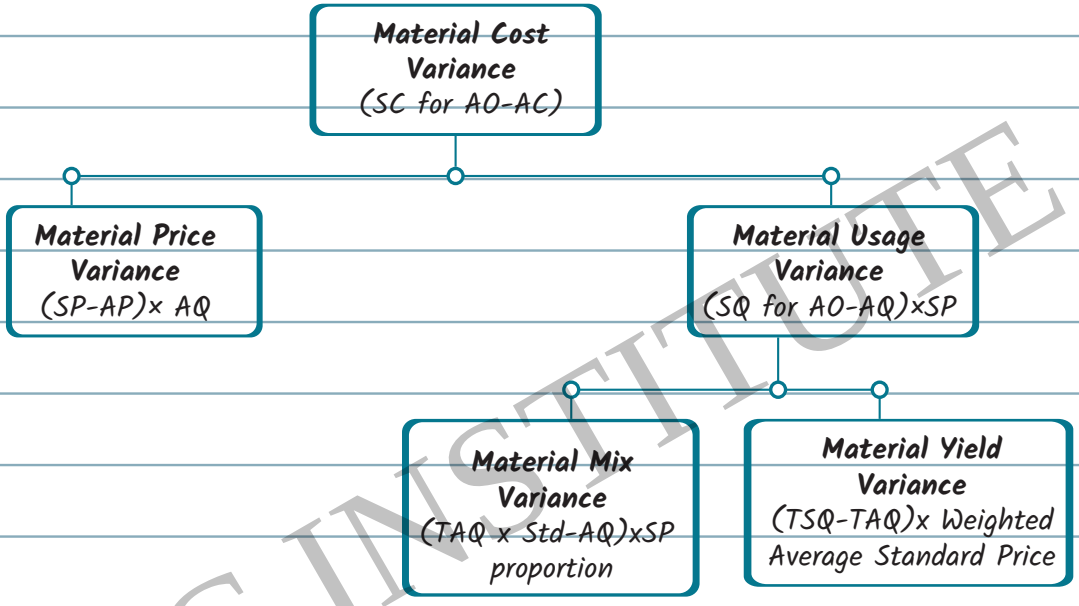
(d) Waste time in non - critical functions

(e) Adaptation of best practice, not merely adapt it



Standard Analysis or Variance Analysis

I. Material Variances



- **Presentation** - N1 - Analysis of data, N2 - Material Cost Card, N3 - Statement showing variances.
- **Emergency Purchase** - Production Manager will bear the extra purchase price incurred due to emergency purchase, i.e., it will affect MUV.
- **Standard processing Loss** - Assume total standard input as 100 to compute the standard output.
- **Missing Figure Questions** - First, fill the data given in Cost Card first and then use variances given in the question to complete the Cost Card. After the Cost Card is completed, solve the requirements of the question.

- **Single and Partial Plan –**

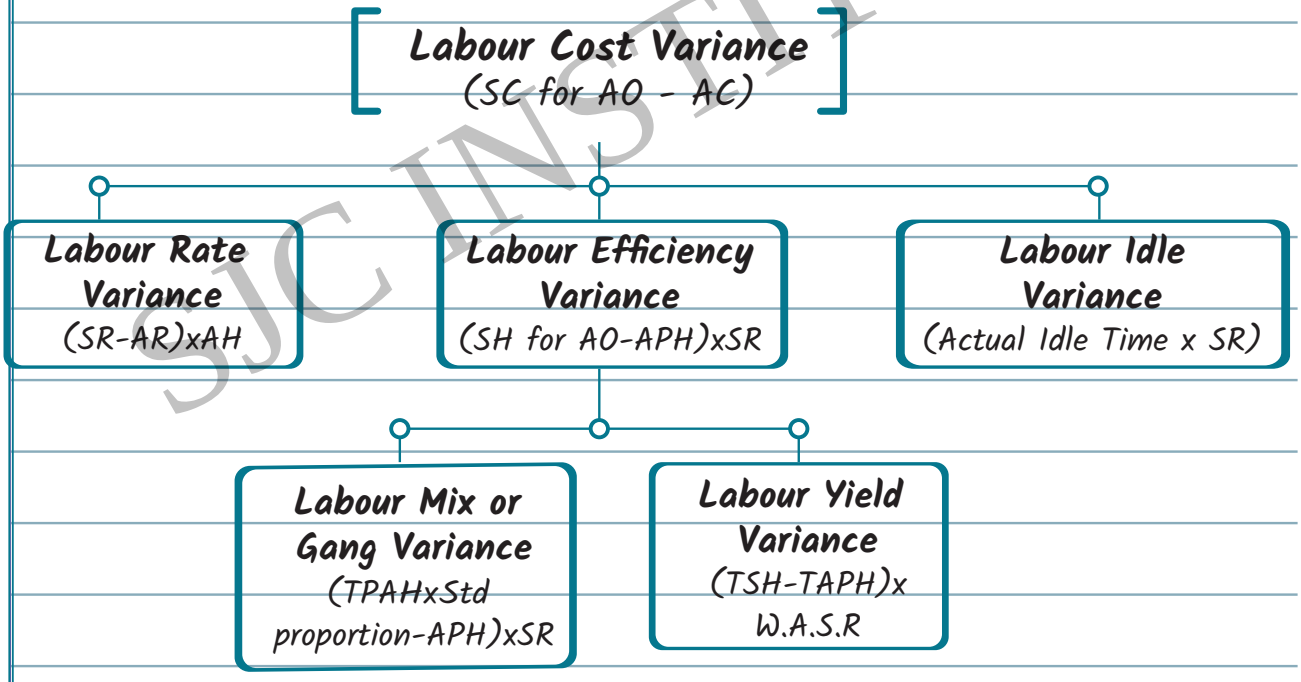
Single Plan –

MPV is recorded on **actual quantity purchased**. Hence, in stores ledger, the quantity purchased is entered at standard price. As a result, closing stock are valued at standard price.

Partial Plan –

MPV is recorded on **actual quantity consumed**. Hence, in stores ledger, the quantity purchased is entered at actual price. As a result, closing stock are valued at actual price.

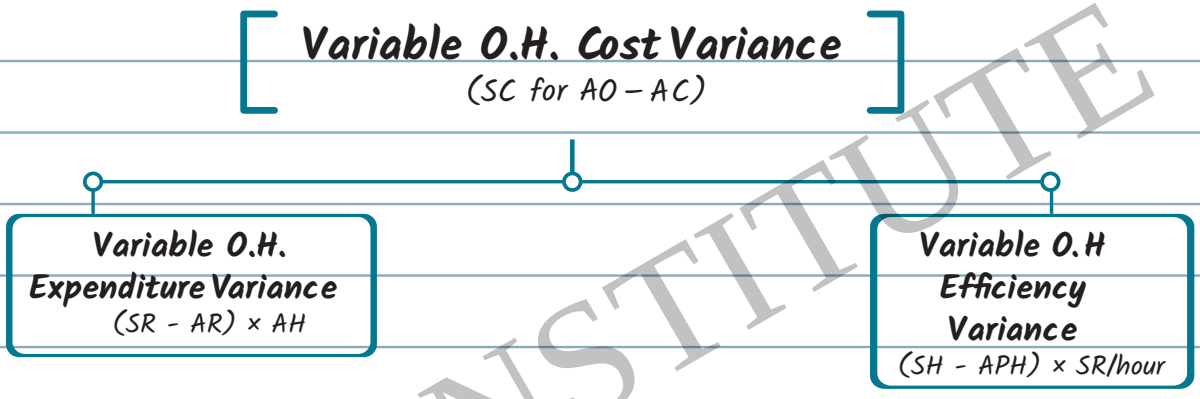
2. Labour Variances



- **Hours** - Implies Man Hours = No. of workers x Hours per worker.
- **Normal Idle time** - It remains included in Man Hours in both Standard and Actual, If given ignore..

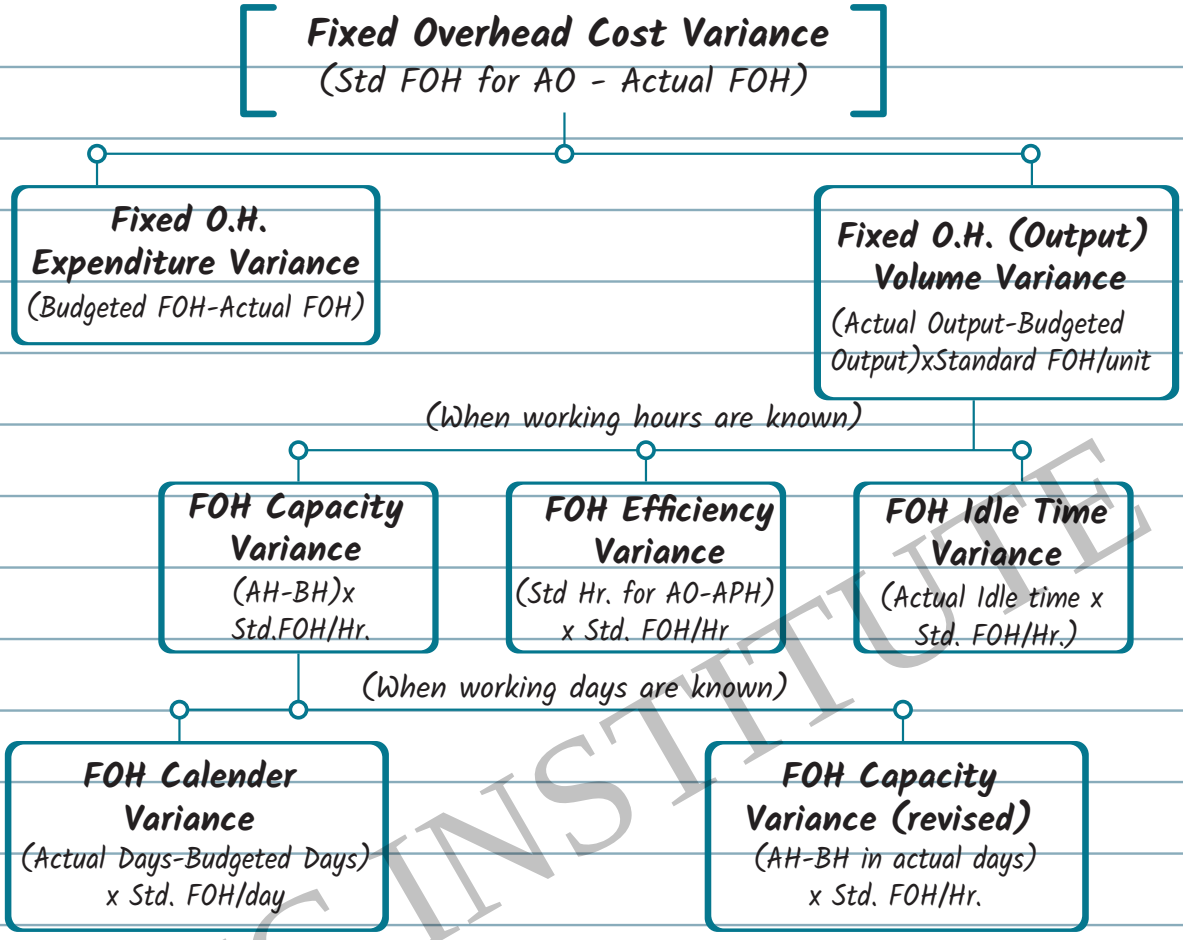
- **Abnormal Idle time** - It is known only in actual and its variance is computed at Standard Rate.
- **Standard Hours Produced** - Used to measure the output when the department is engaged in production of multiple products. Here, if nothing is mentioned, we assume 1 Std Hr taken as input = 1 Std Hr produced as output.

3. Variable Overhead Variances



- **VOH Varying with Quantity Produced** - Here, find only VOH Cost Variance
- **Idle Time effect** - VOH are not incurred for idle time.
- **Question remaining silent** - VOH is assumed to vary with labour hours worked.

4. Fixed Overhead Variances (Absorption Approach)



- **FOH Variance under Marginal Approach**

  FOH Cost Variance = FOH Expenditure Variance = Budgeted Fixed Overhead – Actual Fixed Overhead

- **FOH Ratios :**

  (1) Volume Ratio = (Actual Output / Budgeted Output)

  (2) Capacity Ratio = (Actual Hours / Budgeted Hours)

  (3) Efficiency Ratio = (Standard Hours for AO / Actual Hours)

  [Volume Ratio = Capacity Ratio × Efficiency Ratio]

  (4) Calendar Ratio = Actual Working Days / Budgeted Working Days

(5) Standard Capacity Usage Ratio = Budgeted Hrs / Max Possible Hrs

(6) Actual Capacity Usage Ratio = AH/ Max Possible Hrs

(7) Idle Capacity Ratio = Normal Idle Hrs/ Max Possible Hrs

= 100% - Standard Capacity Usage Ratio

5. Total Overhead Variances

Total Overhead Cost Variance
(Std. TOH for AO - Actual TOH)

TOH Exp Variance	VOH Efficiency Variance	FOH Volume Variance
(Std VOH/Hr. x AH + BFOH) – Actual TOH	(Standard Hr. for AO – Actual Hr.) × Std. VOH/Hr.	(Actual Output – Budgeted Output) × Std. FOH/Unit

- If Variable and Fixed Overhead Variances can be computed fully, then ignore TOH Variances.
- If Variable and Fixed Overhead incurred are not available separately, then calculate TOH Variances only.
- The above analysis of Total OH into 3 Sub-Variances is also called as **Three Point Method**.

