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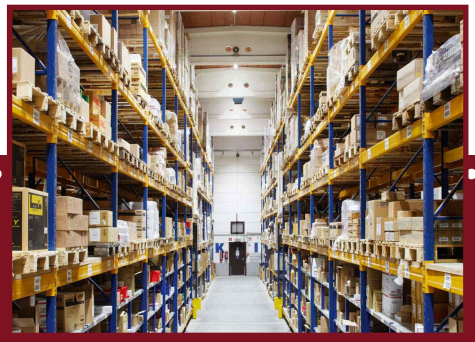
COURSE HANDBOOK

CSCF

Certificate in Supply Chain Fundamentals



Module 3: INVENTORY & LOGISTICS

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Module 3

CSCF

CERTIFICATE IN SUPPLY CHAIN FUNDAMENTALS

BRASI
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INVENTORY & LOGISTICS

Welcome to the CSCF Course.

In this course, you will learn the fundamentals of procurement, procurement processes and evaluations, contract management & strategies, covering the key concepts and terms. It is a self-paced course, allowing you to complete it on your own timing.

This course consists of four modules. Each module contains a knowledge check, which is a learning quiz, providing explanation when an incorrect answer is selected. There is also an advanced test based on the case studies that will help you to brainstorm and answer by using the knowledge you got in this course.
In addition to the interactive slides, you also have access to the handbook comprising the slides and notes. The handbook is already set up for printing, which you can do on your home printer or get it printed at a copy and print shop.

Once you have reviewed all the modules, then you may take the test which is a separate section in the course. Upon passing the test, you will be able to download your certificate. Your certificate will have a unique ID, which is helpful in responding to verification requests in connection with higher education or employment.

Fasten your seat belt and get into the action! Good luck!

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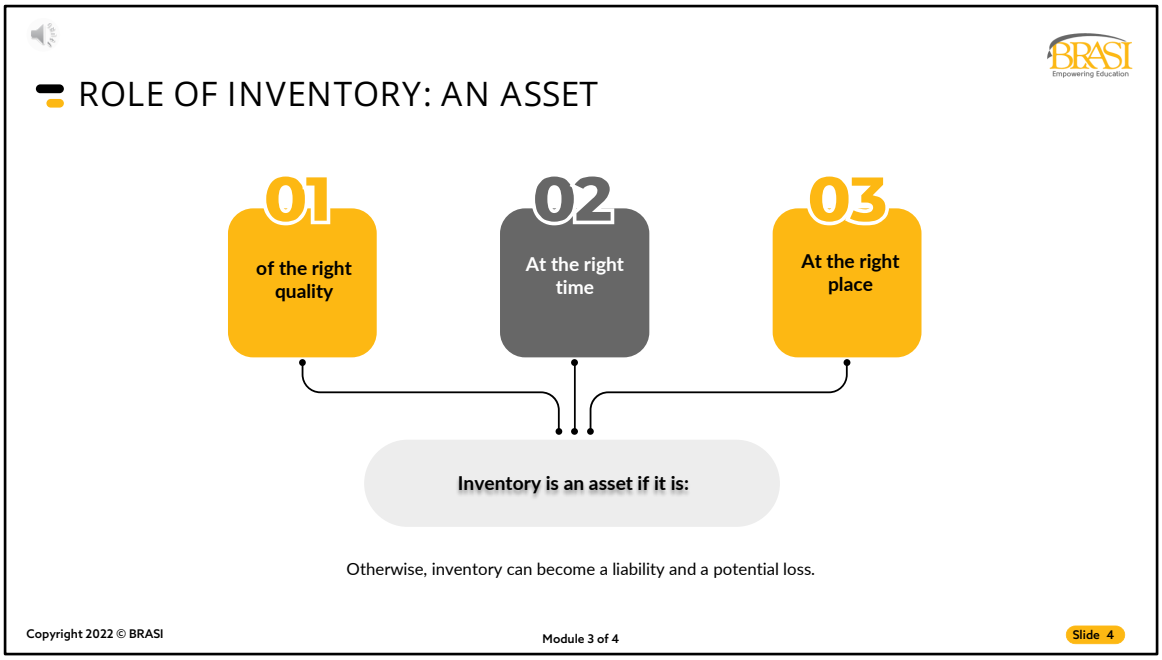
Learning objectives for the CSCF certificate program are based on industry research and stakeholder feedback. These include familiarization with the basic principles and practices, essential skills, tools and methodologies of Supply Chain Management.

You will note that the learning objectives are listed at the beginning of each module, and the portion relevant to each module is covered in that module. This is to help you keep a tab on the overall course content.

WHAT IS INVENTORY?

1. **Financially** – measured in monetary value, all items can be added up for a total inventory value.
2. **Physically** – by items or groups, measured in physical units, cannot be aggregated due to multiple units of measure.

Inventory is the raw materials, work-in-process products and finished goods that are considered to be the portion of a business's assets that are ready or will be ready for sale. Inventory represents one of the most important assets of a business because the turnover of inventory represents one of the primary sources of revenue generation and subsequent earnings for the company's shareholders.



Inventory is an asset. However, it may or may be considered a financial asset depending on the analysis, for example, Total Assets includes inventory value, however, the Quick Ratio (Current Assets compared with Current Liabilities) does not include inventory, being potentially a non-liquid asset with actual value subject to supply and demand, and various other factors.

Inventory is an asset as long as it is of the right quality, right time and right place. Otherwise, inventory can become a liability and potential loss.

ROLE OF INVENTORY: A STRATEGIC TOOL

> Inventory is a tool to implement a company's competitive strategy, as it represents the differentiating factors of Price, Quality, Convenience, Delivery Speed and others.
>
> Dell Computers: Component Planning , Order Aggregation and Assemble to Order strategy made 'Mass Customization' possible.

It can be tedious and difficult to keep accurate track of your product inventory levels, but it's necessary and important, and can be a key part of your financial management. Problems can arise if you have too much of an item on hand, or worse – run out entirely.

However, with an automated inventory management solution, you can not only avoid supply problems, you can use the information to make strategic decisions that benefit your company's bottom line.
Generally, if you are effectively managing your inventory, it's a direct driver to improving customer service and satisfaction. If you haven't seen how automated inventory management can benefit your organization

ROLE OF INVENTORY: A STABILIZING AGENT

Various inventory strategies such as DBR, Safety Stock, Multi-echelon Inventory, VOI, VOMI, Third Party or Toll Manufacturing, Delayed Differentiation/Postponement, Capable To Promise, Substitution, Temporal Aggregation help optimize customer service and cash flow.

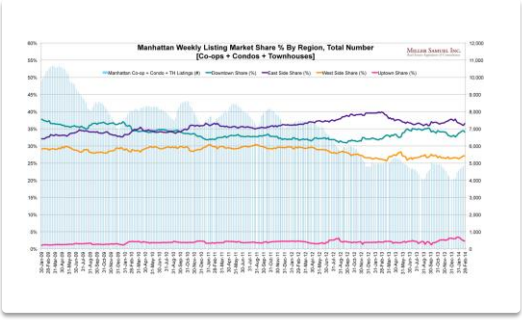
Toyota uses Flex Manufacturing, with quick change of components and assembly supply and retooling to assembly line, to product a large variety with short cycle times.

