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Cognizant | Manufacturing: An Introduction

Getting Started

Manufacturing is the process of transforming raw materials and purchased components into saleable products by using tools and labor. The word 'manufacturing' has been derived from the Latin root "manu factura", which means, "making by hand".

"MAKING THINGS, WITH THE USE OF TOOLS AND LABOR FOR USING AND SELLING"

This course provides an overview of the basics of manufacturing and its classifications based on the products, operations, and processes.

At the end of this course, you will be able to:

- Describe the manufacturing process
- Classify the manufacturing processes
- Understand the types of the manufacturing industries

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Cognizant | Manufacturing: An Introduction

What is Manufacturing?

Manufacturing refers to a range of activities in which raw materials are transformed into finished goods on a large scale. Manufacturing, in new parlance, is defined as the transformation of raw materials, components, and purchased items into a saleable product by using assembly and mechanical or chemical processes in different stages.

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Cognizant | Manufacturing: An Introduction

Types of Economic Systems

Manufacturing takes place in all types of economic systems. Few such examples are:

- Free Market Economy: Here manufacturing is usually directed towards the mass production of products for sale to consumers at a profit. This process occurs under some degree of government regulation.
- Collectivist Economy: Here manufacturing is frequently directed by the state to supply to a centrally planned economy.

Modern manufacturing includes intermediate processes that are required for the production and integration of a product's components. Some industries, such as, semiconductor and steel manufacturers, define modern manufacturing as "fabrication".

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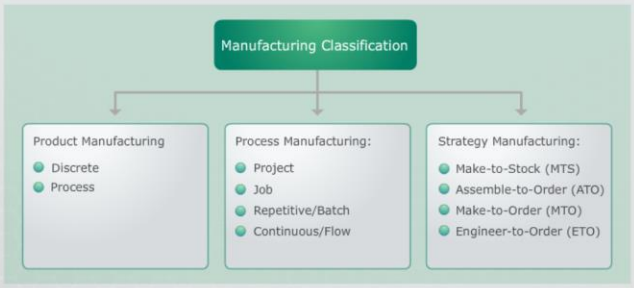
Cognizant | Manufacturing: An Introduction

Classification of Manufacturing

Manufacturing can be classified into three types.