6. Thought Process to determine formulas

Variable Calculation Type	Favourable	Adverse
Subtraction	+ ve	– ve
Divide – Cost	<1	>1
– Sales	>1	<1

7. Sales Margin Variances

Sales Profit Variance
(Actual Profit based on Standard Cost – Budgeted Profit at Standard Cost)

- **Sales Profit Price Variance**
  (Actual Profit p.u. – Standard Profit p.u.) × Actual Output
  = Sales Price Variance
- **Sales Profit Volume Variance**
  (Actual Output – Budgeted Output) × Standard Profit p.u.
  - **Sales Profit Mix Variance**
    (AO Sold - TAO × Std. Proportion) × Standard Profit p.u.
  - **Sales Profit Quantity Variance**
    (TAO - TBO) × Std. Weighted Average Profit p.u.

- Instead of margin, we can use, profit or contribution as per the given details.
- This variance is computed to evaluate performance of sales manager in true sense.
- As Sales Manager is not responsible for changes in cost, we compute profit based on standard cost only.
- **Under Absorption approach :**

  Margin = Profit = Sales – (VC + FC)
- **Under Marginal Approach :**

  Margin = Contribution = Sales – VC
- In a question if details of both cost and sales are given, we always compute Sales Margin Variance even if the question has asked only Sales Variances.

- **MMV vs SMV :** MMV - Quality SMV - Profitability
- **FOH Volume variance vs Sales Volume variance :**

FOH - Quantity produced sales - Quantity sold

8. Effect of WIP on Cost Variances

A. Only Closing WIP is given

- Prepare **Statement of Equivalent Production** in terms of Finished Goods for each element of cost.
- Prepare Cost Card using **equivalent production as Actual Output**.

B. Opening WIP is also given

- Prepare **Statement of Equivalent Production** in terms of Finished Goods using **FIFO**
- FIFO is used to ensure that variance on Closing WIP of previous period is not reaccounted in the current period.

C. FIFO Method

Statement of Equivalent Production

- Finished goods is divided into Opening WIP **(on the basis of balance DOC)** and New Input **(with 100% DOC)**.
- Closing WIP is computed on the basis of given DOC.

Statement of Rate per Equivalent Unit

- Ignore Opening WIP Cost carried forward from previous period.

D. Weighted average

Statement of Equivalent Production

- All FG Qty are taken at 100% DOC irrespective of DOC of Opening WIP, as

it is assumed that Opening WIP is mixed with new input.

- Closing WIP completion is computed at closing DOC.

Statement of Rate per Equivalent Unit

- Opening WIP cost is included with the current cost to find the weighted average rate per equivalent unit.

9. Flexible Budget and Variances

Given Budget = Original Budget for BO

Flexible Budget = Original Budget for AO

= Standard FOH Rate/ut x AO

10.Profit Reconciliation Statement

	Absorption	Marginal	Relevant
Budgeted Profit at Std. Cost (for BO)	x x	x x	x x
(+) Profit Variance			
Sales Price Variance /Profit Price Variance/ Contribution Price Variance	x x	x x	x x
Profit Volume Variance	x x	N/A	N/A
Contribution Volume Variance	N/A	x x	x x (#1)
(+) Cost variance			
MPV	x x	x x	x x
MUV	x x	x x	x x (#2)
LRV	x x	x x	x x
LEV	x x	x x	x x
VOH Expenditure Variance	x x	x x	x x
VOH Efficiency Variance	x x	x x	x x
FOH Expenditure Variance	x x	x x	x x
FOH Volume Variance	x x	N/A	N/A
Actual Profit @ AC (AS – AC)	✓	✓	✓

*Actual Profit is same under all approaches

Cross check for actual profit when inventories are given	Amount	Amount
Actual Sales		✓
(–) Actual Cost		
(Mat, Lab, VOH, FOH)		✓
Cost of Production		✓
(+) Opening WIP (at Standard Cost)	✓	
(–) Closing WIP (at Standard Cost)	✓	
(+) Opening Finished Goods (at Standard Cost)	✓	
(–) Closing Finished Goods (at Standard Cost)	✓	✓
Actual Profit		✓

- Profit reconciliation is also referred as **Income Statement / Annual Profit Statement / Reasons for Variation in Profit / Profit Improvement Plan.**
- There is no change in format even when production and sales quantity are not same
- **Valuation of Stock in Standard Costing**

	Single Plan	Partial Plan
Finished Goods	Standard Cost	Standard Cost
WIP (on equivalent production	Standard Cost	Standard Cost
Raw Material	Standard Cost	Actual Cost

- **Relevant Costing approach :**

  Apply this approach only when Material or Labour input is scarce (Limited Supply)

  The Production Manager bears an additional loss i.e. the contribution lost due to inefficient use of scarce input.

Sales Contribution Volume Variance is reduced by the amount of contribution lost borne by the Production Manager.

#1 **Contribution volume variance under Relevant Costing** = Usual Variance - Loss shifted to production manager.

#2 **MUV** = Usual variance + Loss of contribution due to inefficient use of materials

[Loss of contribution = (Std. contribution / Kg. x Extra Qty. of material used)]

II. Variances based on Ratios

Thought Process

	Cost	Sales	
Favourable	<1	>1	
Adverse	>1	<1	Result in %

Cross Check

1. MCV = MPV × MUV
2. SW = SPV × S.Vol.V

A. Material Ratios

(1) Material Cost Ratio $= \frac{AC}{SC \text{ for } AQ}$

(2) Material Price Ratio $= \frac{AP}{SP}$

(3) Material Usage Ratio $= \frac{AQ}{SQ \text{ for } AQ}$

B. Sales Ratios

(1) Sales Volume Ratio $= \frac{AS}{BS}$

(2) Sales Price Ratio $= \frac{AP}{SP}$

(3) Sales Volume Ratio $= \frac{AQ}{BQ}$

(12) Variances when output details are not given!:-

Step 1 :- Volume Ratio = AO/BO

Using, Sales Value Ratio = Sales Price Ratio × Sales Volume Ratio

Find Sales Volume Ratio

Step 2:- Profit Reconciliation Statement

Particulars	Workings	Amt
Budgeted Profit	For BO	✓
(+) SPV	Act Sales / Sales Price Ratio × % change in SP	✓
Profit Vol Ratio	% change in Volume × Std Profit per unit	✓
Cost Variance		
MPV/LEV/VOH EFV	Act Cost / Price Ratio × % change in Price	✓
MUV/LEV/VOH EFV	BC × Vol Ratio − BC	✓
Fixed Ex V	Bfixed − Afixed	✓
Fixed Vol Var	BC × Vol Ratio − BC	✓
Actual Profit	For AO	✓

(13) Profit Reconciliation with Scrap loss (under Marginal Costing)

Particulars	Amt
Budgeted Profit for Bo	✓
(+) SPV	✓
(+) Contn volume var	✓
(+) MPV/MUV	✓
(+) LRV/LEV	✓
(+) VOH EoV/VOH EfV	✓
(+) FOH EoV	✓
(+) Scrap loss (Scrap unit x Std rate)	✓
(+) Cl.St valuation difference (Cl St units x Std rate) − Act Cost	✓
Actual Profit	✓

#
If Efficiency Ratio is 80%, Sc/lt will be
= Actlt x Efficiency Ratio

14. Traditional, Planning and Operating Variances

 # Ex Ante Standard : Standard set before the event based upon forecast

 # Ex Post Standard : Standard set after the event based upon the actual circumstances

A. Format

Original Standard (Ex -Ante)			Revised Standard (Ex - Post)			Actual		
Quantity	Rate	Amount	Quantity	Rate	Amount	Quantity	Rate	Amount
✓	✓	✓	✓	✓	✓	✓	✓	✓

B. Planning Variance

Here, comparison is done **between Original and Revised Standard**. It can be controllable or uncontrollable or both. Usually it is uncontrollable.

C. Operating Variance

Here, comparison is done **between Revised Standard and Actual**. Any variance arising is controllable in the hands of respective managers.

D. Traditional Variance

Here, comparison is done **between Original budget and Actual**.

= (Planning Variances + Operating Variances)

- Traditional Var = Planning Var + Operating Var but only for total variances like MCV, LCV and not MPV, LRV, etc
- MCV (Traditional) = MCV (Planning) + MCV (Operating)

E. Reconciliation Statement with Planning and Operating Variances

Particulars	Amount (₹)	Amount (₹)
Original Budgeted Profit		✓
(+) Sales Price Variance – Planning Variance	✓	
– Operating Variance	✓	✓
(+) Sales Margin Volume Variance		
– Planning Variance – Mkt. Size		
(+) Cost variance – Planning Variance	✓	
– Operating Variance	✓	✓
Actual Profit		✓

15. Investigation of Variances

Variance analysis require resources. Not all variances indicate out of control situations.

Factors to be considered before investigating

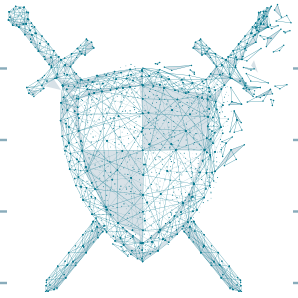
1. **Size** of variance - amount involved/ magnitude of amount
2. **Type** of variance - adverse or favourable (both should be investigated)
3. **Cost** of investigating
4. **Pattern** in variance - if it is worsening, investigation is desirable
5. **Budgetary process** - if it is unrealistic or uncontrollable, budgetary process to be reevaluated than the variances.
6. Accuracy of computation
7. Inherent nature of business

16. Cross Linkage of Variances

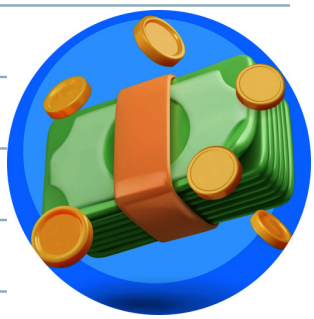
It is essential to interprete several variances together.

Variance	Implication	Reasons
MPV (F)	MUV(A), LEV(A), FOH Volume Variance(A), Sales Volume Variance (A)	**Use of cheaper material** which is of poorer quality, caused more wastage. As a result, lesser output produced and lesser output sold.
MPV (A)	MUV(F), LEV(F), FOH Volume Variance(F), Sales Volume Variance(F)	**Use of premium quality material** which caused less wastage. As a result, more output produced and sold.
MMV (F)	MYV(A)	A **change in composition of materials** might result in a cheaper mix but will lower the yield of materials.
LRV (A)	LEV(F), VOH Efficiency Variance(F), FOH Volume Variance(F), Sales Volume Variance(F)	**Use of more skilled labour** who are experienced resulted into higher productivity caused a savings in time related variable overhead cost and resulted into higher output quantity produced and sold.
LEV (F)	MUV(A)	Workers trying to improve productivity in order to get bonus **might use the materials wastefully** in order to save time.
LMV (F)	LYV(A)	A **change in composition of labour** might result in a cheaper mix but will lower the yield or productivity.

SPV (F)	Sales Volume Variance(A)	High selling price might **affected the quantity demanded adversely**. Similarly adverse price variance might result in higher sales demand.
Sales Industry Size Variance	Sales Volume Variance(F)	A **growth in industry size** has also increased the quantity sold.



Uniform Costing and Inter Firm Comparison



A. Uniform Costing

Uniform Costing *may be defined as the application and use of the same costing principles and procedures by different organisations under the same management or on a common understanding between members of an association.*

1. SCOPE OF UNIFORM COSTING

Uniform Costing methods may be ***advantageously*** *applied:*

(a) In a ***single enterprise*** *having a number of branches or units, each of which may be a separate manufacturing unit.*

(b) In a ***number of concerns in the same industry*** *bound together through a trade association or otherwise, and*

(c) In ***industries which are similar in nature*** *such as gas and electricity, various types of transport, and cotton, jute and woolen textiles.*

2. REQUISITES FOR INSTALLATION OF A UNIFORM COSTING SYSTEM [MTP DEC'19]

The success of a uniform costing system will depend upon the following:

(a) There should be a spirit of ***mutual trust, co-operation*** *and a* ***policy*** *of give and take amongst the participating members.*

(b) There should be **a free exchange of ideas and methods.**

(c) The **bigger units should be prepared** to share with the smaller ones, improvements, achievements of efficiency, benefits of research and know-how.

(d) There **should not be any hiding** or withholding of information.

(e) There **should be no rivalry** or sense of jealousy amongst the members.

In the application of Uniform Costing, the fundamental requirement is, therefore, to locate such differences and to eliminate or overcome, as far as practicable, the causes giving rise to such differences. **The basic reasons for the differences may be as follows:**

(a) Size and organisational set up of the business:

The number and size of the departments, sections and services also vary from one concern to another according to their size and organisation. The difficulty in operating Uniform Cost Systems for concerns which vary widely in regard to size and type of business may to some extent be overcome by arranging the various units in a number of size or type ranges, and applying different uniform systems for each such type.

(b) Methods of production:

The use of different types of machines, plant and equipments, degree of mechanization, difference in materials mix and sequence and nature of operations and processes are mainly responsible for the difference in costs.

(c) Methods and principles of cost accounting applied:

Undertakings manufacturing identical or similar products and having the same system of cost accounting would generally employ different methods of treatment of expenditure on buying, storage and issue of materials, pricing of

stores issues, payment to workers, basis of classification and absorption of overhead, calculation of depreciation, charging rent on freehold or leasehold assets etc.