With significant investments in quality testing and failure analysis, **Flex manufacturing** has developed a reputation for unparalleled quality and reliability. ... With advanced security and restricted access, these facilities keep proprietary products and processes safe throughout the entire **manufacturing** process.

INVENTORY LOSES VALUE OVER TIME

Almost all commercial inventory loses value over time, due to loss of characteristics (for example, potency, chemical changes), change in design (redundancy, style), physical deterioration (weather, handling).

it is advisable to maintain a minimum inventory level which will be consumed within a reasonable amount of time and not cause a financial burden.



Inventory losses happen during storage, due to errors in receipts and issues documentation, damages during handling, damage due to excessive humidity, inclement weather or pilferage.

While it is important to identify and prevent the causes, it is also necessary to check the physical inventory and update the records if there is a mismatch, in order to keep the plans as well as financial information realistic.

Inventory accumulates costs while it is stored. At the same time, it loses value.

Select a product and list the factors that add to carrying cost, and the factors that cause depletion of value during storage.

Based on the above-mentioned factors, would you prefer to keep the inventory moving or hold it for long periods?

Activity 1 (10 min.)

Inventory Cost and Value

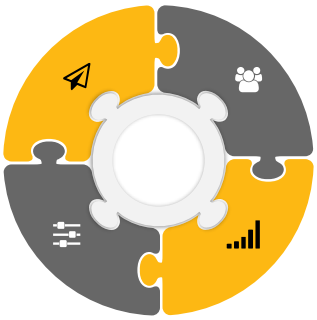
Supply chain management body of knowledge is relatively new.

It has evolved since its inception during the past thirty to forty years, and is mainly attributed to the development of computers and their application to business.

INVENTORY CAN BE MEASURED IN DIFFERENT WAYS

Units (physical or chemical, pieces, packs, volume, length, weight, etc.)

Represented in terms of final product, i.e., inventory = 200 kg of salt, good for 10 batches of the parent product.



Periods of cover = 200 kg of salt, good for 5 weeks of production based on current production plan.

Financial: This is measure of inventory carries the advantage that the value of different types of items can be added together, as used in determining the total inventory holding, inventory turns, etc.

Inventory may be represented in various forms, depending on the intended use of the information.

The basic measure is the physical units, i.e., weight, volume, length, etc.

The physical units Inventory may also be converted in terms of final product, to get an idea in terms of production plan or customer service.

From a coverage perspective in order to plan replenishment, inventory may be converted into the number of days of consumption that it will support.

The above-mentioned representations of inventory support operations and planning requirement.

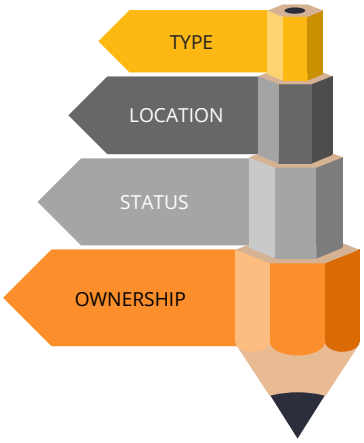
Inventory is frequently represented in terms of value, for the purpose of costing and financial reporting.

INVENTORY PROFILE

Example:

- **Raw Material** Common Salt, Stock Keeping Unit (SKU) No. A0015
- Stored at:
  - Central Warehouse: 5,000 Kg (On QC hold)
  - Distribution Center DC1:
    - 2,000 Kg (**QC released**)
    - 550 Kg (**Issued to Plant**, awaiting shipment)

A0015	QC Released	On QC Hold	Rejected	Issued
CW		5,000		
DC1	2,000			550



An **inventory profile** is used to track and report the movement of items, and the accounting of on-hand inventory quantities, based on the kind of activity that the company engages in. Common inventory types are Raw Materials, Work In Process WIP), Finished Goods and Maintenance/Repair/Operating supplies. Each of these types is charged differently, for example, raw materials and WIP are charged as direct material cost to a production order or a project, whereas other types may be charged to manufacturing overheads or a product family.

Status represents the stage in a materials life cycle, such as: In-stock and available for use, In-stock but under Quality Hold awaiting release, In-stock but allocated to an order, In-transit, Vendor-owned, Customer-owned, Short-dated, Expired, etc. Status information is important from operations planning (schedule feasibility) and financial reporting purposes (asset valuation). Location can be a bin on a plant or warehouse, another city or country, supplier or customer , a project or in-transit. Important from a customer-service and transportation/lead time perspective. Example: Aircraft spares.

Inventory may be located at customer's site but still owned by the vendor. It may be transported by the carrier but owned by either the shipper or the customer, depending on the INCOTERMS. This information is relevant to inventory cost on the books (asset) and liability such as insurance coverage and cost.

INVENTORY REPLENISHMENT POLICIES

1

Reorder Point – place the next order when inventory drops to a predetermined reorder point Time-Phased Order Point – MRP.

2

JIT – Kanban Signal: Order the next item only when needed.

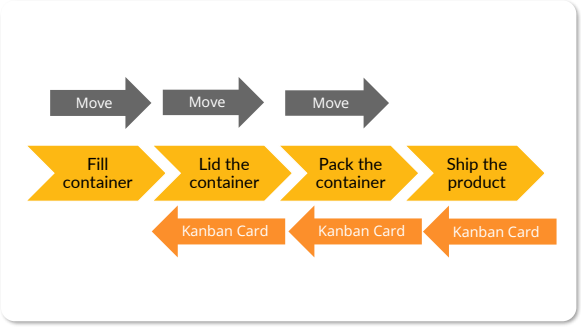
3

Fixed Interval Review – review inventory at fixed intervals, for example, each month, and top it up to a predetermined level.

Here is an overview of the three main approaches to inventory replenishment for an industrial operation.

INVENTORY REPLENISHMENT POLICIES (Contd.)

JIT – Kanban Signal: Ideally single-piece flow in the system – Minimum Inventory Model

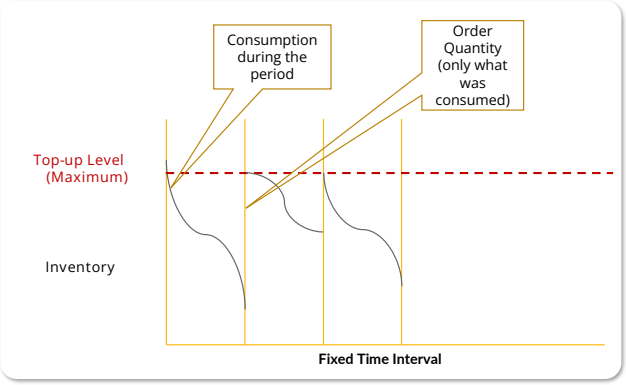


JIT aims at reducing the work-in-process (IP) inventory by eliminating any production in excess of immediate demand.

INVENTORY REPLENISHMENT POLICIES (Contd.)

Fixed Interval Review: Maximum Inventory Level is defined and maintained on a periodic basis.

An example can be if you decide to top-up your gas tank once a week, only filling the amount of gas that was used during the week.



The Fixed Interval Replenishment policy is explained here.

INVENTORY REPLENISHMENT POLICIES (Contd.)