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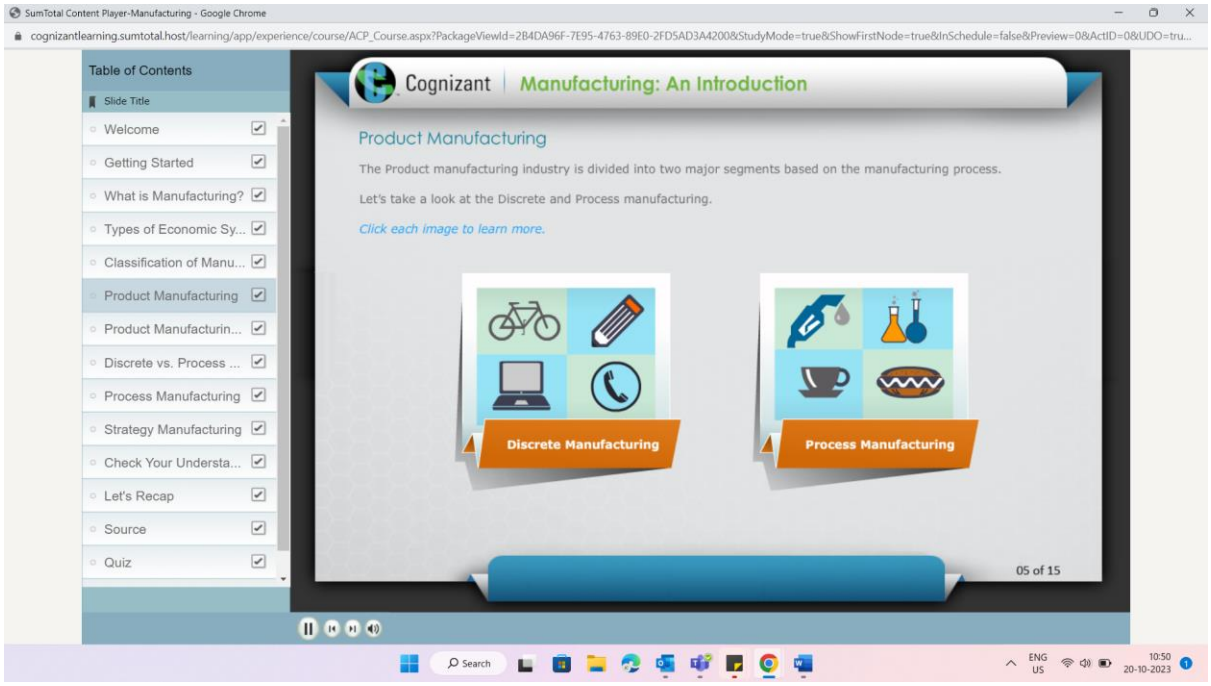
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Manufacturing: An Introduction
Product Manufacturing
The Product manufacturing industry is divided into two major segments based on the manufacturing process.
Let's take a look at the Discrete and Process manufacturing.
Click each image to learn more.
Discrete Manufacturing
Process Manufacturing
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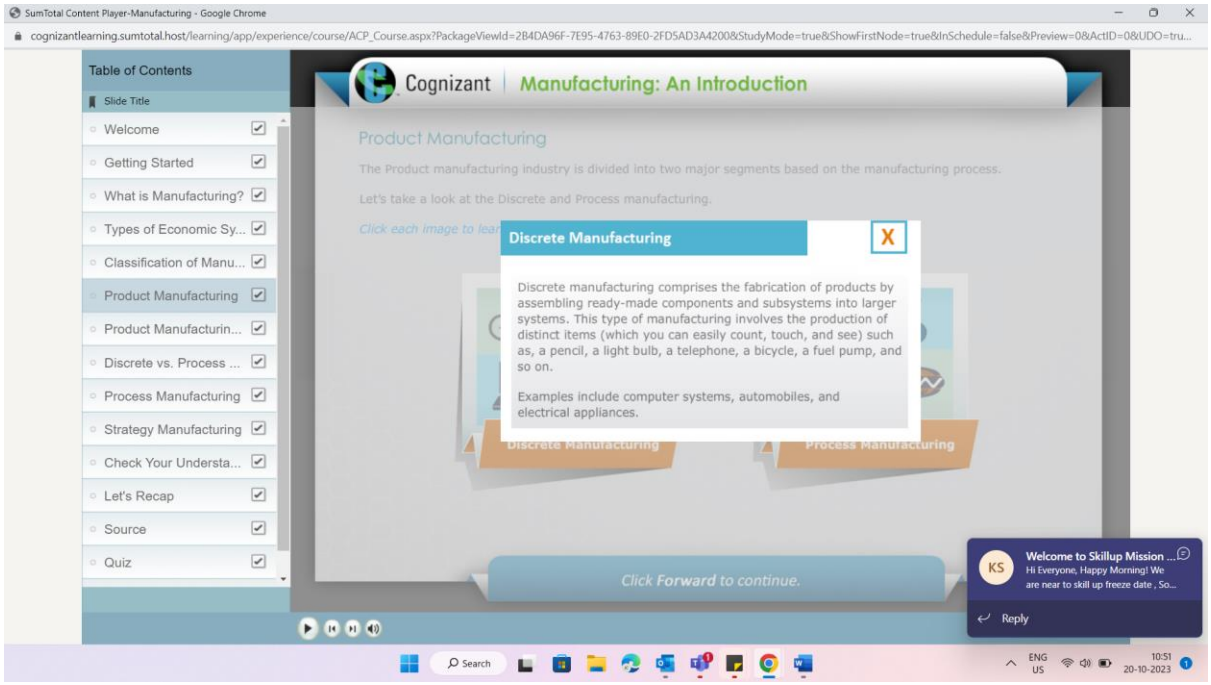
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Product Manufacturing
The Product manufacturing industry is divided into two major segments based on the manufacturing process.
Let's take a look at the Discrete and Process manufacturing.
Discrete Manufacturing
X
Discrete manufacturing comprises the fabrication of products by assembling ready-made components and subsystems into larger systems. This type of manufacturing involves the production of distinct items (which you can easily count, touch, and see) such as, a pencil, a light bulb, a telephone, a bicycle, a fuel pump, and so on.
Examples include computer systems, automobiles, and electrical appliances.
Click Forward to continue.
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Welcome to Skillup Mission ....
Hi Everyone, Happy Morning! We are near to skill up freeze date , So...
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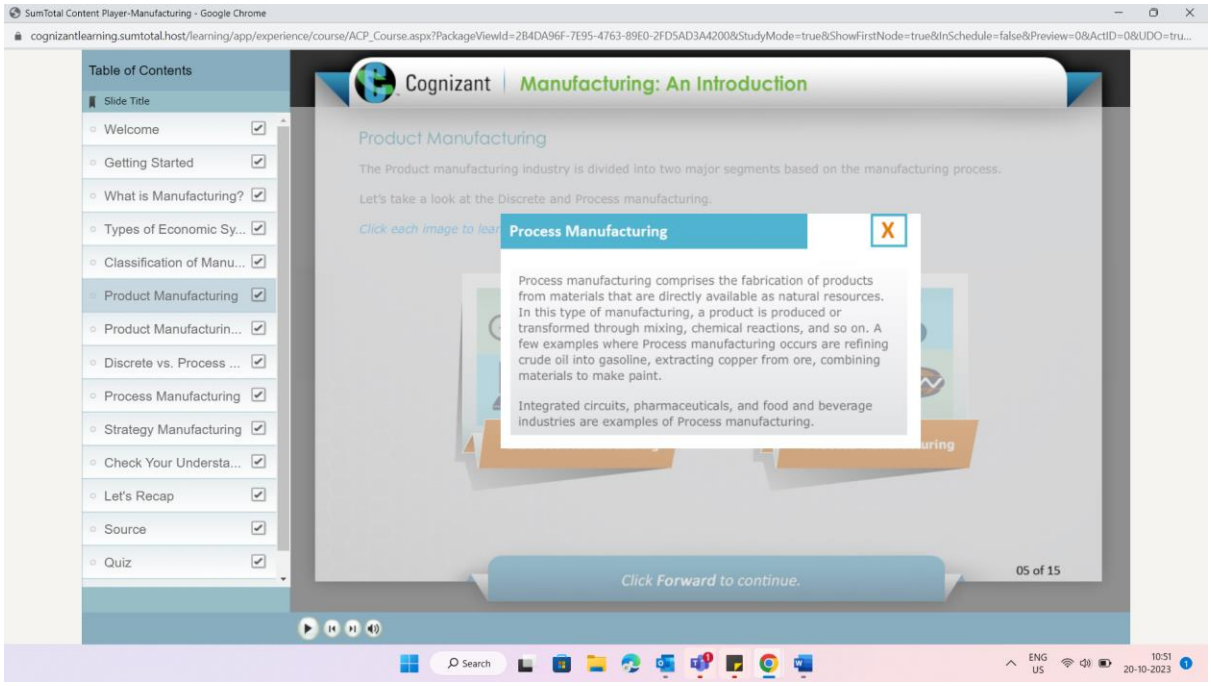
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Let's take a look at the Discrete and Process manufacturing.
Click each image to lear
Process Manufacturing
X
Process manufacturing comprises the fabrication of products from materials that are directly available as natural resources. In this type of manufacturing, a product is produced or transformed through mixing, chemical reactions, and so on. A few examples where Process manufacturing occurs are refining crude oil into gasoline, extracting copper from ore, combining materials to make paint.