3. FIELDS COVERED BY UNIFORM COSTING

There is no system of Uniform Costing which may be found to fit in all circumstances. The system to be installed should be tailored to meet the needs of each individual case. The essential points on which uniformity is normally required may be summarized as follows:

(a) Whether costs are required for the individual products i.e for the cost units or for cost centres.

(b) The method of costing to be applied.

(c) The technique employed such as Standard Costing, Marginal Costing.

(d) Items to be excluded from costs.

(e) The basis of departmentalization.

(f) The basis of allocation of costs to departments and/or service department costs to production departments.

(g) The methods of application administration, selling and distribution overhead to cost of sales.

(h) The method of valuation of work-in-progress.

(i) Methods of treating cost of spoilage, defective work, scrap and wastage.

(j) Methods of accounting of overtime pay bonus and other miscellaneous allowances paid to workers.

(k) Whether purchase, material handling and upkeep expenses are added to the cost of stores or are treated as overhead expenses.

(l) The system of materials control-pricing of issues and valuation of stock.

(m) The system of classification and coding of accounts.

(n) The method of recording accounting information.

4. ADVANTAGES OF UNIFORM COSTING [RTP JUN'18]

Main **advantages** of a Uniform Costing System are summarised below:

(i) It provides **comparative information** to the members of the organisation / association which may by them to reduce or eliminate the evil effects of competition and unnecessary expenses arising from competition.

(ii) It enables the industry to **submit the statutory bodies** reliable and accurate data which might be required to regulate pricing policy or for other purposes.

(iii) It enables the member concerns to **compare their own cost data** with that of the others detect the weakness and to take corrective steps for improvement in efficiency.

(iv) The **benefits of research and development can be passed** on the smaller members of the association lead to economy of the industry as a whole.

(v) It provides **all valuable features of sound cost accounting** such as valued and efficiency of the workers, machines, methods, etc., current reports of comparing major cost items with the predetermined standards, etc.

(vi) It serves as a **prerequisite to Cost Audit** and **inter firm comparison**.

(vii) Uniform Costing is a useful tool for **management control**. Performance of individual units can be measured against norms set for the industry as a whole.

(viii) It **avoids cut-throat completion** by ensuring that competition among member units proceeds on healthy lines.

(ix) The **process of pricing policy** becomes easier when Uniform Costing is adopted.

(x) By showing the one best way of doing things, Uniform Costing creates cost **consciousness** and provides the best system of cost control and cost presentation in the entire industry.

(xi) Uniform costing simplifies the work of wage boards set up to **fix minimum wages** and **fair wages** for an industry.

5. LIMITATIONS OF UNIFORM COSTING [MTP DEC'17; MTP DEC'21]

(i) Uniform costing presumes the application of same principles and methods of Costing in each of the member firms. But **individual units generally differ** in respect of certain key factors and methods.

(ii) For smaller units the **cost of installation and operation** of Uniform Costing System may be more than the benefits derived by them.

(iii) Uniform costing may create conditions that are likely to **develop monopolistic tendencies** within the industry. Prices may be raised artificially and supplies curtailed.

(iv) If complete agreement between the members is not forthcoming, the **statistics presented cannot be relied** upon. This weakens the Uniform Costing System and reduces its usefulness.

B. Inter Firm Comparison

Inter-firm comparison means the techniques of evaluating the performances, efficiencies, deficiencies, costs and profits of similar nature of firms engaged in the same industry or business.

I. Benefits of Inter Firm Comparison

The benefits which are derived from Inter-firm Comparison are appended below :

(a) Inter-firm Comparison makes the management of the organisation aware of **strengths and weakness** in relation to other organisations in same industry.

(b) As only the **significant items are reported** to the Management time and efforts are not unnecessary wasted.

(c) The management is able to **keep up to data information of the trends and ratios** and it becomes easier for them to take the necessary steps for improvement.

(d) It develops **cost consciousness** among the members of the industry.

(e) **Information** about the organisation is made available **freely** without the fear of disclosure of confidential data to outside market or public.

(f) **Specialized knowledge and experience** of professionally run and successful organisations are made available to smaller units who can take the advantages it may be possible for them to have such an infrastructure.

(g) The industry as a whole benefits from the process due to increased productivity, standardization of products, elimination of unfair comparison and the trade practices.

(h) **Reliable and collective data** enhance the organising power in deal in with various authorities and Government bodies.

(i) Inter firm comparison assists in a big way in **identifying industry sickness** and gives a timely warning so that effective remedial steps can be taken to save the organisation.

2. LIMITATIONS OF INTER-FIRM COMPARISON:

The practical difficulties that are likely to arise in the implementation of a scheme of inter-firm comparison are:

(a) The **top management may not be convinced** of the utility of inter-firm comparison.

(b) **Reluctance to disclose data** which a concern considers to be confidential.

(c) **A sense of complacence** on the part of the management who may be satisfied with the present level of profits.

(d) **Absence of a proper system of Cost Accounting** so that the costing figures supplied may not be relied upon for comparison purposes.

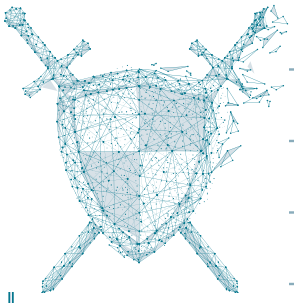
(e) Non-availability of a **suitable base** for comparison.

These **difficulties** may be overcome to a large extent by taking the following steps:

(a) 'Selling' the scheme through **education and propaganda**. Publication of articles in journals and periodicals, and lecturers, seminars and personal discussions may prove useful.

(b) Installation of a system which ensures complete **secrecy**.

(c) Introduction of a **scientific cost system**.



Linear Programming

1. Conditions

- Multiple Products and Multiple Constraints
- Maximisation / Minimisation Objective

2. Flow of Solving

Original Problem ➤ **Formulation** ➤ **Solution** ➤ **Interpretation**

3. Formulation Steps

(a) Tabulate the given data

(b) Identify decision variables

(c) Write objective function ('Z')

(d) Write constraints functions represented by inequations or equations

(e) Do not forget to mention the non negativity assumption

4. Methods to Solve a LPP

Methods to solve a LPP : (i) Graph; (ii) Simples; (iii) Assignment; (iv) Transportation

5. Solution Method

Graphical method

2 variable problems

No restriction in no. of constraints

Steps

1. Convert inequation into equation.
2. Take two points for each equation.
3. Plot the points on the graph and draw the equation line.
4. Identify the feasible area of each inequation, using the test point or by checking its sign
5. Shade the common feasible area.
6. Solve for Z at different boundary points of the common area.

#Unbounded Feasible Area :

Maximization objective cannot be solved.

Minimization objective can be solved by taking the lower boundary points

Test point (0,0) to be avoided when line posses through the origin.

Find intersection points by solving the equations, if needed.

6. Formulation Under Simplex Method

for type ≤

If $x \leq a$, then $x + S = a$

Introduce a new variable, Slack Variables

- One equation can have only one slack variable
- If multiple ≤ inequations are given, use one slack variable for each inequation. ie. S_1, S_2, S_3, etc. for different inequations.
- Slack variable ≥ 0 (Non negative)

- In inequations, the coefficient of Slack variable is 1
- In objective function, the coefficient of Slack variable is 0.

Eg. Formulation

Maximise $Z = 3x_1 + 2x_2 + 5x_3$

Subject to Constraints :-

(1) $x_1 + 2x_2 + x_3 \leq 430$

(2) $3x_1 + 2x_3 \leq 460$

(3) $x_1 + 4x_2 \leq 420$

(4) $x_1, x_2, x_3 \geq 0$

Simplex Reformulation

Maximise $Z = 3x_1 + 2x_2 + 5x_3 + 0S_1 + 0S_2 + 0S_3$

Subject to Constraints :-

(1) $x_1 + 2x_2 + x_3 + S_1 = 430$

(2) $3x_1 + 2x_3 + S_2 = 460$

(3) $x_1 + 4x_2 + S_3 = 420$

(4) $x_1, x_2, x_3, S_1, S_2, S_3 \geq 0$

7. Primal & Dual of LPP

Primal

1. Maximise Z (Profit)
2. Variable = Products Produced
3. Constraints $\leq$
4. NNA

Maximise $Z = 35x_1 + 25x_2$

Subject to:-

$3x_1 + 2x_2 \leq 350$

$4x_1 + 3x_2 \leq 600$

$2x_1 + 2x_2 \leq 550$

$x_1, x_2 \geq 0$

Dual

1. Minimise Z (Opportunity loss)
2. Variable = Constraints
   = Rent charges/unit or Sub Contract Price/unit
3. Constraints $\geq$
4. NNA

Minimise $Z = 350y_1 + 600y_2 + 550y_3$

Subject to:

$3y_1 + 4y_2 + 2y_3 \geq 35$

$2y_1 + 3y_2 + 2y_3 \geq 25$

$y_1, y_2, y_3 \geq 0$

Step 1: Primal is - Maximise Objective

Condition: Ensure all constraints in Primal are of $\leq$ or $=$ type.
If Constraints of $\geq$ type are given, change its sign to $\leq$ type

Primal

Objective: Max Z =

Subject to:

$\leq$
$\leq$
$=$

NNA

$\geq$, unrestricted

Main variables = $x_1, x_2, x_3 = 3$

Constraints = 2 (say)

Dual

Objective: Min G =

Variable

Subject to :-

same sign if unrestricted, use =

NNA

Opposite sign if =, use unrestricted.

Main variable → 2

Constraints = 3

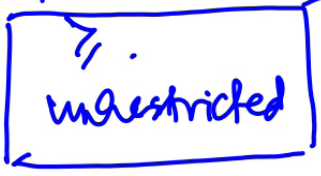
Step II Primal is minimise objective

Condition: Ensure all constraints are of $\geq$ or $=$ type.
If constraints of $\leq$ type are given, change its sign to $\geq$

Primal

- Objective :- Min $Z =$
- Subject to :-

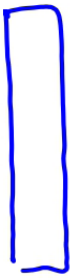
- NNA



Main Variables = 2 (say)
Constraints = 4 (say)