Reorder Point: Minimum Inventory Level is defined (zero or safety stock) and is maintained by receiving new supply (replenishing) when the minimum level is reached.

This policy is used in the MRP Grid discussed in Module 1.

The basic principle of the Time Phased Order Point Planning is mentioned here. Detailed calculation in provided in the demo file.

Inventory Accuracy: The Cycle Counting Process

The purpose of Cycle Counting process is to maintain inventory accuracy by routinely checking physical inventory and comparing with the book balance and making adjustments as necessary in order to keep the book and physical synchronized.

Inventory items are classified into Class A, Class B and Class B for cycle counting purposes.

The purpose of Cycle Counting process is to maintain inventory accuracy by routinely checking physical inventory and comparing with the book balance and making adjustments as necessary in order to keep the book and physical synchronized. Inventory adjustment may require appropriate level of approval, depending on its nature and value. of the adjustments.

ABC CLASSIFICATION OF INVENTORY

A Category Items Comprise 20% of SKU & Contribute to 80% of $ spend.

Highest priority for counting. Ensure tight control where needed.

B Category Items Comprise 30% of SKU & Contribute to 15% of $ spend.

Moderate control, relative lower frequency of counting.

C Category Items Comprise 50% of SKU & Contribute to 5% of $ spend.

Basic controls and lowest frequency counting frequency.

ABC Classification of inventory is an approach to identify few, significant items from the many, common items in order to focus the cycle counting effort on the most important and critical items from a value and use perspective. More valuable or critical use items are checked more frequently compared with low value and bulk items which can be easily replaced.

ABC CLASSIFICATION OF INVENTORY

ITEM	ANNUAL USAGE IN NO. UNITS	UNIT COST-$	USAGE IN DOLLARS	PERCENTAGE OF TOTAL DOLLAR USAGE
1	5,000	1.00	5,000	1.96%
2	1,500	4.50	6,750	2.65%
3	10,000	14.00	140,000	54.96%
4	6,000	2.00	12,000	4.71%
5	7,500	0.35	2,625	1.03%
6	6,000	11.00	66,000	25.91%
7	5,000	0.27	1,325	0.52%
8	4,500	0.45	2,025	0.79%
9	7,000	2.50	17,500	6.87%
10	3,000	0.50	1,500	0.59%
TOTAL			$254,725	100.00%

The ABC approach states that, when reviewing inventory, a company should **rate items from A to C**, based on the annual spend on the item.

Class A items are goods which **annual consumption value** is **the highest**.

Class B-items are the interclass items, with a **medium consumption value.**

Class C items are, on the contrary, items with the **lowest consumption value**.

ABC CLASSIFICATION OF INVENTORY

Item	Annual Usage in No. Units	Unit Cost-$	Usage in Dollars	Percentage of Total Dollar Usage	Cumluative %age
3	10,000	14	140,000	54.96%	54.96%
6	6,000	11	66,000	25.91%	80.87%
9	7,000	2.5	17,500	6.87%	87.74%
2	1,500	4.5	6,750	2.65%	90.39%
4	6,000	2	12,000	4.71%	95.10%
1	5,000	1	5,000	1.96%	97.07%
10	3,000	0.5	1,500	0.59%	97.65%
8	4,500	0.45	2,025	0.79%	98.45%
5	7,500	0.35	2,625	1.03%	99.48%
7	5,000	0.27	1,325	0.52%	100.00%
Total			**$254,725**	**100.00%**	

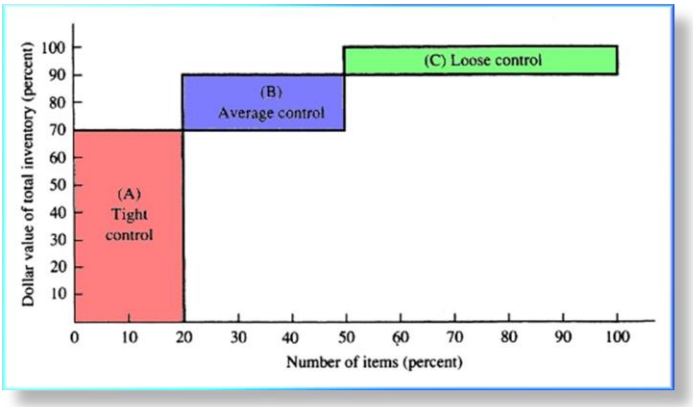
Demo – ABC Classification

Policies based on ABC analysis leverage the sales imbalance outlined by the Pareto principle. This implies that each item should receive a weighed treatment corresponding to its class:

Class **A items** should have tight inventory control, more secured storage areas and better sales forecasts. Reorders should be frequent, with weekly or even daily reorder. Avoiding stock-outs on Class A items is a priority.

ABC CLASSIFICATION OF INVENTORY

It is an approach to identify few, significant items from the many, common items in order to focus the cycle counting effort on the most important and critical items from a value and use perspective.



Reordering Class C items is made less frequently. A typically inventory policy for C-items consist of having only 1 unit on hand, and of reordering only when an actual purchase is made. This approach leads to stock-out situation after each purchase which can be an acceptable situation, as the C-items present both low demand and higher risk of excessive inventory costs. For C-items, the question is not so much *how many units do we store?* but rather *do we even keep this item in store?*

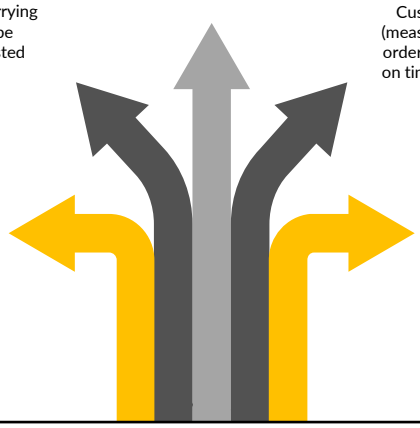
Class B items benefit from an intermediate status between A and C. An important aspect of class B is the **monitoring of** potential evolution toward class A or, in the contrary, toward the class C.

SUPPLY/DEMAND VARIABILITY AND SAFETY STOCK

Safety stock calculation is based on the following factors:

Being an item of inventory, safety stock incurs carrying cost. So, it should be monitored and adjusted periodically.