Integrated circuits, pharmaceuticals, and food and beverage industries are examples of Process manufacturing.
Click Forward to continue.
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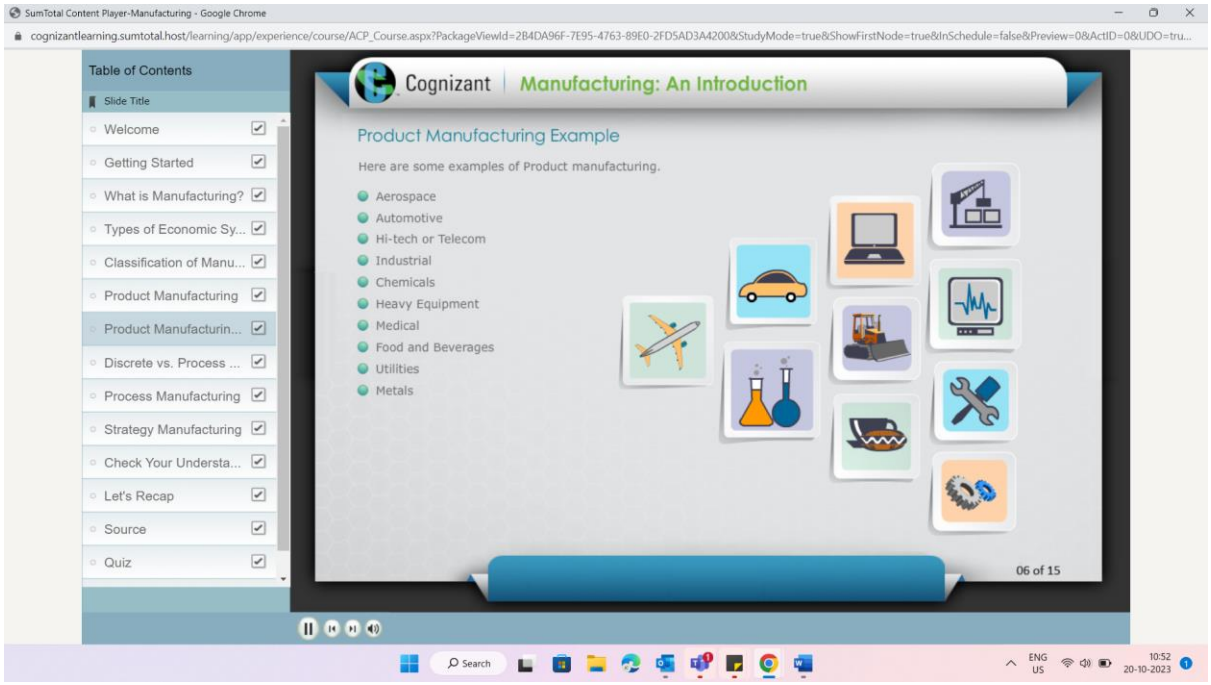
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Product Manufacturing Example
Here are some examples of Product manufacturing.
Aerospace
Automotive
Hi-tech or Telecom
Industrial
Chemicals
Heavy Equipment
Medical
Food and Beverages
Utilities
Metals
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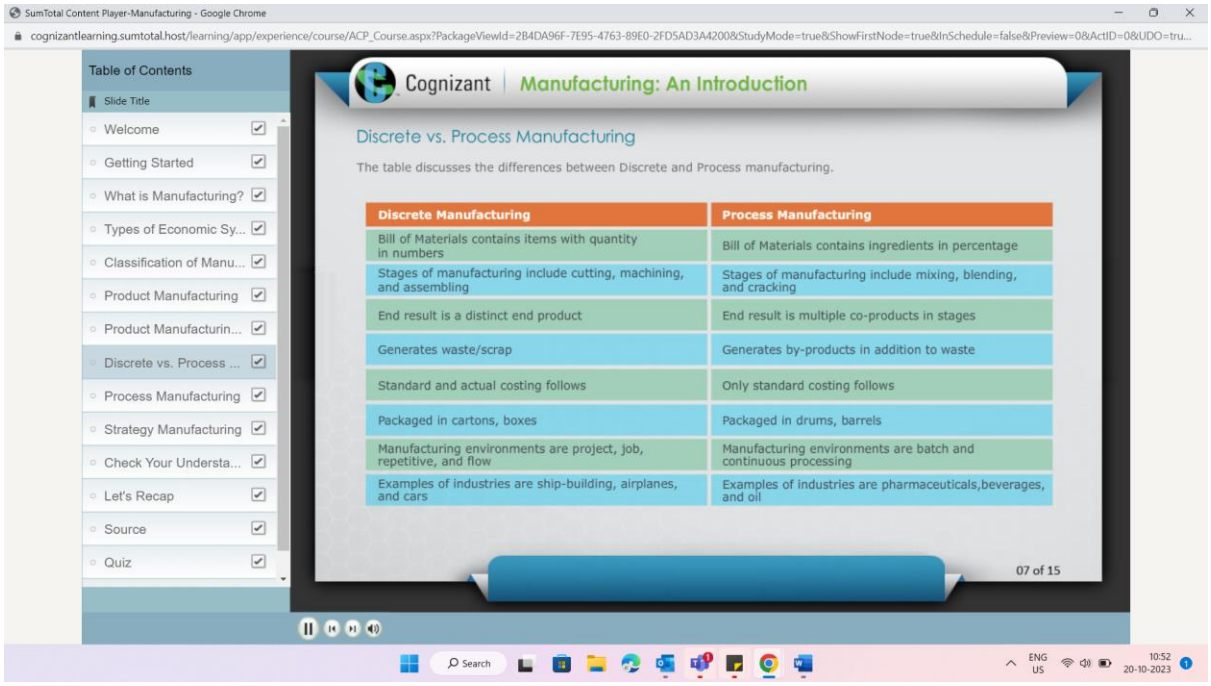
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Discrete vs. Process Manufacturing
The table discusses the differences between Discrete and Process manufacturing.
Discrete Manufacturing
Process Manufacturing
Bill of Materials contains items with quantity in numbers
Bill of Materials contains ingredients in percentage
Stages of manufacturing include cutting, machining, and assembling
Stages of manufacturing include mixing, blending, and cracking
End result is a distinct end product
End result is multiple co-products in stages
Generates waste/scrap
Generates by-products in addition to waste
Standard and actual costing follows
Only standard costing follows
Packaged in cartons, boxes
Packaged in drums, barrels
Manufacturing environments are project, job, repetitive, and flow
Manufacturing environments are batch and continuous processing
Examples of industries are ship-building, airplanes, and cars
Examples of industries are pharmaceuticals,beverages, and oil
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Process Manufacturing
The Process manufacturing industry adopts four ways of producing goods, based on product requirements in terms of their uniqueness and volume needed.
Product Requirement
Continuous/Flow Process-based
(High)
Repetitive/ Batch-based
Job-based
Project-based
Product Volume
(Low)
(Unique)
Product Variety
(Regular)
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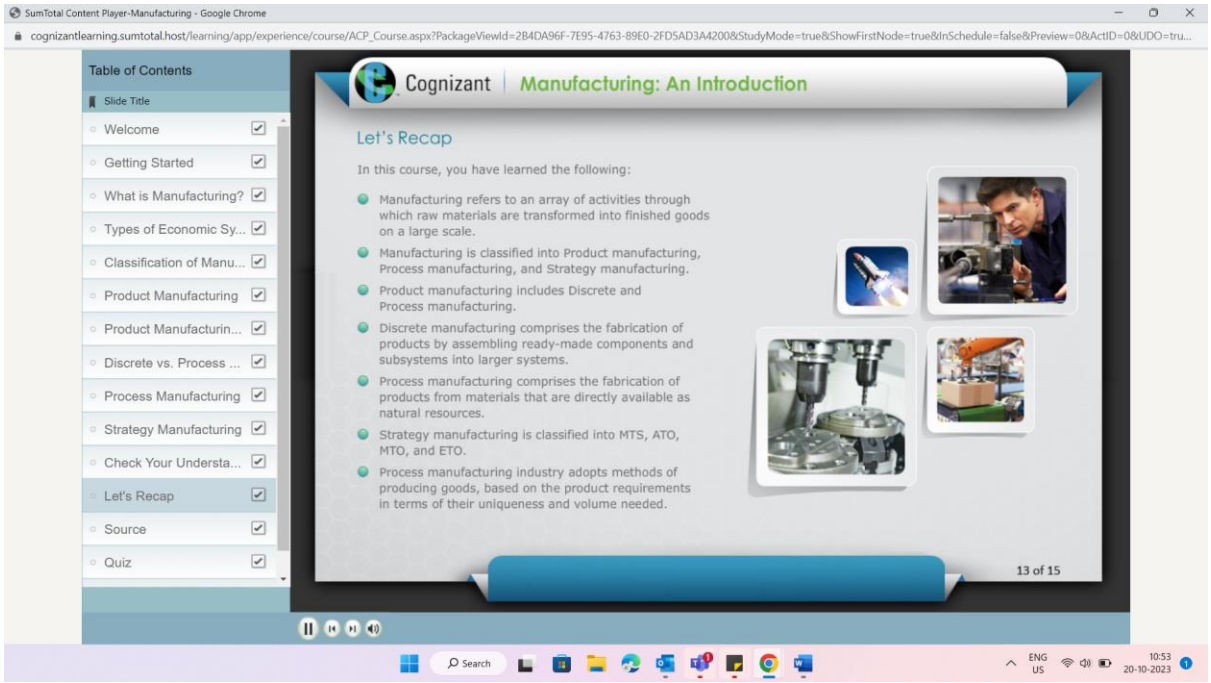