Dual

- Objective :- Max $G =$
- Subject to :-

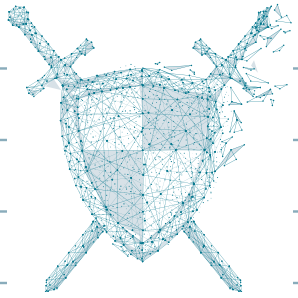


opposite sign of unrestricted, use =

NNA :-

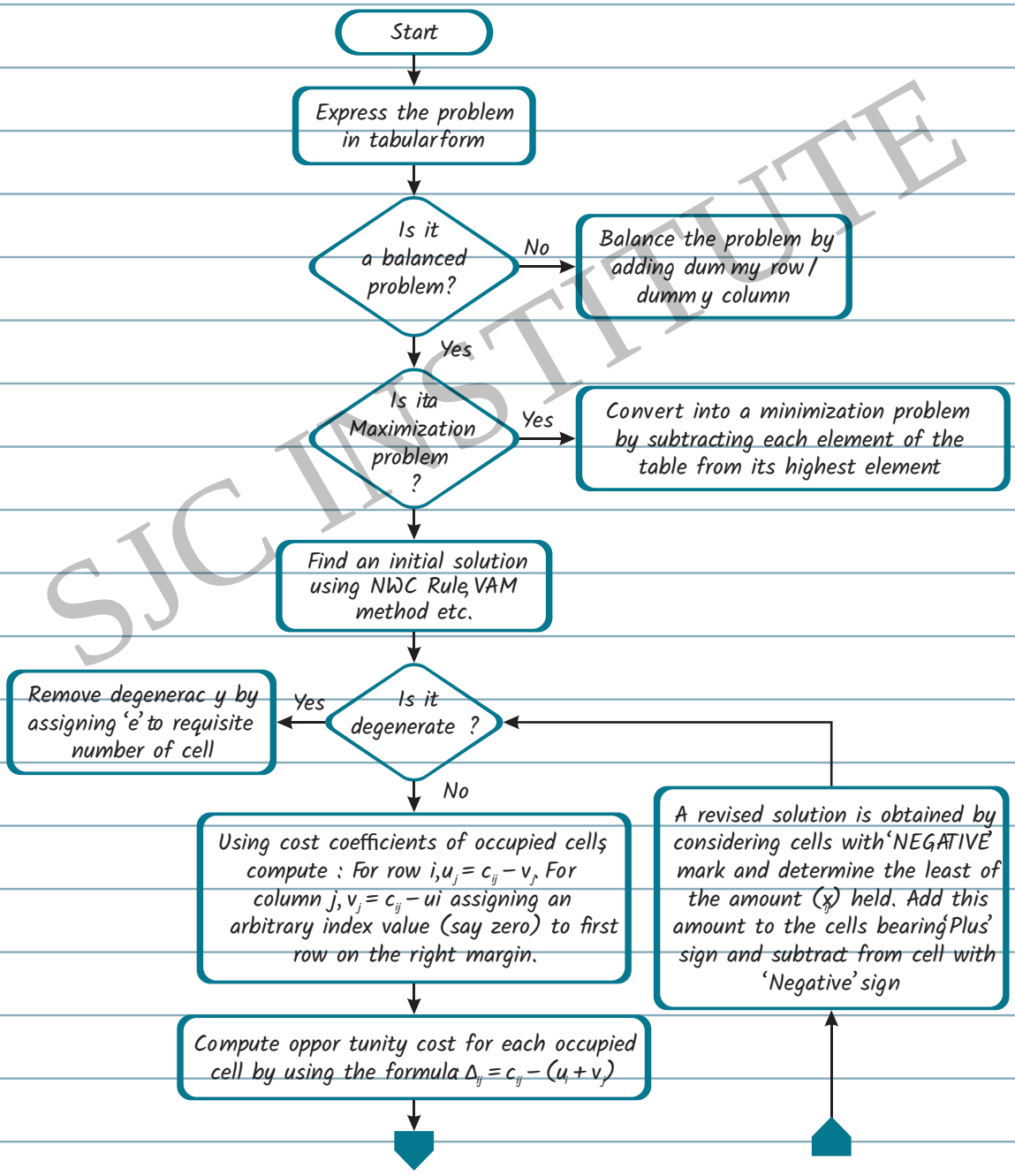
Same sign of =, use unrestricted

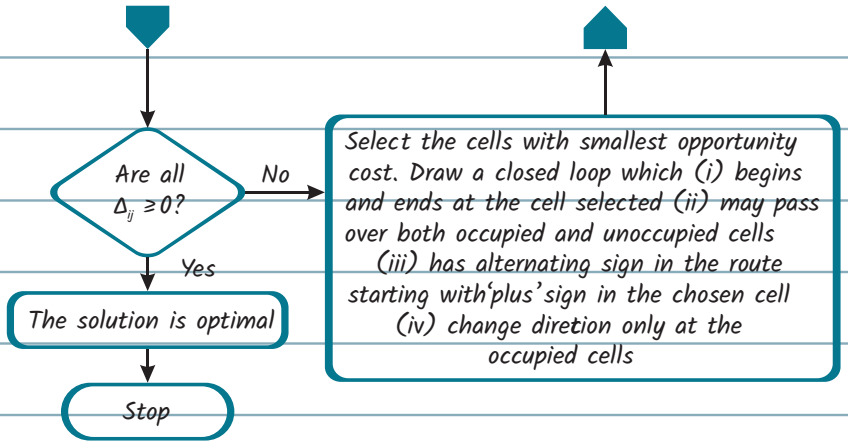
Main Variables = 4
Constraints = 2



Transportation

I. MODI Method - Schematic Diagram





 # Can a transportation problem be solved using Assignment technique?

Ans : Yes if the problem is of type – equal number of rows and columns (ex. 3 × 3) with same requirements and availabilities in each column i.e.

	W1	W2	W3	Availability
F1				100
F2				100
F3				100
Requirements	100	100	100	

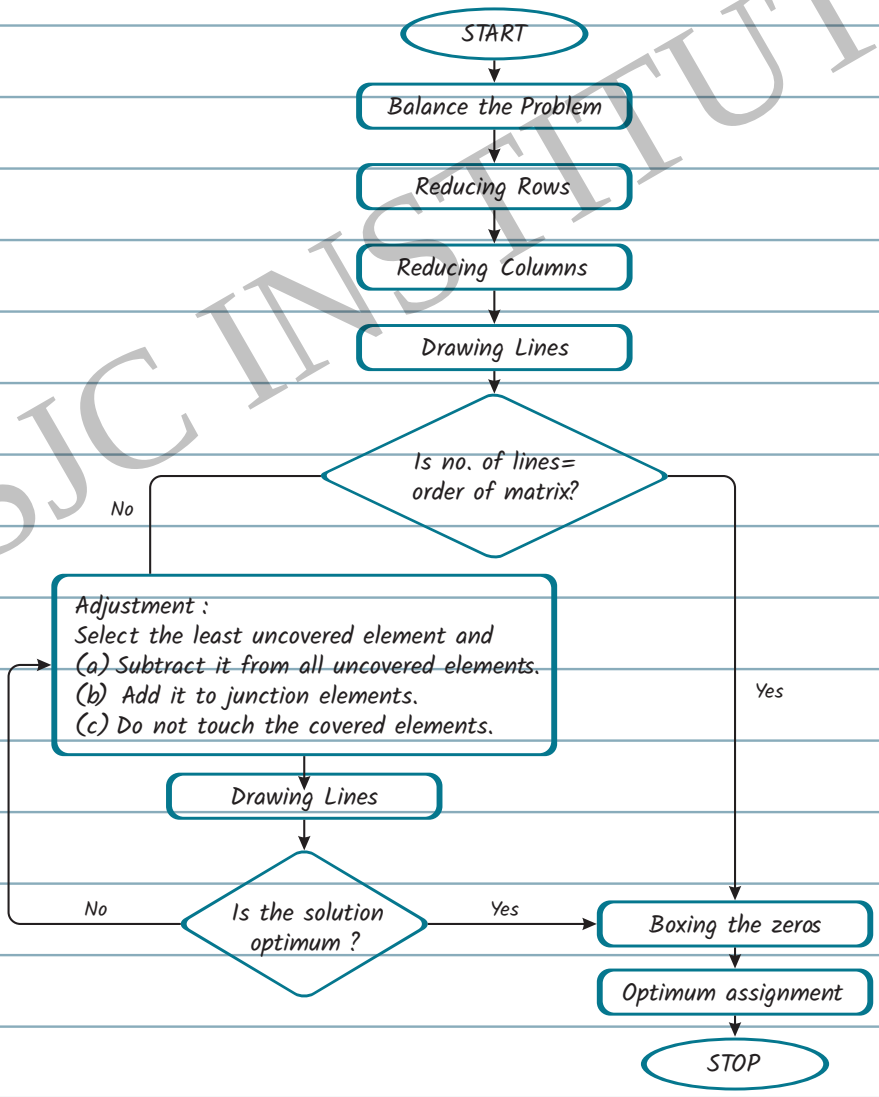
 # Check Comparative Study of LP Methods chapter for more interpretations.

Assignment

A. Objective

Minimisation of Time / Cost

B. Hungarian Rule Steps



C. Unbalanced Problem

Use dummy in original matrix

D. Maximisation Objective

Opportunity Loss Matrix (Highest Value - Given Values). If unbalanced, use dummy in Profit Matrix.

E. Multiple Solution

Arbitrary boxing. No Single 0 in a row or column.

F. Prohibited Assignment

Use M ($M \rightarrow \infty$) in the prohibited cell. There will be no boxing at M.

G. Conditional Assignment

Eliminate the row and the column. Apply steps on the reduced matrix.

H. Rank Matrix

Prepare rank matrix in order of preference

I. Airlines Minimum Idle Time Matrix

(1) Idle time with base as city A

(2) Idle time with base as city B

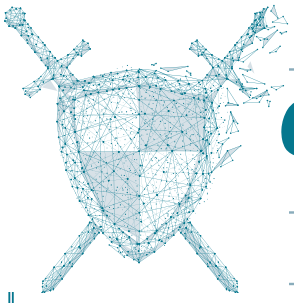
(3) Minimum idle time by comparing city A & B

(4) Apply Hungarian Rule on above matrix

J. Travelling Salesman Cycle

(1) Check cycle is completed or not in the optimum assignment

(2) If not, box any row column at 1, instead of 0 and check. Try to break the loop in the last solution



Game Theory

I. Basic Terms

1. **Player** - Company or FIrms - Participating in the game
2. **2 Person Game** - 2 players
3. **N Person Game** - More than 2 players
4. **Strategy** - Actions taken by the players against one another.
5. **Pay off** - Quantitative outcome for each strategy in the game. Eg. Income, Market share, etc
6. **Optimal Strategy** - The most preferred position or strategy for a player
7. **Pay off Matric** - profit
   a. Row - Maximising player
   b. Column - Minimising player

   Note: If in a question, the details of maximising player is given column wise, then transpose the matrix

   c. Since both of them know each others reaction, they will play conservative (assuming - less fayda and more nuksaan for itself)
   d. **Maximising player's principle** - Maximin or Maximum of Minimum income
   e. **Minimising player's principle** - Minimax or Minimum of Maximum losses
   f. If the Payoff of Maximin and Minimax are the same, it is a pure strategy and Value of Game is considered 0.

8. **Types of Strategies:**

   a. **Pure Strategy** - One player exactly knows about the other player. It is a deterministic situation.

   Objective is to maximise the gains.

   If maximin - minimax, it is a pure strategy game.

   In this case, it is also said that, saddle point exists.

   b. **Mixed Strategy** - One player is guessing the other players strategy. It is a probabilistic situation.

   Objective is to maximise the expected gain.

   If there is ano saddle point, it is a mixed strategy.

   Mixed strategy is a combination of several pure strategy with some fixed probabilities.

9. **Zero Sum Game:**

   Value of Game is zero

   Win of one = Loss of other

10. **Non Zero Sum Game:**

    Win of A > Loss of B

    Win of A < Loss of B

2. Limitations of Game Theory

1. Players have knowledge of own and opponent's payoff is unrealistic.
2. Complexity increases if number of players increases,
3. Pure Strategy Games

	B1	B2	Min
A1	9	2	2
A2	8	6	6
A3	6	4	4
Max	9	6	

Maximin = 6

Minimax = 6

Optimal strategy:

Firm	Pref Strategy	Payoff
A	A2	6
B	B2	-6
	Value of Game	0

As the Value of Game is 0, saddle point exists and it is a pure strategy game.

4. Rule of Dominance

It helps to reduce the size of payoff matrix.

Preferred reduced order of matrix is 2 x 2

Normal Method

Rule 1: Row elimination - (Think from maximimsing plyer - it will reject the lower profits)

If Ri is less than or equal to Rj, Ri can be eliminated, as Rj is dominating Ri

Rule 2 : Column Elimination - (Think from minimising player - it will reject the higher losses)

If Ci is more than or equal to Cj, Ci can be eliminated.

We continue these two rules in any order such that the given payoff matrix is reduced to 2x2

Average Method

Rule 1: Row elimination - (Think from maximimsing plyer - it will reject the lower profits)

If Ri is less than or equal to Average of two or more rows, Ri can be eliminated,

Rule 2 - Column Elimination - (Think from minimising player - it will reject the higher losses)

If Ci is more than or equal to Average of two or more columns.

5. Mixed Strategy Game

Value of Game is not zero

How to identify it is a mixed strategy?

Step 1: - Play it like a pure strategy

- If Value of Game is not equal to zero then it is a mixed strategy

Step 2: - Dominance Method - to reduce the size of matrix to 2x2

Step 3: - Odds Method - is used to solve 2x2 type

Under Mixed Strategy, a player opts for more than one strategy in a certain probability for its optimum strategy.

	B1	B2	Odds	Probability
A1	a1	a2	b1-b2	A1
A2	b1	b2	a1-a2	A2
Odds	a2-b2	a1-b1	(b1-b2) + (a1-a2)	
Probability	B1	B2		

P(A1) = (b1-b2) / (b1-b2) + (a1-a2)

P(A2) = (a1-a2) / (b1-b2) + (a1-a2) = 1- P(A1)

P(B1) = (a2 - b2) / (a2 - b2) + (a1 - b1)

P (B2) = (a1 - b1) / (a2 - b2) + (a1 - b1) = 1 - P(B1)

Value of Game for Player A = a1 x P(A1) + b1 x P(A2) or a2 x P(A1)

= b2 x P(A2)

Value of Game for Player B = a1 x P(B1) + a2 x P(B2) or b1 x P(B1)

= b2 x P(B2)

Mixed Strategy - (2xn) Type

This is solvable using Graphical method

Step 1: Play it like a Pure strategy Game. If there is no saddle point, then it is a mixed strategy.

Step 2: If matrix is (2x n), solve using Graphical method

Graphical method is used to reduce the matrix to size 2x2 - after that odds method should be applied.

Steps of Graphical Method:

Step 1:	Row 1 - X1 = 1
	Row 2 - X1 = 0
Step 2:	Plot all values of Row 1 and Row 2 and Join the points in pair of columns
Step 3:	Identify the lower envelope and select its highest point - by observation
Step 4	Identify the pair intersecting at the highest point. This will reduce the matrix to 2 x 2

Now continue by the Odds Method.

Mixed Strategy - (mx2) Type

This is solvable using Graphical method

Step 1: Play it like a Pure strategy Game. If there is no saddle point, then it is a mixed strategy.

Step 2: If matrix is (2x n), solve using Graphical method

Graphical method is used to reduce the matrix to size 2x2 - after that odds method should be applied.

Steps of Graphical Method:

Step 1: Column 1 - X1 = 1

Column 2 - X1 = 0

(same vertical axis)

Step 2: Plot all values of Col 1 and Col 2 and Join the points in pair of rows

Step 3: Identify the upper envelope and select its lowest point - by observation

Step 4: Identify the pair intersecting at the highest point. This will reduce the matrix to 2 x 2

Now continue by the Odds Method.

Simulation

1. Definition of Simulation

Simulation is a quantitative procedure which describes a process by developing a model of that process and then conducting a series of organised trial and error experiments to predict the behaviour of the process over time.

2. Monte Carlo Simulation

It is the earliest method and uses random numbers to solve problems that depend on probability. In situations where physical experimentation is not practicable and creation of mathematical model is impossible, the Monte Carlo method is employed.

The following steps are followed:

Step 1: Find cumulative frequencies or probabilities of the required variable and find the random number intervals.