Customer Service Level (measured as percentage of orders target to be shipped on time and in full quantity)

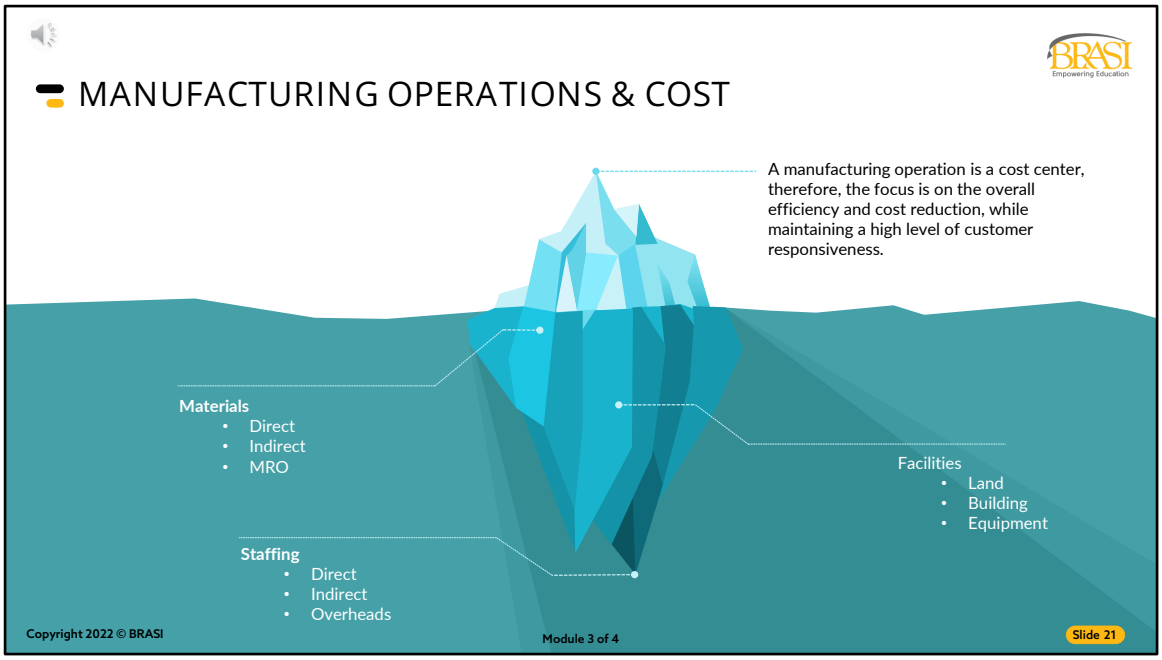


Safety Stock is maintained where necessary, to buffer the variability in supply and/or demand against a forecast.

Variability in supply/demand (measures as standard deviation)

Slide 20

Safety stock is maintained at the Raw materials and Finished Goods sages, in order to buffer against variability in supply and or demand.



As products and processes become more standardized, many companies outsource their manufacturing to third party manufacturers, which may be cost effective because of specialization. However, it also takes away some of the opportunity for in-house product development. As the saying goes, ”Development soars on the wings of production” (Tufail A. Khan, Economist and Writer). Therefore, some companies keep maintain their own manufacturing facilities for their flagship products and development work, while outsourcing rest of the product line.

Direct materials consist of all of the materials that become an integral part of the finished product. Direct materials should include the actual cost of the materials, as well as freight in, import duties, purchasing costs, receiving costs, storage costs and other directly attributable costs of acquiring the materials. Direct materials should be recorded net of any trade, quantity or cash discounts attributed to the materials.

Direct labor consists of all of the personnel costs required to manufacture the finished product. Direct labor should include wages, payroll taxes, and benefits associated with personnel who are integral to manufacturing the finished product.

Factory overhead consists of all of the other costs required to manufacture the

finished product that do not fit into the direct material or direct labor elements. They consist mainly of indirect material, indirect labor, depreciation, utilities, rent, repairs and maintenance and insurance.

TYPES OF COST

Each item manufactured or purchased represents two types of costs

Fixed costs regardless of quantity ordered (for example: Cost of placing the order, cost of machine set-up)

Variable costs: Cost of carrying inventory as a percentage of material cost (the more you keep, the higher the carrying cost)

Direct cost: Direct labor, direct materials, commissions, piece rate wages, and manufacturing supplies. These costs change with change in volume, hence called **Variable Cost.** The difference in the use of the terms Direct Cost and Variable Cost is that direct cost is treated per unit, in the context of costing, whereas variable cost is the total cost hat changes with volume.

Indirect cost: Production supervision salaries, quality control costs, insurance, and depreciation. These costs do not change with a change a in volume within a reasonable range, hence called **Fixed Costs**. The difference in the use of the terms Indirect Cost and Fixed Cost is that indirect cost is treated per unit, in the context of costing, whereas fixed cost is the total amount of manufacturing overheads that does no change with a change in volume within a reasonable range.

FIXED & VARIABLE COST

Fixed cost is that portion of the total cost that does not change with change in volume within a certain range. Cost of equipment is an example.

The portion of total cost that is incurred only when product is made, for example, direct material and direct labour

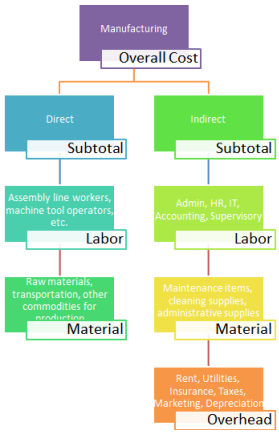
Fixed cost is the manufacturing overhead that does not change with change in production volume within a reasonable range.

Variable cost is the total cost of direct materials, labor and supplies that increase or decrease with an increase or decrease in the quantity produced.

DIRECT & INDIRECT COST

Direct labour and direct material used to make a unit of product.

Indirect cost includes factory or manufacturing overheads, represented as total value or cost per unit.



Example:
Turbo Scooter uses direct materials and supplies worth $50, labor worth $90.
Total Direct cost per scooter = $50+$90 = $140.
Manufacturing overheads are $600,000 per year and the plant produces 10,000 scooters per year, therefore, the indirect cost per scooter = $600,000/10,000 units = $60 per unit. Total product cost = $140+$60=$200.00

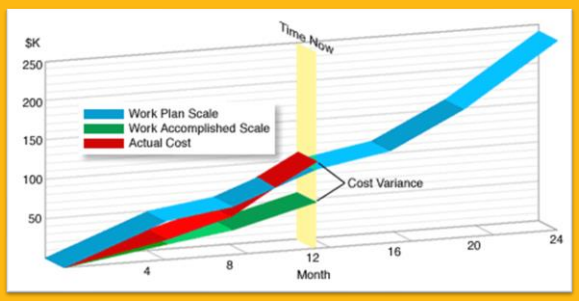
Total variable and fixed costs at different levels of output would be as follows:

<u>Production volume: 10,000 scooters</u>
Variable cost = $140 x 10,0000 = $1,400,000
Fixed cost = $600,000
Total Operating expense = $1,400,000 + $ 600,000 = **$ 2,000,000**
Product cost = $140 + ($600,000/10,000) = **$200**

<u>Production volume: 8,000 scooters</u>
Variable cost = $140 x 8,000 = $1,120,000
Fixed cost = $600,000
Total Operating expense = $1,120,000 + $ 600,000 = **$ 1,720,000**
Product cost = $140 + ($600,000/8,000) = **$215**

VARIANCE

When the Standard Costing method is used for product costing, variance represents the difference between the estimated standard cost and the actual costs incurred. Variance may be positive (favourable) or negative (unfavourable).