What is Push vs. Pull Manufacturing?

In Push vs Pull Manufacturing: Which is Best for You?, we discussed the different ways in which manufacturers can either push their product onto the market from already established inventory or adopt lean practices that enable current demand to dictate the rate of production.

In case you don't have time to read the full article, here's a short definition of push and pull manufacturing that will help everyone understand this article a little better.

- **Push Manufacturing**: Production is not linked to current demand. Rather, production schedules and amounts are dictated by a forecasted demand. Companies will produce a certain amount of stock and then push their product onto the market from an already established inventory.
- **Pull Manufacturing**: Production is directly linked to current demand. When customers place an order, production and distribution are directly affected and stimulated. This prompts production to either produce the required product for the customer directly or replenish the space left in a smaller inventory.

With these two methods in mind, let's delve a little deeper into advanced strategies like MTS, MTO, and ATO that utilize push or pull manufacturing. We'll explore each method's, which advantages, disadvantages, and associated risks while showcasing an example product that suits each method.

MTS: Key Takeaways

- MTS strategy depends on matching production and inventory with forecasted demand.
- Products are produced prior to receiving the customer's order. The order is completed by picking item from existing stock.
- Works best for low variety products where demand can be more easily forecasted.
- **Advantages**: Customer orders are pulled from existing pre-manufactured stock, enabling orders to be fulfilled instantaneously.
- **Disadvantages**: Significant upfront expenses developing inventory while adding the potential for underproduction or overproduction if forecasted demand is inaccurate.
- **Example**: Seasonal clothing requires fabrication prior to customer orders. To meet future market demand, clothing manufacturers will forecast demand based on past data and then produce according to the predetermined figures. Overproduced items are then sold at liquidation prices to deplete inventory and make room for newly produced items.

MTO: Key Takeaways

- Under MTO, products are only produced after the receipt of a customer order.
- Enables customers to purchase products that are customized to their exact specifications and demands.

- Works best for companies that build products with a high variety of customization or build expensive products that need significant investment before production can take place.
- **Advantages**: MTO enables complete product customization while enabling businesses to reduce inventory costs and wasteful activities like overproduction and underproduction.
- **Disadvantages**: Depending on the business, MTO items typically have longer lead times than other traditional strategies like MTS.
- **Example**: Manufacturers of aircrafts will only manufacture their products after orders and contracts are in place. The product is too expensive to begin production without an order and a secure investment in place.

ATO/CTO: Key Takeaways

- Assemble to order is a combination of Make to Order and Make to Stock.
- Products are produced quickly by assembling components (subassemblies) once the order is confirmed.
- The majority of expenses occur from producing and storing the different components, while the final assembly is relatively fast and inexpensive.
- **Advantages**: Ability to break down products into subassemblies, providing greater flexibility while also enabling a faster lead time.
- **Disadvantages**: Requires producing and storing the subassemblies which requires greater upfront investment by the manufacturer.
- **Example**: A personal computer distributor will already have all the required parts for a wide variety of final products. Once the order is made, then the computer will be assembled under the customer's specifications.