Step 2: Using random numbers select the specified number of variables.

Step 3: Taking these variables as the basis of calculation, determine the required data.

If multiple probability distribution are given, create RN interval for each.

3. Variety of Applications

1. **Bakery :** Demand of Cakes. Sales = Lower of supply and demand.
2. **Truck carrying mopeds :** empty space in lorry and mopeds waiting
3. **Doctor's Clinic :**

   (a) Average waiting time of patients

   (b) Pb of waiting beyond 3 mins = $\frac{\text{No. of such cases}}{\text{Total Cases}}$

   (c) Average waiting time/ patient if there is an instance of waiting

   $= \frac{\text{Total wait time}}{\text{No. of instances of waiting}}$

   (d) Proportion of time doctor is Idle = $\frac{\text{Total idle time}}{\text{Total Operating time of clinic}}$

4. **Bank's Teller Counter / Retail Store billing Counter :** Idle time of teller / biller and waiting time of customers
5. **Assembly line with two workstations :** Second worker waits for first to complete the work.
6. **Airline delay time :** Flights delayed
7. **Rainfall based on previous day's weather**
8. **Book Store :** Ordering books based on current stock and previous order

   Total Cost = Ordering Cost + Carrying Cost
9. **Demand and Supply :**

   (a) Loss on unsatisfied demand.

   (b) Dd met $\Rightarrow$ ss > dd. Extra Supply = Stock

   (c) Dd not met $\Rightarrow$ ss < dd

4. Advantages of simulation

(a) Experiment and study complex interactions of a system

(b) Better insights and indication for improvement

(c) Training

(d) New situations can be pre tested

5. Types of Simulation

A. Behaviral simulation

B. Functional simulation

C. Static filing analysis

D. Gate level simulation

E. Switch level simulation

F. Transistor level or circuit level simulation

G. Monte Carlo simulation

Network Analysis - PERT & CPM

1. Meaning of Project Management

A. Project means a work with the following characteristics

(1) Customized

(2) Uniqueness

(3) Requires time and resource

(4) Divided into several activities

The project management is the use of tools and techniques of management to satisfy the need and expectations of stakeholders.

B. The objective of project management is two fold

(1) Deliver the project within time

(2) Satisfy the stakeholder from the quality

2. Network Diagram/Arrow Diagram

It is a diagrammatic presentation of work to be done in a project.

It is to be understood in the following aspects :-

A. Activities :

(1) Activity is represented by an arrow in left to right direction / virtical direction.

(2) An activity must consume some time and resources.

(3) The name of an activity is written above or below its arrow.

(4) The duration of an activity is written in brackets besides its name.

(5) The length of arrow of the activity has no relation to its duration.

(6) Activities can be parallel or sequential.

(7) Every activity must start from and end to an event.

(8) All the preceding activities must be completed before the succeeding activities is to be started.

B. Events/ Nodes :

These are the indicators of start and end of an activity. It is shown by a circle in network diagram.

Event can be of following types:

(1) **Start Event or Tail Event and End Event or Head Event :** W.r.t an activity

(2) **First Event and Last Event :** W.r.t a project

Start of project = First event

End of project = Last event

There can be only one first and last event.

(3) **Merge Event or Convergent Event and Burst Event or Divergent Event:** W.r.t multiple activities

C. Error in Network Diagram :

(1) **General Rule 1 :** All event should be numbered in such a manner that a higher numbered event would be towards the right side of lower numbered events or in the same vertical direction (upward or downward) of lower numbered event.

If this rule is not follow, then there would be an error – "**Looping**"

Rectification of Looping - By correcting the event numbers or resizing the arrows

(2) **General Rule 2 :** Every event must have at least one activity entering into it and at least one activity leaving from it, except the first and last event.

If this rule is not followed, then the error is called as "**DANGLING**" Error.

Rectification of Dangling –

Option 1 – By joining the dangling activity to the last event

Option 2 - By using a dummy activity, from the dangling event and joining to the last event.

#**Dummy activity** is used to rectify errors or to link two or more activities in order to make a network logical. It is shown by dotted arrows. Dummy does not consume any time or resource.

(3) **General Rule 3 :** No two activities can have same head event and tail event.

If this rule is not followed, the error is called as "**Duplicating**" Error.

Rectification of Duplicating –

By using a dummy activity and a dummy event

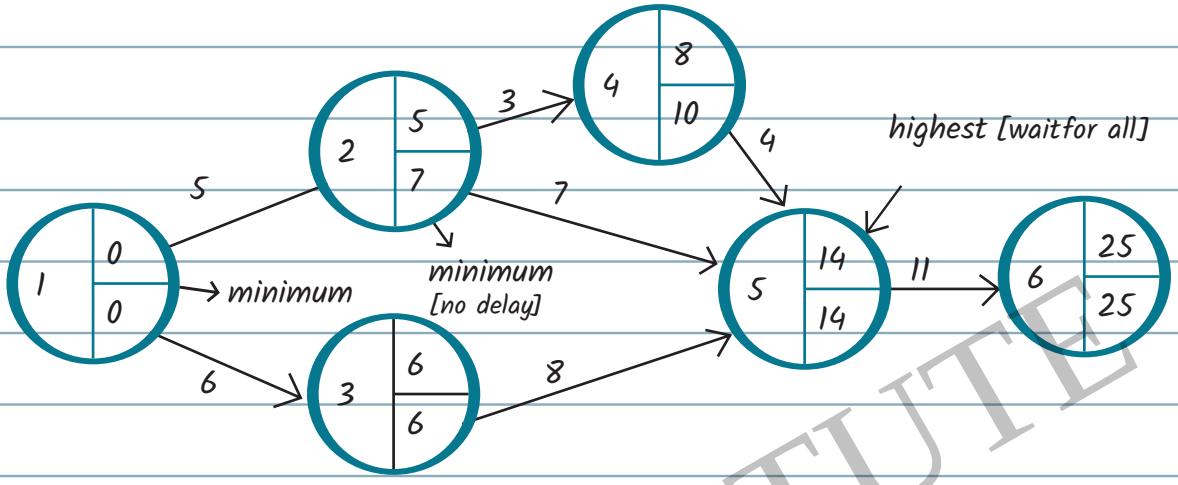
3. Critical Path and Float Analysis

Example :

Activities	Duration Days
1 – 2	5
1 – 3	6
2 – 4	3
2 – 5	7
3 – 5	8

4 – 5	4
5 – 6	11

A. Network Diagram :



B. List all the Paths and Their Duration

Paths means the link of several activities that would join its event to the last event.

Paths	Duration
1 – 2 – 4 – 5 – 6	23 [5 + 3 + 4 + 11]
1 – 2 – 5 – 6	23 [5 + 7 + 11]
1 – 3 – 5 – 6	25 [6 + 8 + 11]

C. Critical Path

- Critical path is the path with longest duration.
- It is shown in network by bold or shaded arrows.
- The activities on the critical path are called as critical activities.

The critical path is 1 – 3 – 5 – 6 as its duration is longest at 25 days.

D. Minimum Project Duration

The minimum project duration is the duration of critical path = 25 days.

E. Earliest start time or Forward pass for each activity.

- Earliest start time is donated by "E"
- For Ist event E = 0 and for next event duration of activity leading to it is added. If there are multiple activities leading to the event, take the highest duration.
- To check the E of an activity – check E of its Tail Event.
- Earlier Finish Time = Earlier start time + Duration.

F. Latest Finish Time or Backward Pass

- Latest Finish Time is denoted by "L"
- For last event L = E, and for preceding events duration of activity emanating from it is subtracted.
- If there are multiple activity, emanating then take the least duration i.e. min. value
- To check the L of an activity – Check L of its Head Event
- Latest Start Time = Latest Finish Time – Duration.

G. Float of the Path

It is applicable only for the non-critical paths. It is the combined float of all the activities on the path.

Float of a path = Duration of critical path – Duration of non- critical path.

Path	Float or Slack
1 – 2 – 4 – 5 – 6	= 25 – 23 = 2 days
1 – 2 – 5 – 6	= 25 – 23 = 2 days

H. Slack of an event

= L – E of the event

I. Total Float of an Activity

- It is the time period by which if an activity is delayed, it will not affect the completion of the project as scheduled.
- It is applicable only for non-critical activities.
- For critical activity it must be zero.

Total float = [LFT of Head Event – EST of Tail Event] – Duration

OR

= Latest Start Time – Earliest Start Time = Δ Start time

OR

= Latest Finish Time – Earliest Finish Time = Δ Finish Time

Time Schedule

Activity (TE) (HE)	Duration (D)	Earliest Start Time (E)	Earliest Finish Time (E + D)	Latest Finish Time (L)	Latest Start Time (L – D)	Total Float [LFT – EST] or [LST – EST]	SHE	FF	STE	IF
1 – 2	5	0	5	7	2	2	2	0	0	0
1 – 3	6	0	6	6	0	0	0	0	0	0
2 – 4	3	5	8	10	7	2	2	0	2	0
2 – 5	7	5	12	14	7	2	0	2	2	0
3 – 5	8	6	14	14	6	0	0	0	0	0

Activity (TE) (HE)	Duration (D)	Earliest Start Time (E)	Earliest Finish Time (E + D)	Latest Finish Time (L)	Latest Start Time (L – D)	Total Float [LFT – EST] or [LST – EST]	SHE	FF	STE	IF
4 – 5	4	8	12	14	10	2	0	2	2	0
5 – 6	11	14	25	25	14	0	0	0	0	0

J. Free Float

It is the time period by which if an activity is delayed, it will not delay the start of its succeeding activity.

Free Float = (EST of Head Event – EST of Tail Event) – Duration

= Total Float – Slack of Head Event

K. Interfering Float

It is the maximum interference that an activity can cause to its succeeding activity.

Interfering Float = Total Float – Free Float = Slack of Head Event

L. Independent Float

It is the time period by which if an activity is delayed, it will neither delay the start of its succeeding activity nor it will interfere with the completion of its preceding activity.

Independent Float = (EST of Head Event – LFT of Tail Event) – Duration

= Free Float – Slack of Tail Event

 # If independent float is negative, then take it as zero.

Observations

(1) For critical activities, Total Float = Free Float = Interfering Float = Independent Float = 0 (use this as Chor Buddhi)

(2) Total Float ≥ Free Float ≥ Independent Floa

(3) For events on the critical path, E=L. (use this as chor buddhi to identify the critical path)

4. Crashing the project

A. Meaning

Crashing means completing a project earlier than scheduled. This is done by increasing the man-power or other resources.

B. Benefits of Crashing

(1) Savings in overhead cost allocated to the project

(2) Reward for early completion

C. Cost of Crashing

Additional cost of overtime, extra machine, hiring, etc.

D. Crash Cost Slope

It means additional cost to reduce one day of the project

$$= \frac{\text{Crash Cost} - \text{Normal Cost}}{\text{Normal Time} - \text{Crash Time}} = \frac{\text{Change in Cost}}{\text{Change in time}}$$

E. Total Cost of the Project

- Direct Costs = normal costs of the project
- Indirect Costs = overhead costs allocated to the project
- Additional Crash Cost = additional cost to reduce the project duration

Due to crashing, the additional crash cost incurred saves the indirect costs allocated to the project.

F. Two Objectives

(1) Optimum completion time –

- The duration where the total project cost would be minimum.
- Crash cost slope should be less than or equal to overhead cost saved due to crashing.

(2) Minimum Completion Time –

- The duration where the project duration is minimum, but the cost may be higher than the optimum duration.
- Crash cost slope may exceed the indirect cost saved.

G. Focus of Crashing

Ultimately, the objective of crashing is to reduce the **project duration**

↓

Project duration is determined from **critical path duration**

↓

And critical path duration is determined from **critical activity duration**. Therefore, the focus of crashing should be to reduce the critical activity duration.

H. Process of Crashing

Four basic ingredients

(1) Network Diagram – with both normal duration and crash duration noted for each activity

(2) All the **Paths** and their **normal duration**

(3) **Crash cost slope** of each activity

(4) **Critical Path**, Critical activities and their cost slopes.

Steps of Crashing

(1) **Single Critical Path** –

Crash or reduce the duration of a critical activity by 1 day (or week) in order of least cost slope, keeping in mind the indirect cost saved.

Crash the critical activities one by one and follow four cross checks –

B = **Bracket** the outflow

N = Reduce the normal duration of the critical activities in the **Network Diagram**

D = Reduce the normal **duration of the paths**

K = Use **khatiya** for dead (fully crashed) activities in the list of paths.

Continue crashing in this step, unless there are multiple critical paths

(2) **Multiple Critical Paths** –

- Select a combination of critical activities from all the critical paths, in such a way that if a set is crashed by a day, all the critical paths get reduced by a day.
- While preparing sets, keep following checks –

  (a) Do not include a dead activity

  (b) There can be a common critical activity

  (c) Double check that there is no dual effect of the set on any critical path

- Find the crash cost slope of each set.

- Select a set in order of least cost slope and crash or reduce the duration of a set by 1 day (or week) keeping in mind the indirect cost saved.

A set can have multiple activities, but it reduces the project duration by 1 day only.

Follow four cross checks as above – B, N, D, K

Continue crashing until –

(i) **For Optimum Duration Objective** – Crash cost slope ≥ Indirect cost saved

(ii) **For Minimum Duration Objective** – Any one of the critical path has been fully crashed.