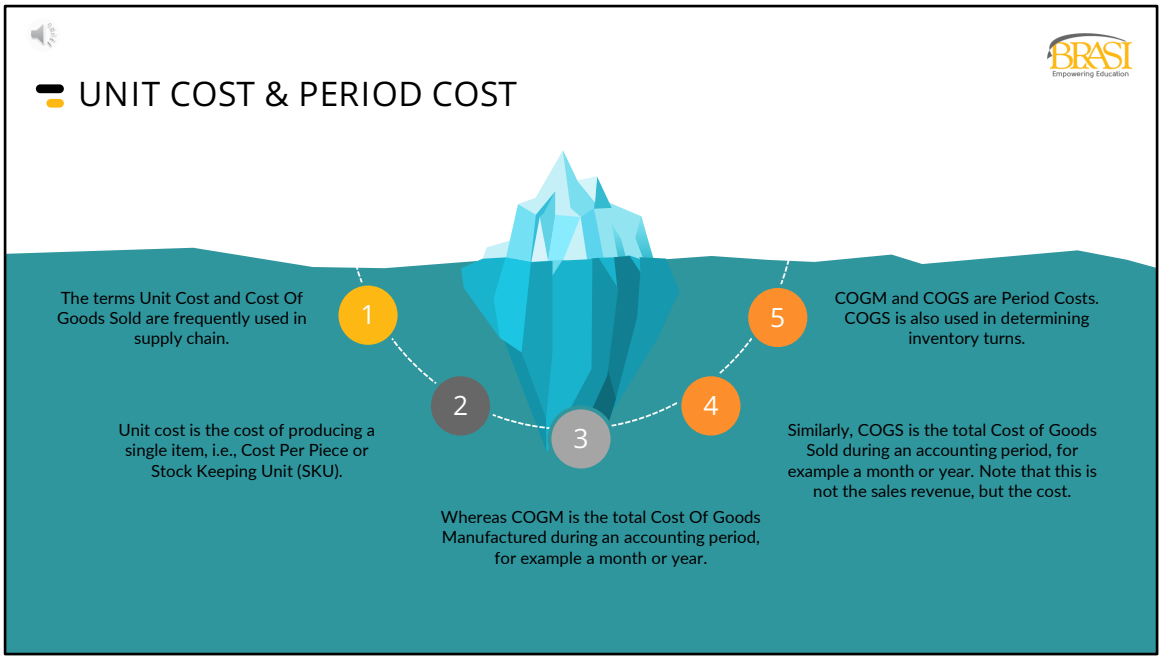
Cost standards are established as a part of the budgeting process. These include the following elements:

1. Purchase price of raw materials and other inputs.
2. Head count and wages.
3. Productive hours per costing period.
4. Plant overheads.
5. Maintenance and other operating expenditure.
6. Related costs.

Upon completion of each accounting period – typically a calendar or fiscal month – actual costs are compared with the budgeted standard. Any difference is reported as variance – either favorable or unfavorable. Key variances include the following:

- Purchase Price Variance: Owing to price changes affected by vendors or other market channels which are not locked in by a price contract, or are affected by change in demand.
- Manufacturing Cost Variance: This may be caused by change in efficiencies, quality issues, rework, downtime being different than planned, and other activity related factors.
- Overhead Absorption: This is the distribution of plant overhead over the umber of units produced, and depends on the throughput planned vs. actual throughput achieved.

Variance analysis is an important element in supply chain management, as it helps identify the trend, and take the necessary steps as needed.



Unit product cost is the total **cost** of a production run, divided by the number of units produced. It is useful to delve into the concept in more detail, to understand how costs are accumulated. A business commonly manufactures similar products in batches that may include hundreds or thousands of units per batch

A unit cost is the total expenditure incurred by a company to produce, store and sell one unit of a particular product or service. Unit costs include all fixed costs, or overhead costs, and all variable costs, or direct material costs and direct labor costs, involved in production.

UNIT COST & CONTRIBUTION MARGIN

Unit Cost is used to determine the profitability of an individual product.
Unit Cost = Direct Materials + Direct Labor + Factory Overheads (excluding General or Administrative Overheads).

Sales Price = The price at which the product is sold to the customer.

Contribution Margin = The difference between sales price and unit cost, that each unit contributes towards general overheads and profit.

CM = Sales Price Per Unit – Direct Cost Per Unit

Different products have different contribution margins, depending on their variable costs and overhead allocation.

A contribution Margin analysis help prioritize decisions concerning product life cycle and arbitrage in the event of product shortage.

CONTRIBUTION MARGIN AND BREAKEVEN VOLUME

Example:
A company sells one item only, whose cost per unit is $7.65, and the sales price per unit is $10.00. The company has a general and administrative overhead of $1,000,000 per year. How many units must be sold in a year in order to breakeven, i.e., what is the breakeven volume for the company?

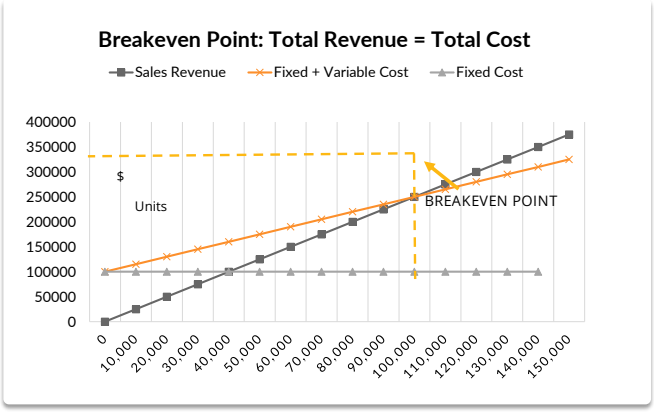
Solution:
Cost per unit = $7.65
Sales price per unit = $10.00
Contribution Margin (CM) per unit = Sales Price/unit – Cost/unit = $10.00 – $7.65 **= $2.35/unit**
Breakeven Volume = Overhead Cost/CM = 1,000,000/2.35 =
425,532 Units need to be sold in order to absorb the general and administrative overheads, i.e., no profit, no loss or breakeven.

The relationships and formulas mentioned above explain the basic concept of contribution margin.

CONTRIBUTION MARGIN (CM)

Contribution Margin (CM) is the difference between the variable cost and sales price per unit, i.e., the balance amount per unit that is contributed to absorb the fixed costs, overheads and profit margin.

Demo - Breakeven



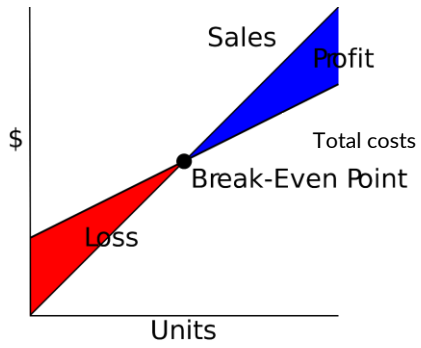
Contribution margin is a product's price minus all associated variable costs, resulting in the incremental profit earned for each unit sold. The total contribution margin generated by an entity represents the total earnings available to pay for fixed expenses and to generate a profit.

The contribution margin ratio is the difference between a company's sales and variable expenses, expressed as a percentage. The total margin generated by an entity represents the total earnings available to pay for fixed expenses and generate a profit. When used on an individual unit sale, the ratio expresses the proportion of profit generated on that specific sale.

BREAKEVEN ANALYSIS

A break-even analysis is an analysis to determine the point at which revenue received equals the costs associated with receiving the revenue

Break-even analysis calculates what is known as a margin of safety, the amount that revenues exceed the break-even point.



Contribution margin and breakeven point are interlinked, since the higher the contribution margin, the lower the breakeven point, meaning that a product with a large difference in product cost and sales price will help cover the general overheads with fewer units sold, compared to a product with smaller contribution margin.