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Manufacturing: Operations
Getting Started
Operations are a major part of Manufacturing and Logistics. It involves Work Center, Routing, Lead Time, Quality Management, Cost of Quality, and a lot more.
At the end of this course, you will be able to:
Define Work Center
Describe Routing
Differentiate Quality Control and Quality Assurance
Describe Total Quality Management (TQM)
Identify cost of quality
Overview
Click Forward to continue.
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Manufacturing: Operations
Work Center
In the Manufacturing industry, a Work Center is an organizational unit that defines where and when an operation is to be performed.
The activities performed at or by the Work Center are evaluated by charge rates. These rates are determined by cost centers and the types of activities performed. A Work Center usually has a capacity limit.
Click each button to learn more.
Work Center Types
Work Center Rates
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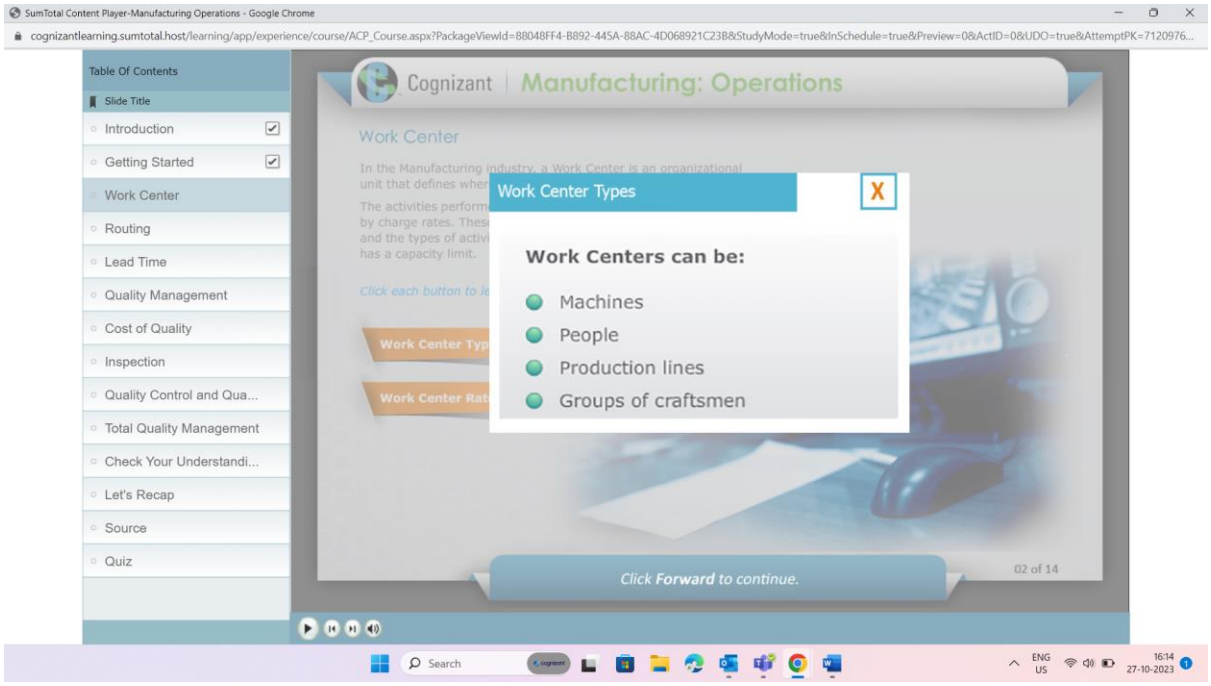
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Work Center
Work Center Types
Work Centers can be:
Machines
People
Production lines
Groups of craftsmen
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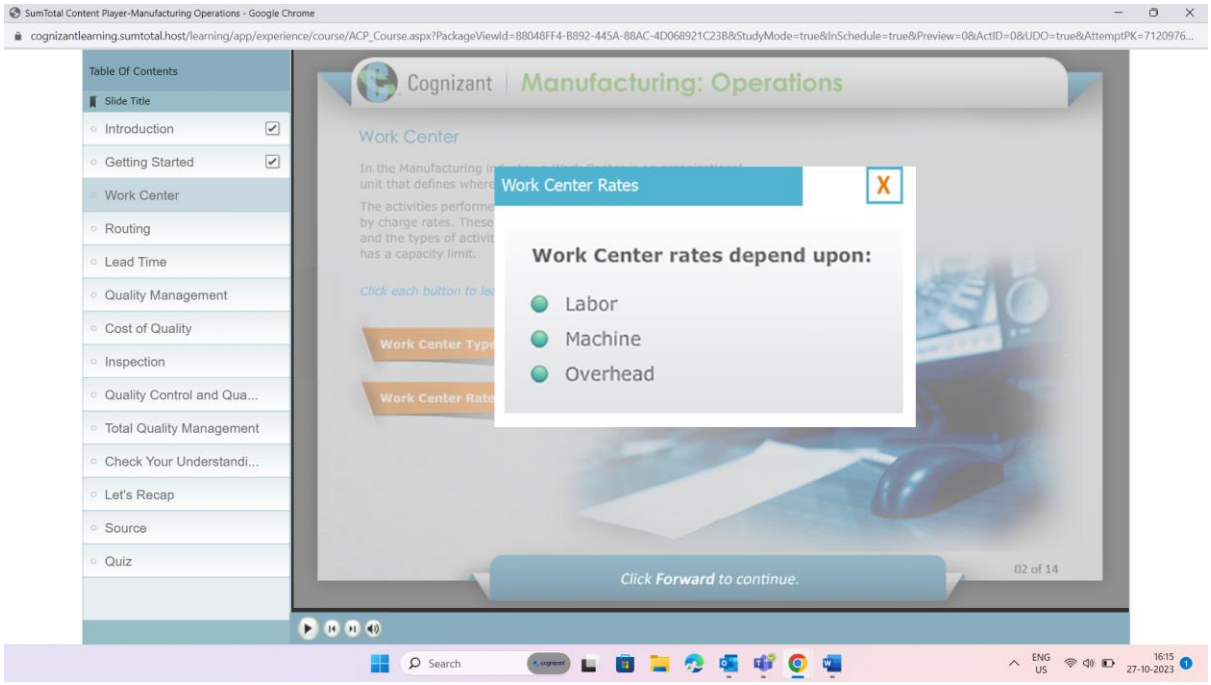
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Work Center Rates
Work Center rates depend upon:
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Machine
Overhead
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Cognizant | Manufacturing: Operations

Routing

Routing defines the sequence of operations for assembling or manufacturing an item at a Work Center.

Routing Details:

- Sequence
- Operation description
- Work Centers
- Set-up time
- Labor time
- Machine time
- Outside operations
- Equipment details

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Cognizant | Manufacturing: Operations

Lead Time

Lead Time is the time lag between placing an order and actually receiving it. This extra time needs to be estimated and considered during planning.