(3) Conclusion

- Latest Project Duration will be the latest longest duration
- Latest Total Cost will be the sum total of Direct Cost, Indirect Cost and Additional Crash Cost.

In some questions, where **sales revenue or bonus or penalty** is given, the optimum duration is computed by ignoring the indirect cost saved. We compute the minimum duration of the project and then prepare profitability statement at each different date of completion to determine the duration where the project profit is maximum.

5. Updating the Network Diagram

A. Need of Updating

After starting the project, there may be a requirement of updating the network due to increase /decrease in duration of activities in a project.

These changes may occur due to revised specifications by project customers or

due to operational hurdles not anticipated before.

The project duration gets revised due to updation of the critical path.

In exam, we need to present –

- Updated network diagram
- Revised critical path
- Revised project duration

B. Process of Updating

Step 1: Draw the original network diagram. Find E and L of each event and shade the critical path.

Step 2: Analysis of status of activities as on the date of updation into three categories – (a) Completed (b) In progress (c) Not yet started

Step 3: The revised duration of activities in progress will be –

Days already worked + Days to be worked

Days already worked is calculated using the EST as per original schedule.

Days to be worked is given in the question.

Step 4: The revised duration of activities not yet started will be –

Revised duration, as given or same as original, if no information

Step 5: Draw the updated network diagram

Step 6: Find the revised critical path and project duration.

6. Project Evaluation and Review Technique (PERT)

PERT is more relevant for projects where there is a good measure of uncertainty in the estimation of activity duration. Here, we obtain three estimates of activity duration:

(a) **The Optimistic Time Estimate:** This is the shortest possible time in which an activity can be completed. It is estimated under the best case situation and is denoted by to

(b) **The Pessimistic Time Estimate:** This is the longest possible time in which an activity can be completed. It is estimated under the worst case situation and is denoted by tp

(c) **The Most Likely Time Estimate:** This is the normal time in which an activity can be completed. It is estimated under the most probable situation and is denoted by tm

From the above three estimates an average or expected time of activity is calculated for any subsequent analysis.

A. **Expected Time of activity**

This is the duration of the activity found by calculating the weighted average of the three time estimates and is given by:

Duration of activity = $T_E = \frac{t_0 + 4t_m + t_p}{6}$

B. **Expected Project Time**

This is the longest duration or the critical path duration and is found by adding the expected times of the critical activities.

C. Variances and Standard Deviations

(1) Standard Deviation of an activity:

$$S.D. = \frac{(t_p - t_o)}{6}$$

(2) Variance of an activity = $(S.D.)^2$

(3) Variance of the critical path: This is obtained by adding variances of all the activities on the critical path.

(4) Standard Deviation of the Critical Path: This is obtained by the formula given below and not by adding the SD's of the critical path activities.

$$S.D. = \sqrt{\text{variance of critical path}}$$

D. To find the Probabilities of completion of Project in the given time

(1) The time of completion of project for which the probability is required is expressed as P(x)

(2) To find the probability for a given value of x, first find z using the following formula:

$$z = \frac{x - T_{cp}}{S_{cp}}$$

T_{cp} = Expected Project Duration i.e. Duration of the critical path

S_{cp} = Standard Deviation of the Project or Critical path.

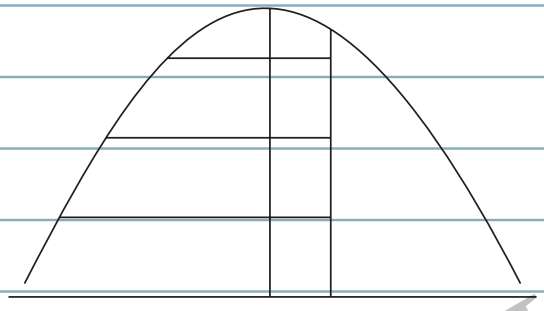
(3) The required probability of x would be the area under the curve for respective value of z.

P(X) = A(Z).

E. To find the time of the project completion when the probability is given

(1) Find the value of z against the probability or area from the tables. The area corresponding to P(X) is always the area to the left of the value Z.

A (z) : This area is the probability of Completing the project in given time X.



(2) Calculate the respective x using the following:

$$Z = \frac{X - T_{cp}}{S_{cp}}$$

F. Characteristics of Standard Normal Curve

(1) It is a symmetrical bell shaped curve.

(2) The total area under the curve is 1.

(3) Because of symmetry, the area to the left and the right of central axis are both equal and is 0.5

(4) The maximum value of Z for which area will be 0.5 on either side of axis can be 3.49

(5) The area A(z) would mean area between z = 0 and the given value of z.

(6) Because of symmetry, A(-z) = A(z)

7. Time Scaled Network

In the network diagrams which we have considered, it has been stressed that the length of the individual arrows has no relation to the duration of the activity which arrow represented. It is of course possible to draw the arrows to a time scale, and this can be a very useful method of presentation of networks.

Steps :

1. Draw Network Diagram normally.
2. Identify the Critical Path with E and L
3. Draw a graph, with duration on x axis and the first event on the project on y axis.
4. Draw Critical Path as a straight line parallel to x axis.
5. Draw Non Critical Paths above or below the Critical Path.
6. Do not draw any event twice. To join the non-critical activity to a critical event, use dotted lines (float).

Critical path is arranged as a straight line with non critical activities above or below it. The dotted horizontal lines represent floats in the activity and the dotted vertical lines represent dummy activities.

A. RESOURCE SMOOTHING

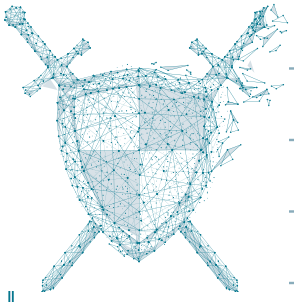
It is a network technique used for smoothening peak resource requirement during different periods of the project network. Under this technique the total project duration is maintained at the minimum level. For example, if the duration of a project is 15 days, then the project duration is maintained, but the resources required for completing different activities of a project are smoothened by utilising floats available on non critical activities. These non

critical activities having floats are rescheduled or shifted so that a uniform demand on resource is achieved. In other words, the constraint in the case of resource smoothing operation would be on the project duration time. Resource smoothing is a useful technique for business managers to estimate the total resource requirements for various project activities.

In resource smoothing, the time scaled diagram of various activities and their floats (if any), along with resource requirements are used. The periods of maximum demand for resources are identified and non critical activities during these periods are staggered by rescheduling them according to their floats for balancing the resource requirements i.e. the activities having floats are shifted in such a way that the demand for resources is smoothened out.

B. RESOURCE LEVELLING

It is also a network technique which is used for reducing the requirement of a particular resource due to its paucity. The process of resource levelling utilizes the large floats available on non critical activities of the project and thus cuts down the demand on the resource. In resource levelling, the maximum demand of a resource should not exceed the available limit at any point of time. In order to achieve this, non critical activities are rescheduled by utilising their floats. Sometimes, the use of resource levelling may lead to increase in the completion time of the project.



Learning Curve Theory

1. Applicability and Non Applicability

Applicability	Non - applicability
Human efforts	Automated efforts
New product / process	Existing product / process
Repetitive	Non repetitive
Regular workers	Non regular / Casual workers
Skilled / unskilled workers	Experienced workers / Experts
On Variable cost or Direct Costs	On Fixed Cost or Indirect Costs
On fixed costs - if absorption costing is followed	On fixed costs - if marginal costing is followed

2. Learning Rate

$$= \frac{\text{Average time or cost per unit of first } 2n \text{ units}}{\text{Average time or cost per unit of first } n \text{ units}}$$

[where n is the lot size]

 # 1. Learning Rate + Improvement Rate = 1

 # 2. Higher learning rate implies lower improvement rate.

 # 3. Learning rate of highly experienced people or machines is 100%

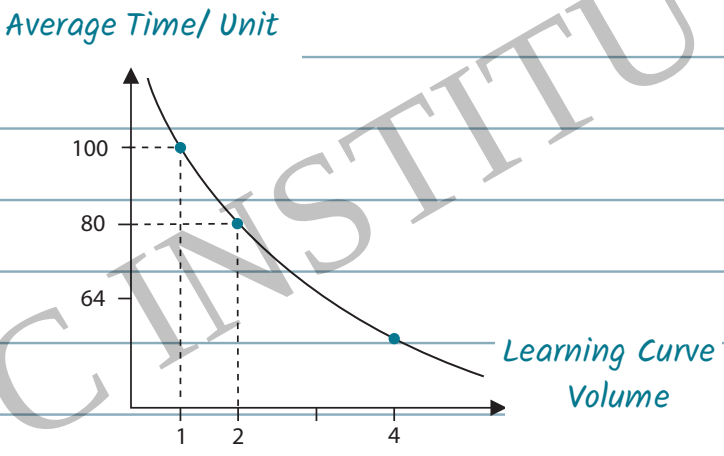
3. Learning Curve Theory

The average time or cost per unit decreases at a constant learning rate when production is doubled.

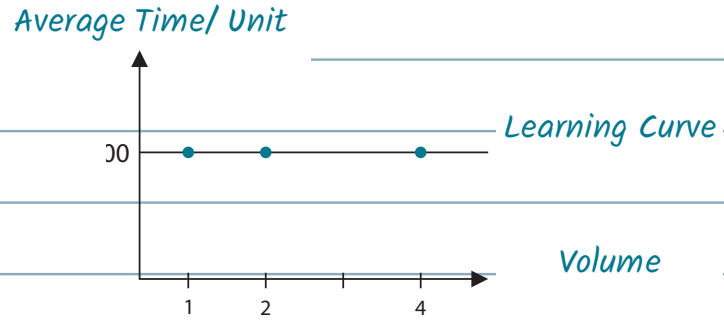
 # Learning rate may not be infinite. It may stop after certain volume and for the volume after that, the time or cost per unit of the latest unit or batch may only continue to remain applicable.

4. Graphical Presentation

Learning Curve



Learning Curve of machines/ very experienced people



5. Uses of Learning Curve Theory

(a) Pricing Decisions over life time or for one time order or for a repeat order.

(b) Setting standards to measure performance

(c) Product profitability analysis

(d) Suggest Cost Reduction Opportunities

(e) Suggest Correct Staffing

(f) Evaluation of Effectiveness of Training

(g) Working Capital Required Estimation

(h) Further Inventory Turnovers

(i) Useful for Make/ Buy Decision

6. Limitations of Learning Curve Theory

(a) It assumes **stable conditions** in manufacturing environment - like continuous availability of raw materials, no downtime of machines.

(b) The **break** between repeat production **must not be too long**.

(c) The workers **may not be always motivated** to improve.

(d) Learning eventually ceases due to limitations in machine efficiency, workers efficiency or raw material yield capacity.

(e) Basis of determination of learning rate **may not be reliable.**

(f) 80% Learning rate may not be universally applied.

(g) Changes other than Learning may effect the Learning Curve.
E.g., Improvement its facilities, arrangements, employee morale etc.

7. Factors affecting Learning Curve

(i) Pricing for Bids : Tendency is to set up a high initial labour cost so as to show a high Learning Curve. This shows that Learning Curve is useless.

(ii) Method of Production

(iii) Labour Turnover Rate

(iv) Changes in a product or in the methods

(v) Strikes, Lock out, Shut downs

8. Prediction by Double of Production Volume

Assuming a 90% learning rate

Cumulative output (units or batch)	Cumulative Average time per unit or batch	Total time (hours)	Incremental time (hours)
1	50	50	50
2	45	90	40
4	40.50	162	72
8	36.45	291.6	129.6

 # We use average time per unit to estimate the cost of an order comprising of all the cumulative units or the initial order.

9. Prediction at Any Volume using Learning Curve Equation

Preferred when the required average time or cost per unit cannot be determined by doubling the production volume.

$Y = a \times X^{b}$

Where,

a = Total time of first unit or batch or average time of first unit or batch

X = Volume (units or batches) whose average is required

b = Learning curve index = Log LCR / Log 2

Solve this equation by using **given values** or **log and antilog** or **by dirty power concept** in calculator

The Learning Curve Equation can be solved as:-

Op1: If LCI is given or known - Use Simple Calculator

Eg $Y = 1000 \times 5^{-0.3219}$

then, $5^{-0.3219}$ can be solved in Calculator as below:-

Step 1 :- $\left(\frac{1}{5}\right)^{0.3219}$

2 :- Square root of $\frac{1}{5}$ - 12 times

3 :- -1

4 :- Multiply by dirty power

5 :- $+1$

6 :- Square 12 times $\Rightarrow x_1 = 12$ times

Op2 If log and antilog values are given - Use log & Antilog

$Y = a \times x^b$

$$\log Y = \log (a \times x^b)$$

$$\log Y = \log a + \log x^b$$

$$\log Y = \log a + b \log x$$

$$\log Y = Z \text{ (say)}$$

$$Y = \text{Antilog } (Z)$$

$$Y = \text{Answer}$$

9. for Repeat Orders

Eg. 1st order = 4 lots = 400 units

Repeat Order = 2 lots.

∴ Time for Repeat order of 2 lots =

Step 1 Avg time/lot for 6 lots (first order + Repeat Order)

Step 2 Avg time/lot for 4 lots (first Order)

Step 3 Time for 2 lots =

= Total time of 6 lots - Total time of 4 lots

= (Avg time/lot × 6 lots) - (Avg time/lot × 4 lots)

10. Experience Curve

BCG observed in case of semiconductor chips.