At the breakeven volume of sales, total revenue equals total cost, i.e., no profit, no loss, hence the term, “breakeven volume or breakeven point”.

BREAKEVEN VOLUME AND COST CEILING

Cost Ceiling: In a competitive environment, sales price is influenced or determined by the market. At the same time, a company has a profit target in order to support growth and enhance value for the shareholders or investors.
These factors play a large role in determining the maximum sustainable unit cost of the product. This is explained in the following example.

Example:
Product's sales volume = 1,000,000 units per year.
Competitive sales price = $ 11.99/Unit
Profit Target = $ 2,500,000 per year
General and Administrative Overheads = $ 1,500,000 per year
What is the **maximum allowed** Manufacturing Cost/Unit?

General and Administrative overheads per unit = $1,500,000/1,000,000 units = $1.50 per unit
Target profit margin = $2,500,000/1,000,000 units = $2.50 per unit
Sum of Gen & Admin O'head and Profit Target = $1.50 + $2.50 = $4.00 per unit
Sales price = $11.99 - $4.00 = $7.99 per unit available for Manufacturing Cost.

Corollary: An increase in the sales volume will improve profitability by reducing the overhead cost per unit, and a decrease in the sale volume will reduce profit due to higher portion of overhead per unit.

Breakeven sales **volume** is the amount of your product that you will need to produce and sell to cover total costs of production. This can be computed under a range of sale prices with the formula below. A key concept of this formula is the Contributions Margin.

breakeven volume. Number of units sold for total sales revenue to equal total costs (total variable and fixed costs, general and administrative expenses, etc.).

BREAKEVEN POINT OR VOLUME

It is the volume of sales at which total cost equals total revenue, i.e., no profit, no loss. With a positive contribution per unit, sales beyond the breakeven point start to accumulate profit. Breakeven is represented by the following equation.

$$\textbf{Breakeven Volume} = \frac{\text{TotalFixedCost}}{\text{Contribution Margin}}$$

What is Break-even Point?

In accounting, the break-even point refers to the revenues needed to cover a company's total amount of fixed and variable expenses during a specified period of time. The revenues could be stated in dollars (or other currencies), in units, hours of services provided, etc.

The break-even calculations are based on the assumption that the change in a company's expenses is related to the change in revenues

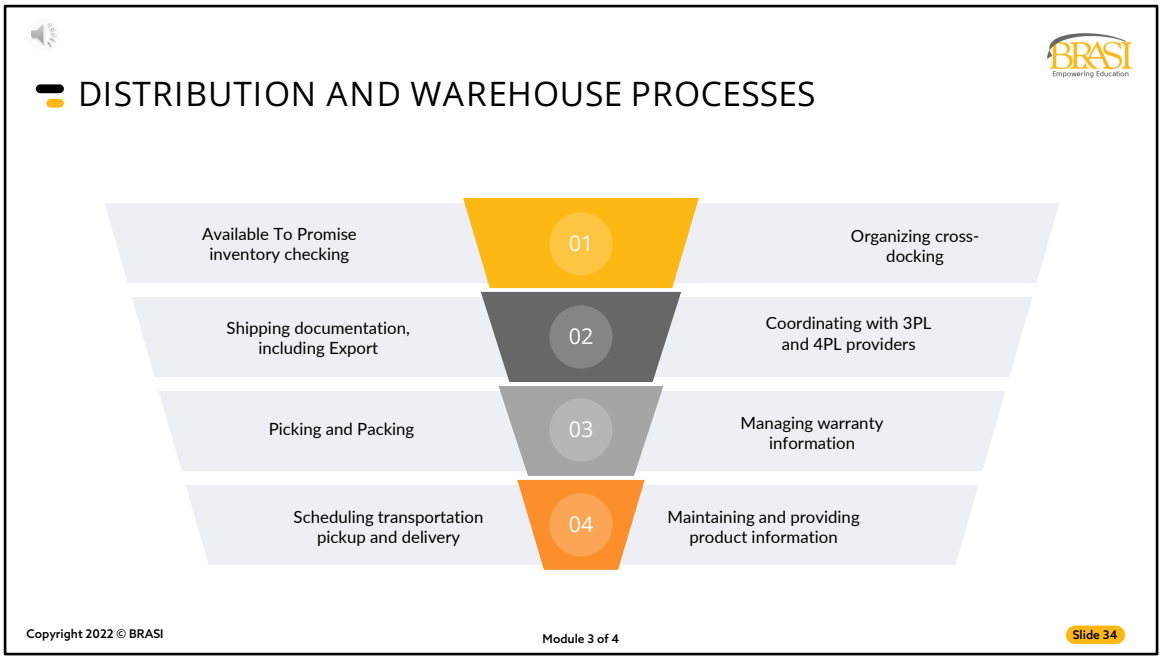
STORAGE TYPES AND WAREHOUSE LAYOUTS

TYPES OF STORAGE:
- Ambient Temperature
- Cold Storage
- Central Warehouse
- Satellite Warehouse

TYPES OF WAREHOUSE LAYOUTS:
- Dedicated Areas
- Flexible Space
- Mixed Layout

A key element of DRP is the DRP table, which usually includes elements that are important in the process, including:

- forecast demands
- current inventory levels
- target safety stock
- recommended replenishment quantities
- replenishment lead times



What is 'Distribution Management'

Overseeing the movement of goods from supplier or manufacturer to point of sale. Distribution management is an overarching term that refers to numerous activities and processes such as packaging, inventory, warehousing, supply chain and logistics.

BREAKING DOWN 'Distribution Management'

Effectively managing the entire distribution process is critical to financial success and corporate longevity. The larger a corporation or the greater the number of supply points a company has, the more it will need to rely on automation to effectively manage the distribution process.

STEPS IN SHIPPING

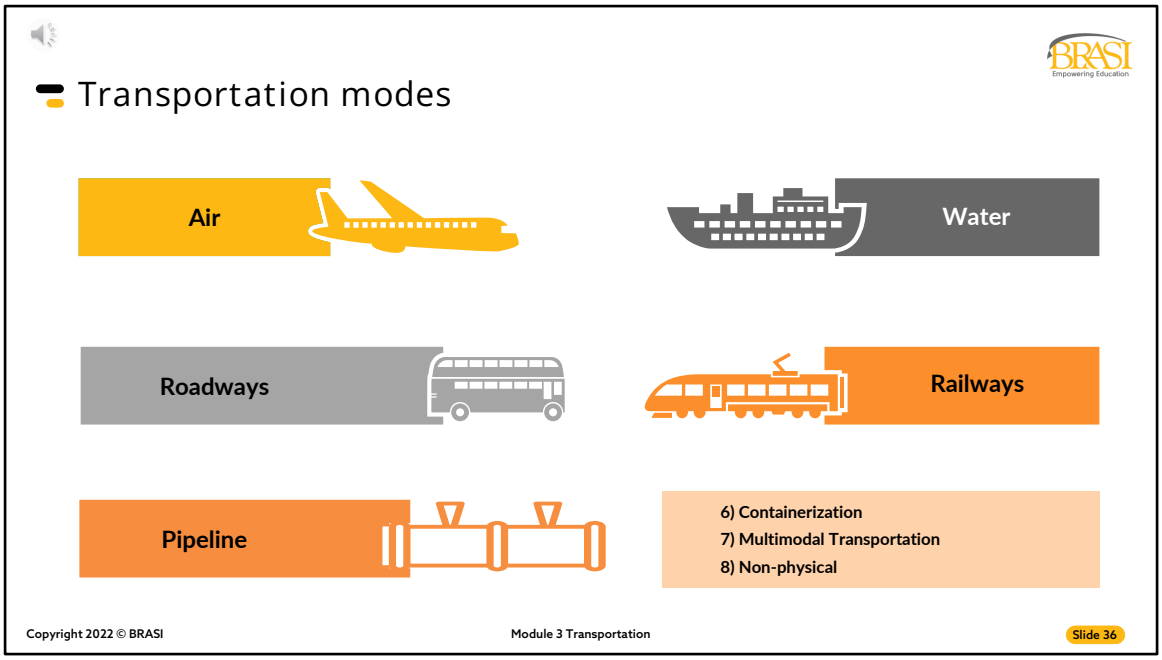
PICK, PACK AND LOAD
- Bin, Pallet, Forklift, conveyor, other handling