Lead Time depends on:

- Serial or overlap of operations
- Fixed or variable Lead Time indicator
- Labor, setup, and machine hours in Routing
- Work Center, which is machine or labor centric
- Number of employees in a Work Center
- Hours per shift and shifts per day

*Click the **Some Important Terms** icon to learn more.*

Some Important Terms

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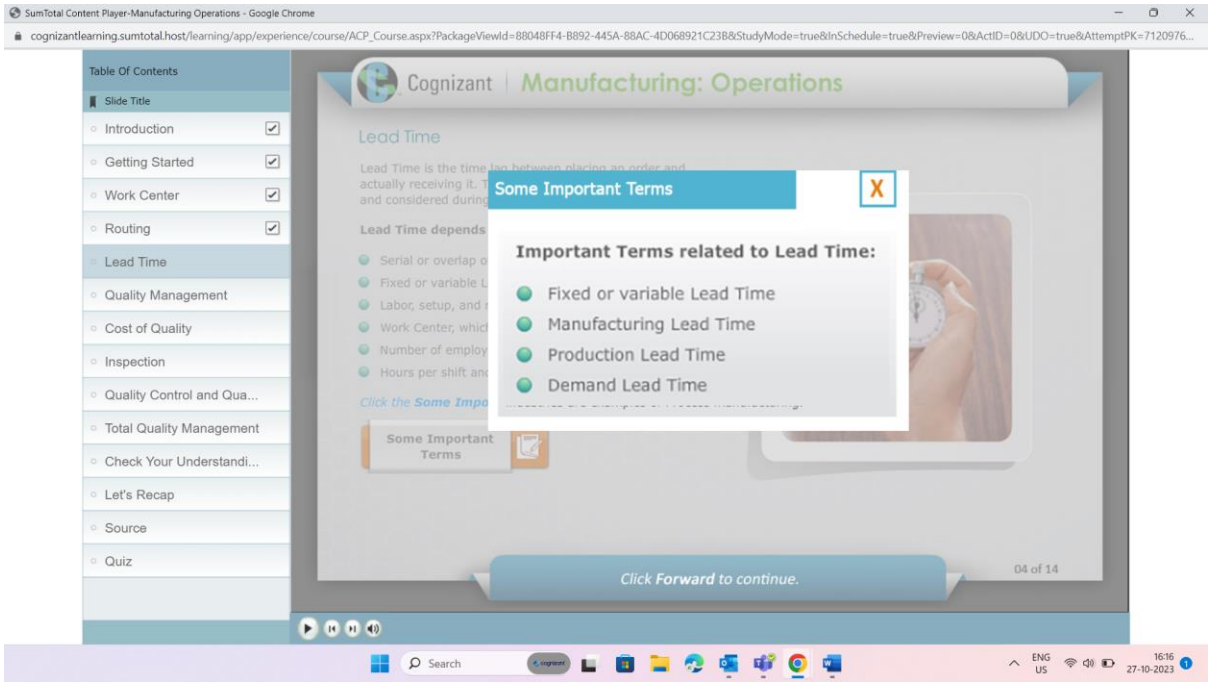
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Important Terms related to Lead Time:
Fixed or variable Lead Time
Manufacturing Lead Time
Production Lead Time
Demand Lead Time
Some Important Terms
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Quality Management
Quality means user satisfaction. To achieve that, Quality Management has to satisfy the needs and expectations of the user with the goods or services provided.
Dimensions of Quality:
Performance: Basic operating characteristics of a product
Features: Extra items added to basic features
Reliability: Probability of a product to operate properly within an expected time frame
Conformance: Degree to which a product meets pre-established standards
Durability: Longevity of a product
Serviceability: Ease of getting repairs
Aesthetics: Look, feel, sound, smell, or taste of a product
Safety: Security related to a product
Perceptions: Subjective perceptions based on brand name, advertising, and so on
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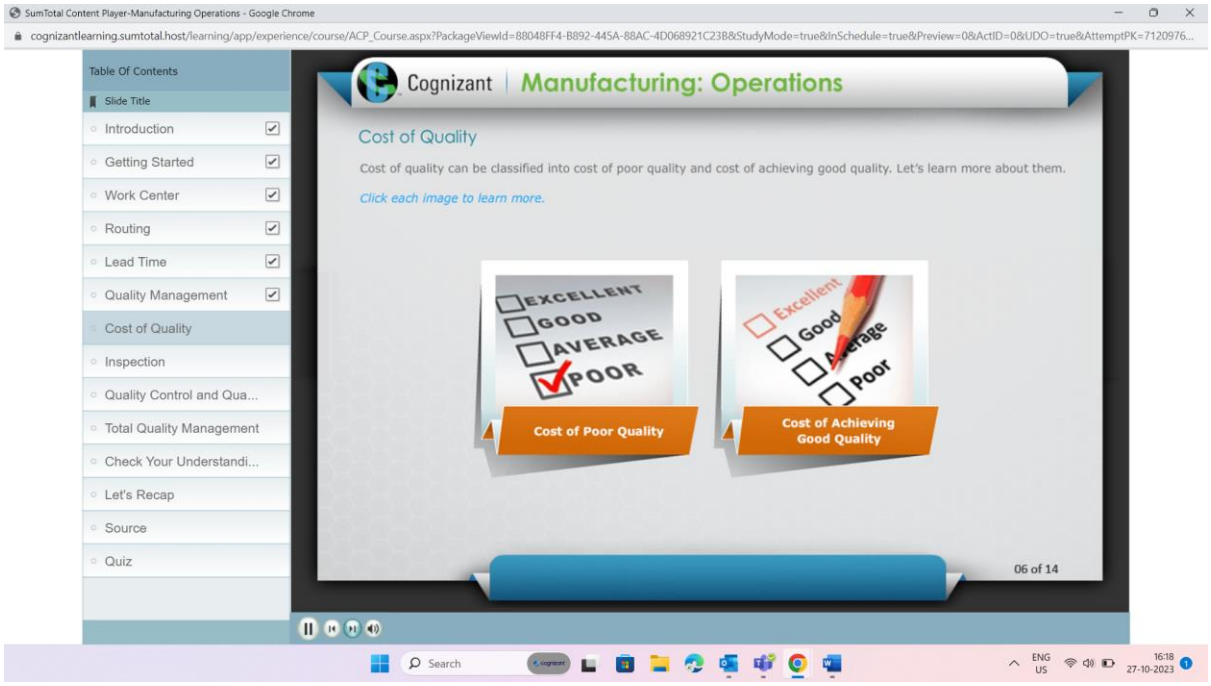
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Cost of Quality
Cost of quality can be classified into cost of poor quality and cost of achieving good quality. Let's learn more about them.