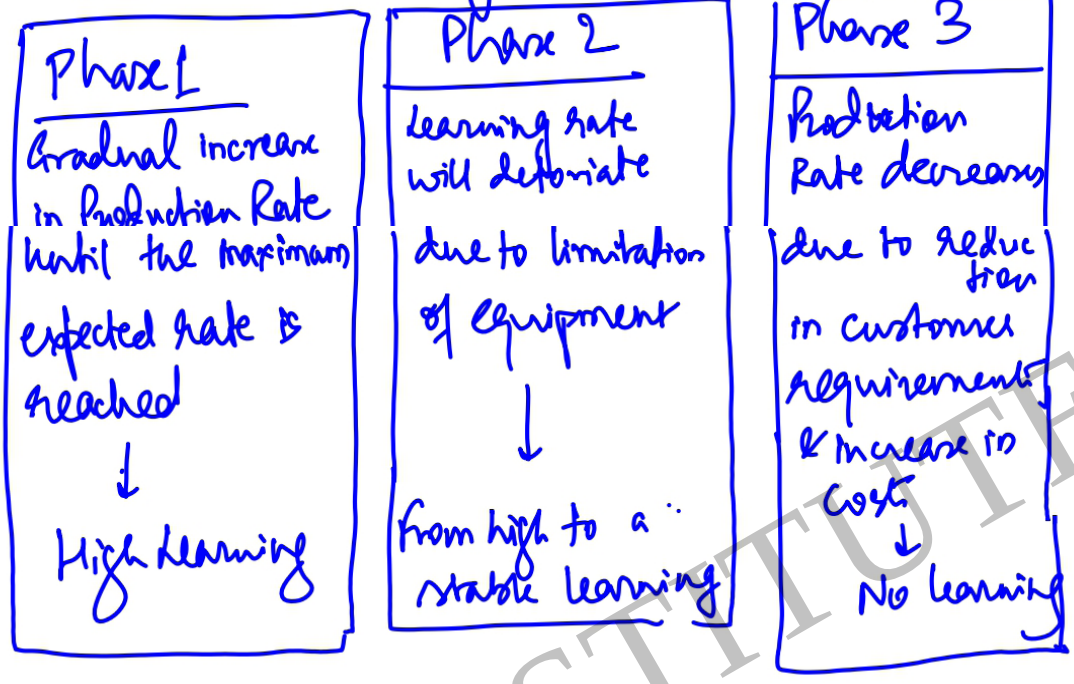
If Prodn goes up, Cost goes down - resulting into competitive advantage.

Two types of Experience Curve :-

(a) Fulfilling demand - low cost, large scale, consistent quality

(b) Creating / Shaping demand → Inventions

11. Phases in Learning Curve



Business Application of Maxima and Minima

A. Single Variable Optimisation

B. Multi Variable Optimisation

A. Single Variable Optimisation

1. **Basics of Differentiation**

   To be copied and pasted from and notes

2. **Steps for Maxima and Minima**

   Step 1: Function or Equation between the variables

   Step 2: First order derivatives of given equation

   Step 3: Solve for x by taking dz/dx = 0

   Step 4: Second order derivative of given equation

   Step 5: If second order derivative is negative - then it is maxima

   If second order derivative is positive - then it is minima

> **Note:** Saddle point = to calculate this - take second order derivative as zero and find the values

3. **Basics of Economics**

   Revenue

   Total Revenue = Price x Qty (P = a-bx)

   Average Revenue = TR / Qty = TR / x

   Marginal Revenue = dTR/dQ

Cost

Total Cost = TVC + TFC = VC/unit x Qty + TFC = mx + c

Average Cost = TC/x

Marginal Cost = d (TC) / dx

Profit

Profit = TR - TC

Average Profit = AR - AC

Marginal Profit = MR - MC = d(Profit)/dx

4. **Equilibrium of Firms**

Condition: This is for Monopolistic Competitive Firms

They need to think what price to set in order to earn maximum profit. This level is called as Equilibrium.

It's a Profit Maximisation Problem

Two approaches are there:

1. **Profit Equation Based -**

   Profit Equation

   First order derivative

   Take First order derivative = 0, Solve for x

   Check whether second order derivative is negative

2. **Equilibrium Based -**

   MR

   MC

Equate MR and MC to solve for x

Check whether Slope of MR < Slope of MC

5. **Marginal Cost Falls Continuously** - Additional cost for additional one unit. In general, MC falls with an increase in output.

To prove that MC is falling continuously, MC should be positive.

B. Multi Variable Optimisation

1. Basics of Partial Differentiation

To be copied and pasted from hand notes

2. Optimisation with Multiple Variables

Say, profit maximization is required and profit is dependent on joint impact of two independent variables (labour availability and sales demand)

It is done by assuming one variable as constant, when the other variable is changing.

E.g. Labour availability is assumed to be constant when sales demand is changing.

This concept is used in Partial Derivatives.

Steps:

1. Function whose maximisation/minimisation is required.
2. $Zx = dz/dx$, $Zy = dz/dy$
3. Take $Zx = 0$ and $Zy = 0$ and use this to solve for values of x and y
4. Second order partial derivatives -

   $Zxx = A$, $Zxy = B$, $Zyy = C$

   Find the value of these using the values of x and y obtained in Step 3

5. We create a matrix using the values of A,B and C. This matrix is called as Hessian Matrix.

   AB

   BC

   Find its determinant - $D = AC - B^2$

6. If D>0, and A,C>0 - there is a local minima at (x,y)

   If D>0 and A,C<0 - there is a local maxima at (x,y)

   If D<0 - then there is a saddle point at (x,y)

   If D=0 - the test has failed

3. Equilibrium of Multi Plant Producing the Same Product at Different Cost

Plant 1 (P1) = TC1 at x1

Plant 2 (P2) = TC 2 at x2

Market = TR

Steps:

1. MR = d(TR)/dx
2. MC1 = d(TC1)/dx
3. MC2 = d(TC2)/dx
4. Using, MR = MC1, MR = MC2, MC1 = MC2, solve for x1 and x2
5. For Maxima, Partial derivative of MR < Partial derivative of MC1 wrt x1

   Partial derivative of MR < Partial derivative of MC2 wrt x2
6. Find Maximum Profit

4. Equilibrium of Multi Market Selling the same product at different prices

Market 1 = TR1

Market 2 = TR2

Total Cost

Steps:

1. MR1 = d(TR1)/dx1
2. MR2 = d(TR2)/dx2
3. MC = d(TC)/dx
4. Using MR1 = MR2, MR1 = MC, MR2 = MC, solve for x1 and x2
5. For Maxima, Partial derivative of MR1 < Partial derivative of MC wrt x1

   Partial derivative of MR2 < Partial derivative of MC wrt x2
6. Find Maximum Revenue

5. Single Constraint Optimisation – Lagrange Multiplier

E.g. Profit maximisation with a constraint of minimum production

Steps

1. **Given Functions:**

   Main Function = f(x,y)

   Constraint Function – C(x,y)
2. **Convert Constraint function to the form –**

   ax + by + c = 0
3. **Revised Objective function**

   L = f(x,y) – constraint function LHS x Lagrange multiplier (LM)

4. **First order partial derivative**

Lx = dL/dx

Ly = dL/dy

Llm = dlm/dlm

5. **Take Lx, Ly and Llm = 0 and solve for x, y and lm**

6. **Second order partial derivative**

Lxx, Lxy, Lyx, Lyy, Cx = dc/dx, Cy = dc/dy

7. **Hessian Bordered Matrix – Find determinant**

0	Cx	Cy
Cx	Lxx	Lxy
Cy	Lyx	Lyy

Determinant = 0 (Lxx x Lyy – Lyx x Lxy) – Cx (Cx x Lyy – Cy x Lxy) + Cy (Cx x Lyx – Cy x Lxx)

Put the critical value and check the answer of D.

For maxima, D should be > 0

For minima, D should be < 0

4. **Cobb Douglas Production Function**

Total Production Cost

= Cost of Labour + Cost of Capital

= (Wage rate of labour x labour hours) + Capital Cost Rate – rental per hour x Capital hours)

C = wL + rK

As per Marginal Rate of Technical Substitution

Objective Minimisation of TC

$Q = K^{1/2} \times L^{3/2}$

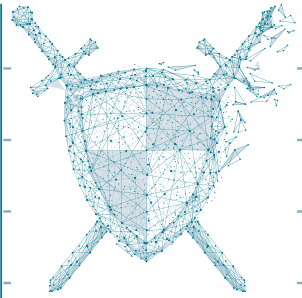
$dq/dk = MRk$

$dq/dl = MRL$

To optimise, the equation will be -

$MRL / MRK = w/r$

Solve for K, L (by putting values of $Q = K^{1/2} \times L^{3/2}$)



Business Forecasting Models

1. Methods of Forecasting

Qualitative	Quantitative
Input - Output Method	Regression
Historical Analogy Method	Time Series
Jury or Panel Discussion or Executive Opinion Method	
Survey Method	
Barometric Method	
Delphi or Questionnaire Method	
Focused Analysis Method	
Grass Root Method	

2. Regression Analysis

Regression - Relationship between 2 variables, create a function or equation between the variables

1. Simple Linear Regression - 1 is to 1
2. Multiple Linear Regression - 1 is to many

1. Simple Linear Regression (SLR)

Type 1 - Y on X type -> $Y = a + bX$

Type 2 - X on Y type -> $X = a + bY$

Type 1: Y on X Type

Use X to get Y

$Y = a+bX$

To find this equation, we have to find the values of a and b, using the values of X and Y, given in the question.

For this, we solve two normal equations:

1. $\Sigma Y = na + b\Sigma X$
2. $\Sigma XY = a\Sigma X + b\Sigma X^2$

We solve the above equations to get the values of a & b

We write the Regression Equation as - $Y = a + bX$

With obtained values a & b

We use this Regression Equation - to find the value of Y and at given Values of X

Type 2 - X on Y

Type $X = a + bY$

To obtain a &b , use normal equations -

(i) $\Sigma X = na + b\Sigma Y$

(ii) $\Sigma Xy = a\Sigma Y + b\Sigma Y^2$

2. Multi Linear Regression (MLR)

$$Y = a + bx_1 + cx_2$$

(1) $a = \frac{\Sigma y}{n} - b.\frac{\Sigma x_1}{n} - c\frac{\Sigma x_2}{n}$

$= \bar{y} - b.\bar{x_1} - c\bar{x_2}$

(2) $b = \frac{\Sigma x_2^2 \cdot \Sigma x_1 y - \Sigma x_1 x_2 \cdot \Sigma x_2 y}{\Sigma x_1^2 \cdot \Sigma x_2^2 - \Sigma(x_1 \cdot x_2)^2}$

(chote)² bada×maa bada×chota chota×mxo

(3) $c = \frac{\Sigma x_1^2 \times \Sigma x_2 y - \Sigma x_1 \cdot x_2 \cdot \Sigma x_1 y}{\Sigma x_1^2 \cdot \Sigma x_2^2 - \Sigma(x_1 \cdot x_2)^2}$

(bada)² × chotamaa bada×chota bada×ma

3. Time Series Analysis

A relationship between time and any variable is called as Time Series

Regression vs Time Series

Regression	Time Series
Relationship between any two variables	Relationship between time and any variable
Casual relationship	The relationship can be broken into several components

Components of Time Series

1. Trend
2. Seasonal Variation
3. Cyclical Variation
4. Irregular or Erratic Variation

Models in Time Series – Multiplicative and Additive

1. Forecasted Y = T x S x C x I
2. Forecasted Y = T + S + C + I

In our studies, we have methods, to determine, T, S &C and the value of I is determined by comparing AV and FV

Methods of Measuring Trend

1. Methods of Least Squares or Regression Method
2. Moving Average Method
3. Exponential Smoothening Method

Methods of Measuring Seasonal Variation

1. Simple Average Method
2. Moving Average Method
3. Trend Ratio Method
4. Link Relative Method
5. Deseasonalisation

I. Method of Measurement of Trend

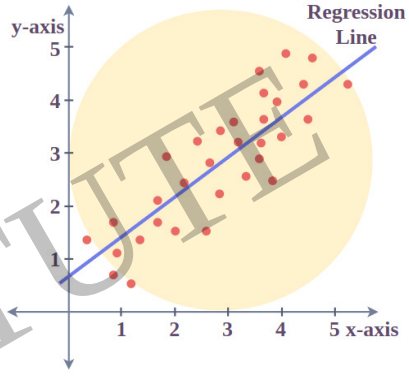
Method I – Method of least squares or regression method

Type I: St Line Trend

Type 2: Quadratic or Parabolic Trend

Type I: Straight Line Trend – Simple Linear Regression

Y = a + bX



Y = any variable

X = (x - origin)/scale

a = intercept = Y when axis is 0

b = slope = rate of change n Y wrt change in X

Origin and scale

Case I: n = odd number

Origin - middle year

Scale is I year

Case 2: n = even number

Origin - average of 2 middle years

Scale - 0.5 year

The value of a,b for straight line trend are obtained using the normal equations

Y = a + bX

I. $\Sigma Y = na + b\Sigma X$

2. $\Sigma XY = a\Sigma X + b\Sigma X^2$

Type 2: Quadratic Trend

$Y = a + bX + cX^2$

X = (x - origin) / scale

The values of a,b,c for quadratic trend are obtained using the normal equations

$Y = a + bX + cX^2$

1. $\Sigma Y = na + b\Sigma X + c\Sigma X^2$
2. $\Sigma XY = a\Sigma X + b\Sigma X^2 + c\Sigma X^3$
3. $\Sigma X^2Y = a\Sigma X^2 + b\Sigma X^3 + C\Sigma X^4$