DOCUMENTATION
- Bill of Lading (B/L) or Airway Bill (AWB)
- Packing Slip
- Quality Certificate
- Invoice
- Customs Documents if applicable

TEMPERATURE MONITORS IF NEEDED

Transportation activity is triggered upon receipt of a customer order.

Some set-ups may include breaking of the bulk, repacking, labeling or even some amount of processing such as dispensing into smaller containers.



The modes of transport include various types of factors or methods to transfer the goods or product from one place to another place.

The modes are:-Each mode of transportation is designed for the type of goods it carries and offers the associated risks and benefits. These are discussed in detail in the next few slides.

Electronic delivery of information, documents and products such as songs and movies, is a form of non-physical transportation.

TRANSPORTATION MODES CHARACTERISTICS

Mode	Suitable for	Merits	Demerits
Railways	Minerals, Coal, Lumber, Steel, Heavy Machinery, Oil, grain, Cattle, other similar items	Large capacity Economical for bulk goods. Mostly weather resistant Major links to seaports	Costly over short distances Slower movement due to interchanges Frequent delays Routes limited to railway tracks. Require station and infrastructure
Waterways	Oil, Minerals, Coal, Lumber, Steel, heavy Machinery, almost all intercontinental trading goods not carried by airway.	Large capacity Economical for bulk goods. Mostly weather resistant	Long travel times compared to other modes. Requires infrastructure ports and handling equipment.
Roadways	Most consumer goods, packaged or fresh food, farm produce, garments, pharmaceuticals, almost anything that can be loaded and secured in a truck.	Economic over short distances. Speedier movement and maneuverability, Does not require huge infrastructure such as railway stations or ports.	Costlier over long distances. Driving hours restrictions may apply. Impacted by inclement weather

This chart outlines the suitability of each mode of transportation as it relates to the type of products carried.

TRANSPORTATION MODES CHARACTERISTICS

Mode	Suitable for	Merits	Demerits
Airways	Fresh fruits, flowers, pharmaceuticals, international mail and parcel, other high value items.	Fastest and most reliable. Mostly not impacted by unfavorable conditions on the ground	High cost per unit weight. Requires infrastructures – airport, runways, maintenance hangars Limited weight carrying capacity Restrictions on carrying certain chemicals for hazardous materials
Pipelines	Mainly oil, gas and water	Low operating cost Continuous supply Reduced risk of spillage or loss Possible underground network- no disruption on the surface	Requires heavy initial investment Potentially exposed to sabotage, or natural disasters

Non-physical transportation is limited to soft version of products, hence not a factor for physical logistics.

LINE HAUL COST

Transportation Hand-offs

- Local Transport at Origin>Long Distance Transport>Local transport at Destination

Line-Haul Cost

- Distance x Operating Cost Per KM or Mile, regardless of full or partial load (FTL or LTL)

Example:

Truck payload capacity = 10,000 KG, Line Haul Rate = $1.50/KM

1. FTL 10,000 KG to 1,000 KM = $1.50 x 1,000 = Total $1,500
   Transportation cost per KG = $1,500/10,000 KG = $ 0.15 per KG
2. LTL 6,000 KG to 1,000 KM = $1.50 x 1,000 = Total $1,500
   Transportation cost per KG = $1,500/6,000 KG = $ 0.25 per KG

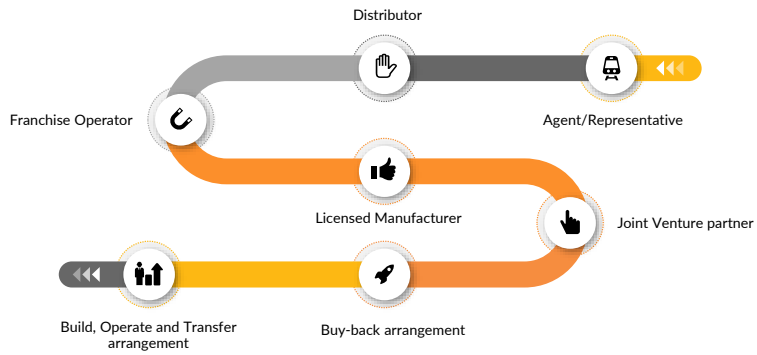
Line-haul cost has total capacity as a fixed element, and the running cost as a variable cost based on the distance covered, regardless of weight carried within defined capacity.

This is a major reason behind airlines seasonal fare policy, discussed under customer service/seasonal pricing. As the aircraft must fly as per published schedule, the line haul cost is committed. Revenue is based on a mix of tickets sold at a lower rate in advance in order to book much of the capacity, leaving the remaining capacity open to higher fare for later/last-minute bookings.

TYPES OF COLLABORATION

An international supply chain's operations are designed around its structure and contracts.

Some common set-ups are as follows:



- Agent/Representative
  - Agents and representative play a key role in the exploration phase of an international supply chain, facilitating various collaborations, licensing, acquisitions and forming the supply chains. They carry limited or no risk arising from business operations or inventories.
- Distributor
  - Distributors are a more integral part of the global supply chain as they take part in the planning process, inventory controls and 3PL/4PL logistics. Typically they own the inventory and carry the risks associated with it.
- Franchise Operator
  - Similar to a local franchisee, a global franchise is bound by the quality and technical agreements and purchase of ingredients, recipes, branding policies, etc. Monitoring of international franchises take more involvement and local agents or branch office can play an overseeing role.
- Licensed Manufacturer:
  - Manufacturing under license has become common due to the centers of manufacturing being different from the markets for many products. Technical agreement and patent laws are more defined and implanted in this arrangement due to the capabilities and potential of the manufacuter.
  - Joint Venture partner
- Build, Operate and Transfer arrangement:
  - The principal helps the local entity to create a project, operate collaboratively and then transfer once the costs are fully recovered. Some agreements may include ongoing maintenance and support. Usually made with governments and large city corporations for infrastructure such as highways and bridges.
- Buy-back arrangement:
  - In this case, the principal is entitled to, or obliged to, buy back a certain portion of production, either as an options or as a requirement in case there is unsold inventory in the producers zone of distribution.