Click each image to learn more.
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GOOD
AVERAGE
POOR
Cost of Poor Quality
Excellent
Good
Average
Poor
Cost of Achieving Good Quality
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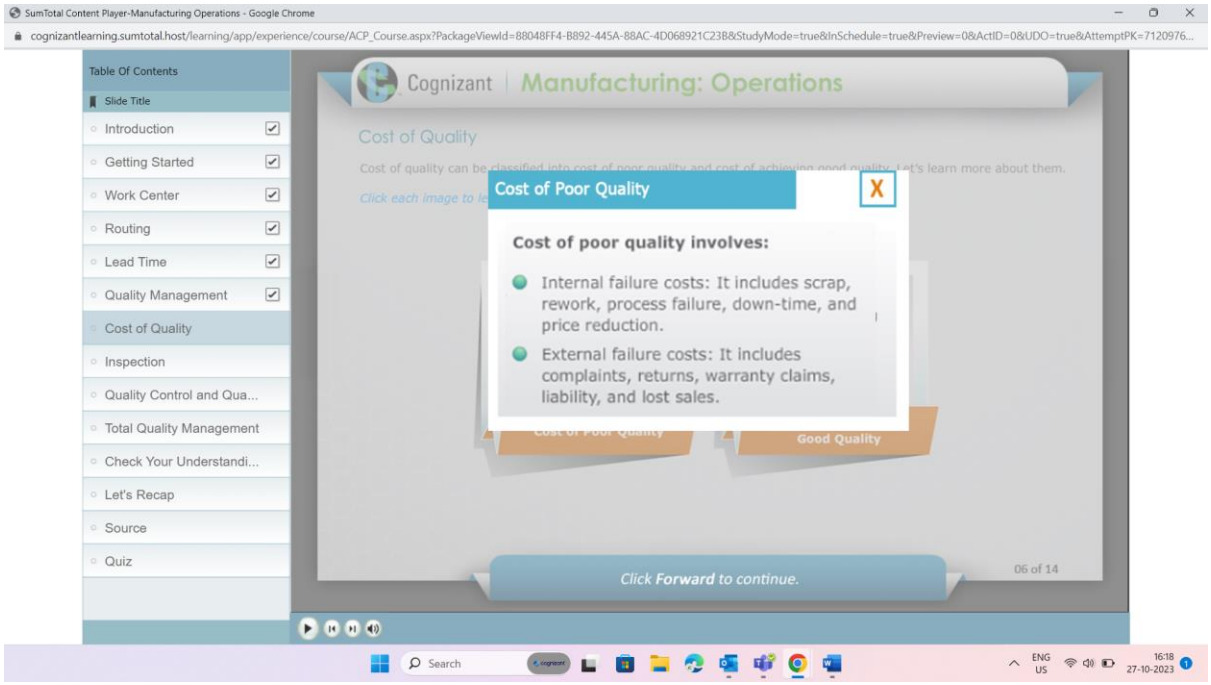
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Cost of Poor Quality
X
Cost of poor quality involves:
Internal failure costs: It includes scrap, rework, process failure, down-time, and price reduction.
External failure costs: It includes complaints, returns, warranty claims, liability, and lost sales.
Good Quality
Click Forward to continue.
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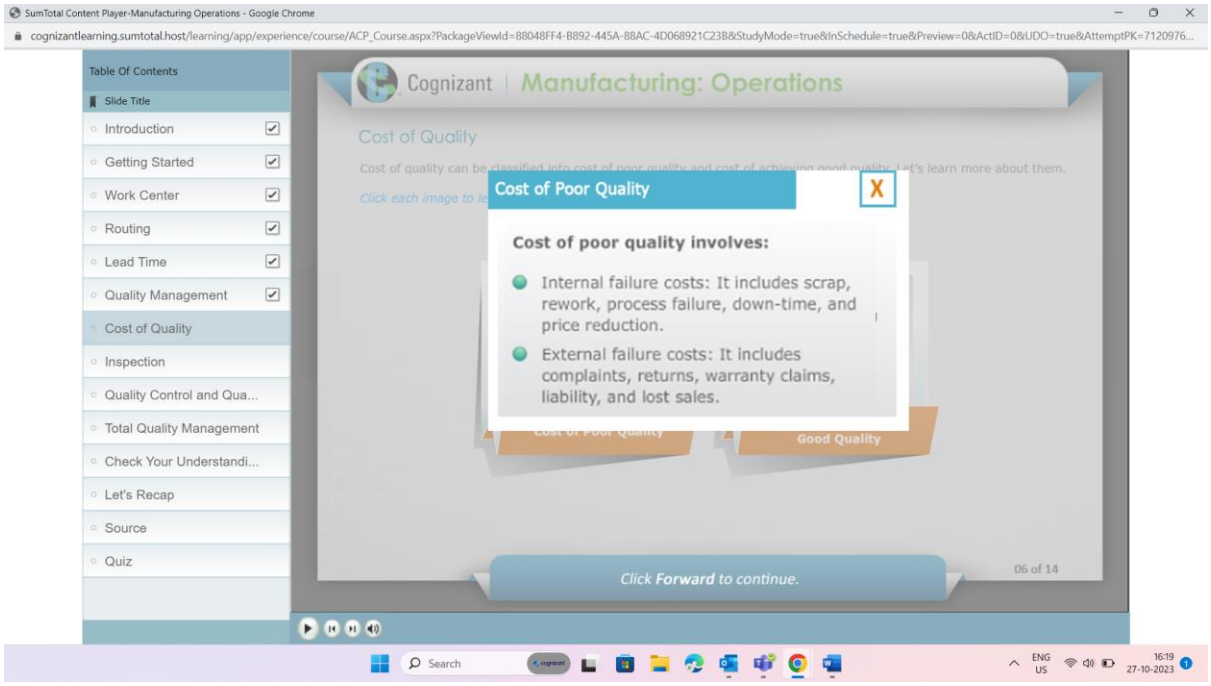
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Good Quality
Click Forward to continue.
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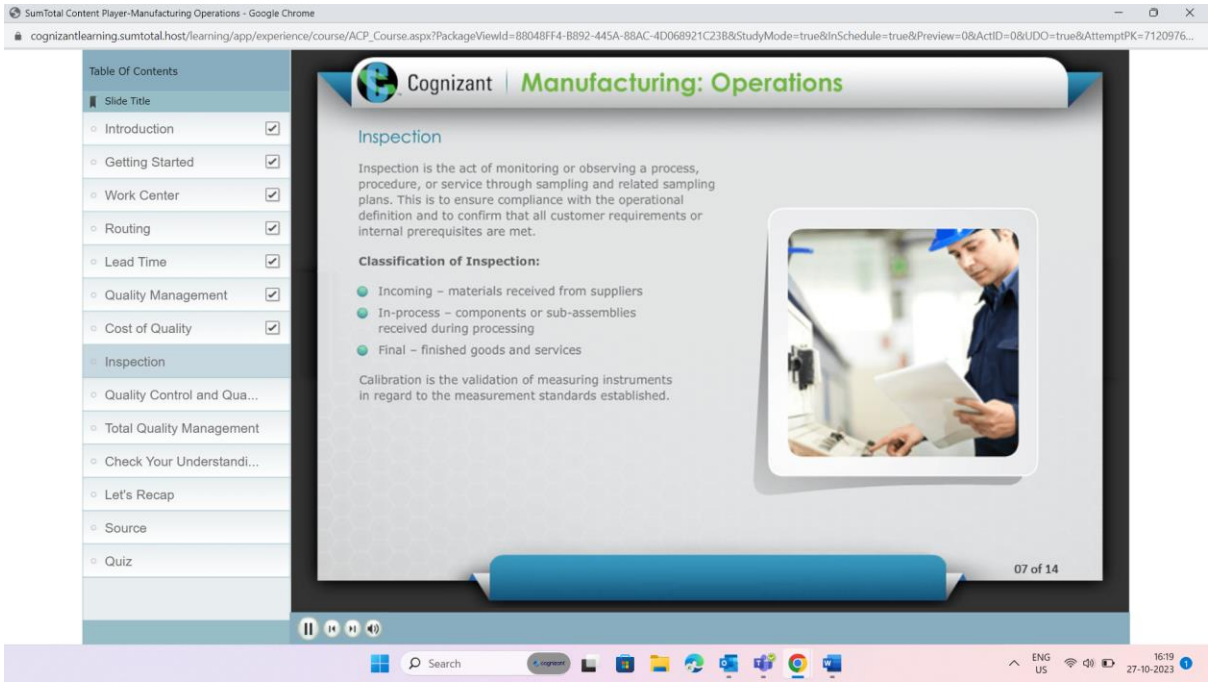
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Inspection
Inspection is the act of monitoring or observing a process, procedure, or service through sampling and related sampling plans. This is to ensure compliance with the operational definition and to confirm that all customer requirements or internal prerequisites are met.
Classification of Inspection:
Incoming – materials received from suppliers
In-process – components or sub-assemblies received during processing
Final – finished goods and services
Calibration is the validation of measuring instruments in regard to the measurement standards established.
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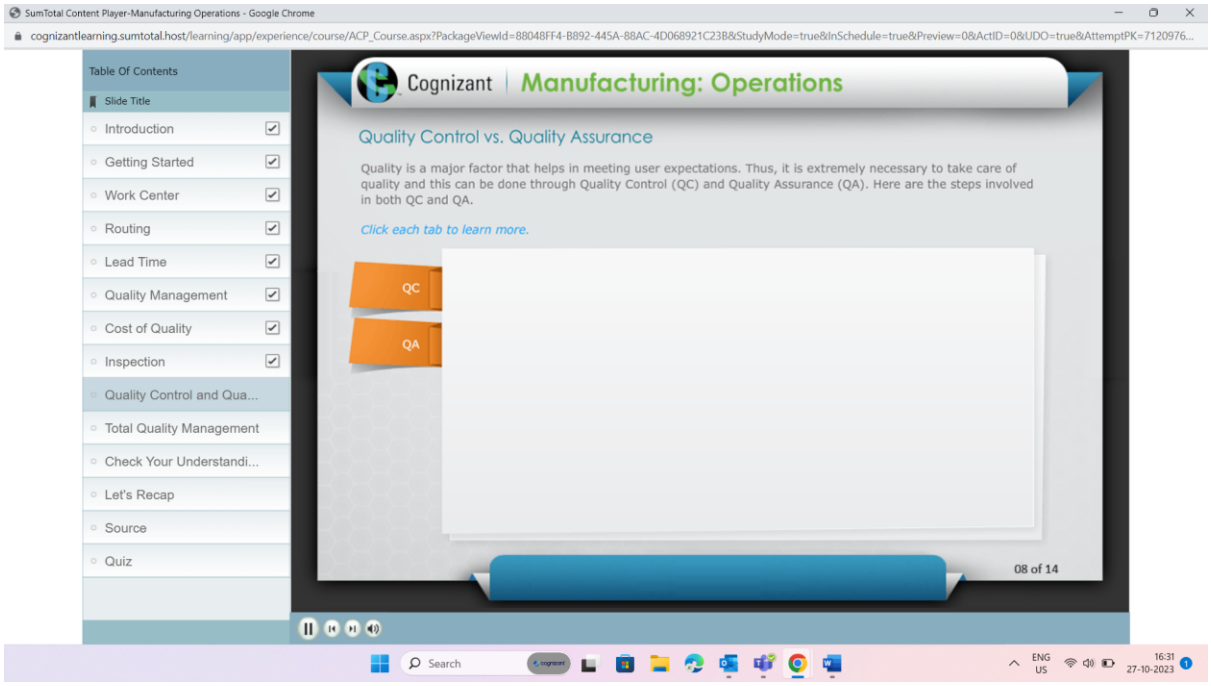
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Quality Control vs. Quality Assurance