Method 2 - Moving Averages Method

(a) Simple Moving Average

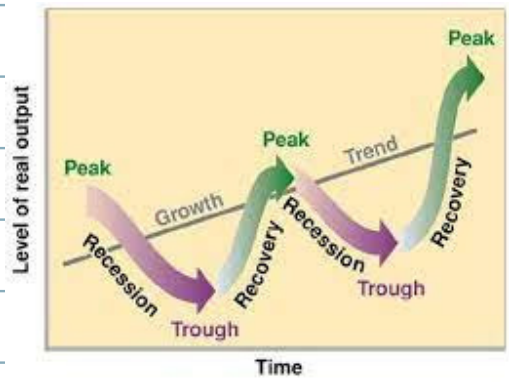
(i) Odd No. of period's average - **Panga**

(ii) Even No. of period's average - **No Panga**

(b) Weighted Moving Average - Even No. of period's average - **No Panga**

2. Seasonal Variations

1. Simple Average Method
2. Moving Average Method
3. Deseasonalization and Estimated Sales
4. Trend Ratio Method
5. Link Relative Method



Method 1 – Simple Average Method

Use this method when there are no high fluctuations

Steps	Particulars	Additive	Multiplicative
1	Find quarterwise average of given data for each period	Total of given values/n	Total of given values /n
2	Find Grand Average	Average of above Averages	Average of above Averages
3	Seasonal Variation	= Deviations	= Index
		= Avg – Grand Avg	= Avg/Grand avg x 100
		The total of all deviations must be 0. If not, go to step 4	The total of all indices must be 400. If not, go to step 4
4	Correction	Total of Seasonal Variations / 4	400 / Actual total in Step 3
	Revised Seasonal Variation	Step 3 – Correction Total must be 0	Step 3 x Correction Total must be 400

Method 2 – Method of Moving Averages

Steps	Particulars	Additive	Multiplicative
1	Trend Value	4 quarterly moving average	4 quarterly moving average
2	Trend eliminated seasonal value – Make a new table – find for each year, quarterwise	Original Value – Trend Value	Original Value / Trend Value

3	Continue with Simple Average Method	1.	Average	1.	Average
		2.	Grand Average	2.	Grand Average
		3.	Average - Grand Average	3.	Average/Grand Average
		4.	Total must be 0	4.	Total must be 400

Method 3 - Deseasonalisation and Estimated Sales

1. Deseasonalisation - Elimination - of seasonal variation (the one whose total is 0 or 400)

Steps	Particulars	Additive	Multiplicative
1	Seasonal Effect	Seasonal variation	Seasonal Indices
2	Deseasonalised Value	Original Data - Seasonal Effect	Original Data / Seasonal Index
3	Estimated Sales (Seasonalised Value)	Trend Value + Seasonal Effect	Trend Value x Seasonal Index

Method 4 - Trend Ratio

Y = T x S

S = Y/T = Original Value / Trend Value

Step 1: Trend Values - using method of least squares

(a) Find **yearly trend value** using Y = a+bX

If no. of years are odd - Origin = middle year, Scale = 1 year

If no. of years are even - Origin = Average of middle year, Scale 0.5 yr

(b) Find **Quarterly Trend Values**

Year	Trend Value
I	**A**
Quarterly Trend Value of Year I	
(use slope of trend equation and find quarterly change = b/4 = B)	
Q1	A - B
Q2	A - B/2 = A1
	A
Q3	A + B/2 = A2
Q4	A+B = A2 + B

Like this, calculate trend values for each year.

Step 2: Trend Eliminated Values (Multiplicative for each quarter) = Original Value/ Trend Value

Step 3: Find Simple Average of above trend eliminated values

Step 4: Find Grand Average

Step 5: Find Seasonal Index = Average / Grand Average (total must be 400)

Method 5 – Link Relative Method

Steps:

1. **Link Relative** = Current Value / Previous Value x 100

   For Ist year - Ist quarter - blank

   Make a Table for year wise and quarter wise

2. **Average link relatives** = Average of link relatives for each quarter

3. **Chain relative**

   = (Avg LR of Current Quarter x Chain Relative of Previous Quarter) / 100

   Assume Ist Quarter's Chain relative as 100

4. **Corrected Chain Relatives**

Second Chain Relative of Q1

= (Avg LR of Q1 x Chain Relatives of Q4)/100

Correction Factor = deviation (d)

= (Second Chain Relative of Q1 - Assumed Value 100)/4

Corrected Chain Relative

Quarter 1 = Second CR pf Q1 - d x 4

Quarter 2 = Chain Relative - d x 1

Quarter 3 = Chain Relative - d x 2

Quarter 4 = Chain Relative - d x 3

5. **Avg Corrected Chain Relative** = Average of all corrected chain relatives

6. **Seasonal Index (Total must be 400)**= Corrected Chain Relative/Average Corrected Chain Relative

3. Exponential Smoothing Method

Forecasted Value (t) =

Forecasted Value of previous period (t-1) + Smoothing Co - efficient x Forecast Error of previous period

$U_t = U_{t-1} + \alpha (y_t - U_{t-1})$ Or

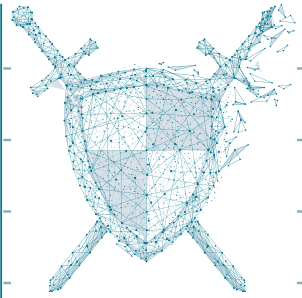
$U_t = \alpha y_t + (1-\alpha) U_{t-1}$

Where,

y_t = actual value

U_{t-1} = Forecasted value of previous period

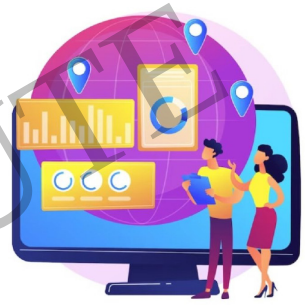
α = Smoothing coefficient



Introduction to Analytics

Role of Data Analytics:

1. Gather hidden insights
2. Generate reports
3. Perform market analysis
4. Improve business requirements



Uses:

1. Cost reduction
2. New product development
3. To increase sales
4. To detect issues
5. Better customer service

Types of Data Analytics:

Descriptive Analysis - What happened

Diagnostic Analysis - Why happened

Predictive Analysis - What will happen

Prescriptive Analysis - What actions to be taken - recommendations

Exploratory Analysis - No hypothesis stated before. Frame questions - manipulate data to find answers

Confirmatory Analysis - Hypothesis is stated from before. Analysis is conducted. Hypothesis is proved/disapproved.Eg. - Is it that more customer satisfaction will result into more sales?

Steps in Data Analytics

1. Data requirement
2. Data collection
3. Data organize
4. Data Cleanup or Data Wrangling
5. Data analysis and report

Tools for Data Analytics:

1. **Data Transformation/ Smoothening Tools** - For cleansing of the available data. Data in specific field types and structures. Extract transform load (ETL) or Extract, Load, Transform (ELT). ETL is more popular.

   Extraction: Data download → Temporary dumping ground → Data staging Area

   Transform: Data from a single unified source converted into a unified data model.

   Load: Transfer of data from source data memories

   Structured Data → Centralised → Data Warehouse (data not optimized for immediate use)

   Structured Data → Decentralised → Data Marts (data for specific groups such as - Marketing Sales, Finance, etc)

Unstructured Data → Data stored in Data Lake ETL Tools: Xplenty, Stitch, ABS, Glue, Skyvia

2. Data Analysis tools

I. Spreadsheets

a. MS Excel - Awareness, User friendliness, Data visualization, Data analysis, Compatibility with other softwares

b. Google Sheet - Collaboration, Data visualization, Data analysis, Integrates with various softwares

c. Quip - Layout/charts - is more attractive

2. Business Intelligence Tools

To retrieve, analyze and transform data into useful business insights usually within easy to read visualization like - charts, graphs and dashboards.

E.g. periodic reports on KPIs

BI Tools: - SAP, Dundas BI, SAS Viya, Geckoboard, Sisense, Oracle BI, Tableau, Domo

Data Mining - Activity of Data Discovery because here the patterns and inconsistencies of data unveiled through automated or semi automated data analysis. Association rule helps most.

Natural Language Processing:

Data comes in three forms - structured, semi structured and unstructured. Of these, the most common is unstructured which includes text documents and other types of files that cannot be read by computer easily.

NLP softwares also known as Text Analytics Softwares combines large sets of unstructured data to find hidden patterns. It can track key words or phrases

from different languages also.

BI Reporting focuses on presentation of these findings:

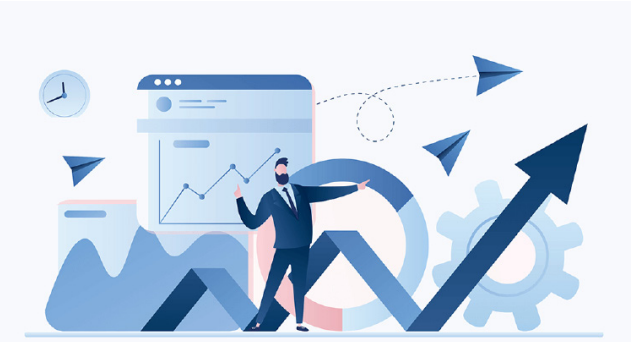
1. OLAP - multidimensional databases to enable users to query data
2. Data visualization - Present findings in a graph, chart, or a map
3. Dashboards - Sales, Marketing, Customer success, IT
4. Alerts and Notifications - for immediate actions
5. Embedded analytics - :to serve dynamically to the non technical employees within the company and to its customers by embedding BIin a cloud app or webpage

3. Financial data analytics tools

Uses:

1. Profitability of different products or services
2. Valuable customer segments
3. Current risks and future challenges
4. Different sales channel
5. Future events impacting the stock price

Types of Financial analytics:



1. Predictive sales analysis
2. Product profitability analytics
3. Value Driver analytics
4. Financial ratio analysis
5. Scenario and Sensitivity analysis
6. Growth rate analysis

7. Cash flow analysis
8. Variance analysis

Tools: Jedox, Zoho Analytics, Quickbooks, Hyper Ana, Netsuite, FICO

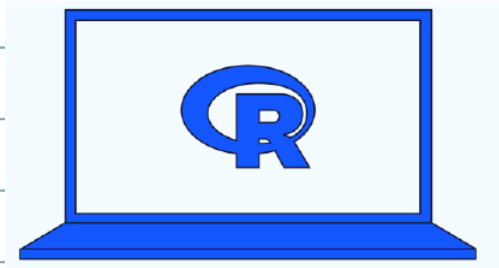
4. Programming languages

R Programming

Open source programming language that is used as a statistical software and data analysis tool. R is platform independent, available across widely used platforms - Windows, Linux, Mac - OS. Leading tool for machine learning, statistical and data analysis.

Reasons for using R -

a. Free Installation
b. Hottest trend
c. Interest with other languages
d. Latest cutting edge technology
e. Platform independence
f. Vast community



Applications of R Programming -

1. **Data science** - gives super powers to data scientists that allow then to collect data in real time, perform statistical and predictive analysis, create visualization and communicate actionable results.
2. **Statistical computing** - Over 9000 packages having every statistical functions one can think of.

3. **Machine Learning** – Lots of use in predictive analytics and machine learning.

Features of R Programming –

1. **Statistical features of R** – Basic Statistics, Static Graphics, Probability Distribution, Data Analysis
2. **Programming features of R** – R packages, distributed computing (sharing of components with multiple computers)

Advantages of R Programming –

1. Most comprehensive statistical analysis package.
2. Open source
3. Cross platform
4. Everyone can provide new packages, bug fixes and enhancements.

Disadvantages of R Programming –

1. Standard is low
2. Pressure on memory management
3. No body to complain
4. Slower than Python and MATLAB

PYTHON:

Reasons for increasing popularity:

1. Code readability, shorter codes, ease of writing
2. Inbuilt functions of almost all frequently used concepts

Language Features:

1. **Directly run the program from source code** – no linking and loading with libraries.

2. Platform independent
3. Free and open source
4. Simple
5. Embeddable within C and C++ programs
6. Robust
7. Rich library support

5. Statistical data analysis tools

For all kinds of statistical modeling, data management and predictive analysis.

Types of SAS Softwares:

1. Windows or PC SAS
2. SAS EG (Enterprise Guide)
3. SAS EM (Enterprise Miner for predictive analysis)
4. SAS Stats

Features of SAS

1. Easily accessible raw data files and data
2. Manage data using tools for data entry, retrieval, formatting and conversion
3. Advanced analytics to make changes and improvements in business practices
4. Report formation with graphs

Application of SAS

1. **SPSS** – software package for statistical analysis - similar to Excel but expensive.
2. **Eviews** = Statistical and econometric data analysis is done by this tool.

6. Industry specific tools

Used only in specific industries. Eg - SAP, Oracle, Microsoft Dynamics, Sage, Tally, etc.

7. Visualization Tools

To see the visual trends, charts and graphs from data.

Features of Visualisation Tools:

1. Ease of using multiple databases
2. Capability to build relationships between various data sets
3. Capability to attract the users
4. Graphical user interface

Tools - Tableau, Power Bi, Zoho Reports, etc.