ROLE OF TRADE BODIES AND AGREEMENTS

Trade bodies and trade agreements define the policies and terms of trade such as import duties, quotas, subsidies and other fiscal and non-fiscal terms and conditions

If not managed and enforced properly, then the rules and regulations may lead to improper trade practices, leading to potentially 'grey markets', thus defeating the purpose and intent of the rules and regulations

These terms and conditions determine the cost of manufacturing and distribution of goods on a global basis, therefore, influence the decision about plant location, distribution centers and trade routes.

Supply chain managers must be conversant with the applicable trade agreements, in order to benefit from the clauses while ensuring compliance

Trade bodies play an important role I regulating and facilitating international trade. These are funded by the participating countries and managed as independent or autonomous entities.

SOME TRADE BODIES

1. **WTO** - World Trade Organization. It replaced the previous international body GATT (General Agreement on Tariffs and Trade) in 1995. WTO) is an international organization that regulates international trade.

2. **UNCTAD** – United Nations Conference on Trade and Development. is the part of the United Nations Secretariat, dealing with trade, investment and development issues. The organization's goals are to: "maximize the trade, investment, and development opportunities of developing countries and assist them in their efforts to integrate into the world economy on an equitable basis

3. **ICC** - International Chambers of Commerce is the largest, most representative business organization in the world. Its 6 million members in over 100 countries have interests spanning every sector of private enterprise. It sets and maintains the terms for international commerce INCOTERMS:
   1) FOB, C&F, DDP, others
   2) Advantage of standard terms and interpretation for the purpose of developing contracts and settling insurance claims

4. **APEC** – Asia Pacific Economic Cooperation. The Asia-Pacific Economic Cooperation (APEC) is a regional economic forum established in 1989 to leverage the growing interdependence of the Asia-Pacific.

Over time, trade bodies evolve their structure and processes, however, the primary goal remains the same, I.e., support equitable and fair trade between participating countries.

These are only a few trade bodies, many more exist on an international and regional levels, aiming to promote trade and progress among their members states.

SOME TRADE AGREEMENTS

NAFTA: North American Free Trade Agreement/USMCA. An agreement signed by Canada, Mexico and the Unites States, creating a trilateral trade bloc, trade bloc in North America. The agreement came into force on January 1, 1994. It was replaced by a new agreement called USMCA on November 30, 2018. It provides for freer cross-border trade and has specific clauses for aluminum and some farm products.

ASEAN – Association of Southeast Asian Nations Free Trade Area. The ASEAN Free Trade Area is a trade bloc agreement by the Association of Southeast Asian Nations supporting local manufacturing in all ASEAN countries. The AFTA agreement was signed on 28 January 1992 in Singapore.

Trade agreement are long term terms understanding and commitment to follow certain principles, in order to maintain fair market practices.

INCOTERMS

INCOTERMS is a trademark owned by the International Chambers of Commerce (ICC), Geneva. It stands for 'International Commercial Terms'.

Scope: Standard Terms & Conditions for Transportation Cost and Liability
Benefits: Clear delineation of liability, helps settle claims and other matter, in case of accidents or other losses during transportation.

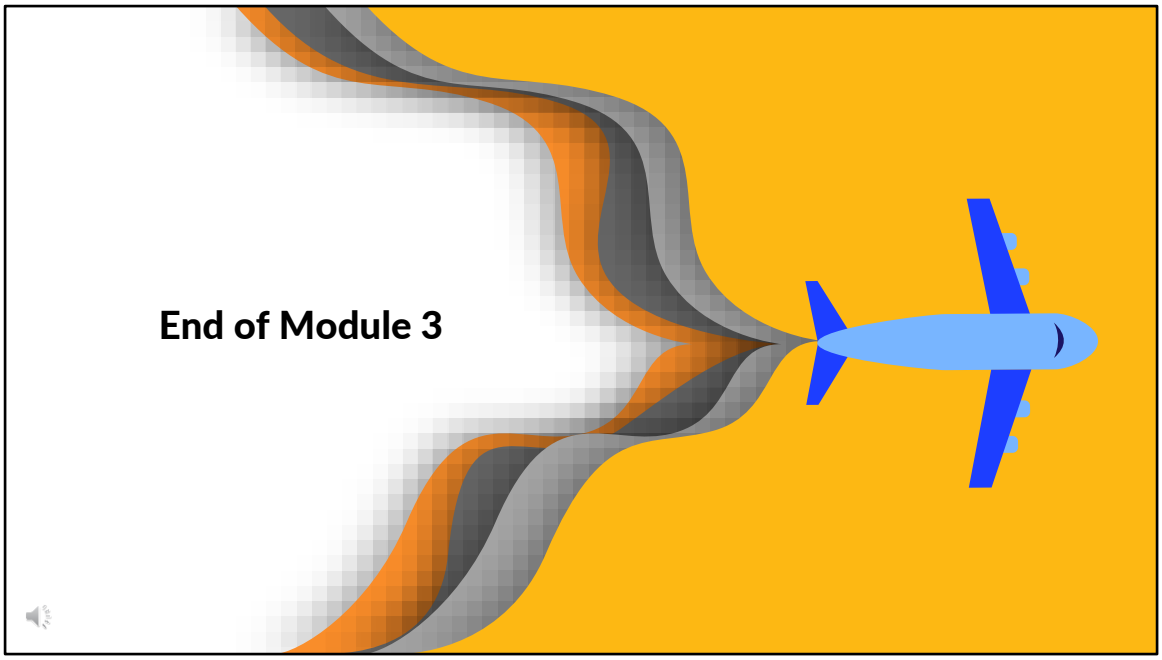
INCOTERM Examples:
FOB (Free On Board): Seller pays for local transportation to the point of loading to the ocean-going vessel or aircraft at the port of origin. Responsibility is transferred from seller to buyer at the point of vessel loading.

CIF (Cost Insurance and Freight): Seller pays for transportation and insurance up to the port of destination.

There are 13 INCOTERMS in total, as follows:

EXW - EX WORKS (... named place)
FCA - FREE CARRIER (... named place)
FAS - FREE ALONGSIDE SHIP (... named port of shipment)
FOB - FREE ON BOARD (... named port of shipment)
CFR - COST AND FREIGHT (... named port of destination)
CIF - COST, INSURANCE AND FREIGHT (... named port of destination)
CPT - CARRIAGE PAID TO (... named place of destination)
CIP - CARRIAGE AND INSURANCE PAID TO (... named place of destination)
DAF - DELIVERED AT FRONTIER (... named place)
DES - DELIVERED EX SHIP (... named port of destination)
DEQ - DELIVERED EX QUAY (DUTY PAID) (... named port of destination)
DDU - DELIVERED DUTY UNPAID (... named place of destination)
DDP - DELIVERED Duty PAID (... named place of destination)

The latest version of INCOTERMS containing complete details can be obtained at the published web site iccwbo.org.



The end of Module 3.

Key Topics

- Customer Relationship Management
- Key Performance Indicators
- Supplier Relationship Management
- Manufacturing Environments & Strategies
- Push and Pull Boundary/Delayed Differentiation
- Inventory Management
- Warehousing and Distribution, INCOTERMS
- Product Cost and Cost of Goods Sold
- Role of Technology in Supply Chain Management

Module 3: INVENTORY & LOGISTICS

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