Quality is a major factor that helps in meeting user expectations. Thus, it is extremely necessary to take care of quality and this can be done through Quality Control (QC) and Quality Assurance (QA). Here are the steps involved in both QC and QA.
Click each tab to learn more.
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Click each tab to learn more.
QC
QA
QC includes the operational techniques and activities that are used to fulfill requirements for quality. It is a reactive and product focused line function. Its purpose is to find defects.
Problem Management
Problem Identification
Problem Analysis
Problem Correction
Feedback to QA
O/P to QA
Click Forward to continue.
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Click each tab to learn more.
QC
QA
QA includes planned and systematic activities implemented to provide adequate confidence that an entity can fulfill requirements for quality. It is a proactive and process focused staff function to prevent defects.
Typical QA Steps
I/P from QC
Data Gathering
Problem Trend Analysis
Process Identification
Process Analysis
Process Improvement
Click Forward to continue.
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Total Quality Management
TQM is a process for managing quality. As per TQM, Quality Management must be a continuous way of life, a philosophy of perpetual improvement in everything one does.
Principles of TQM:
Be Customer Focused
Continual Improvement
Employee Involvement
Communication
Organization
Process Centered
Fact Based Decision Making
Integrated System
Strategic and Systematic Approach
Outlook
HR - India(Cognizant)
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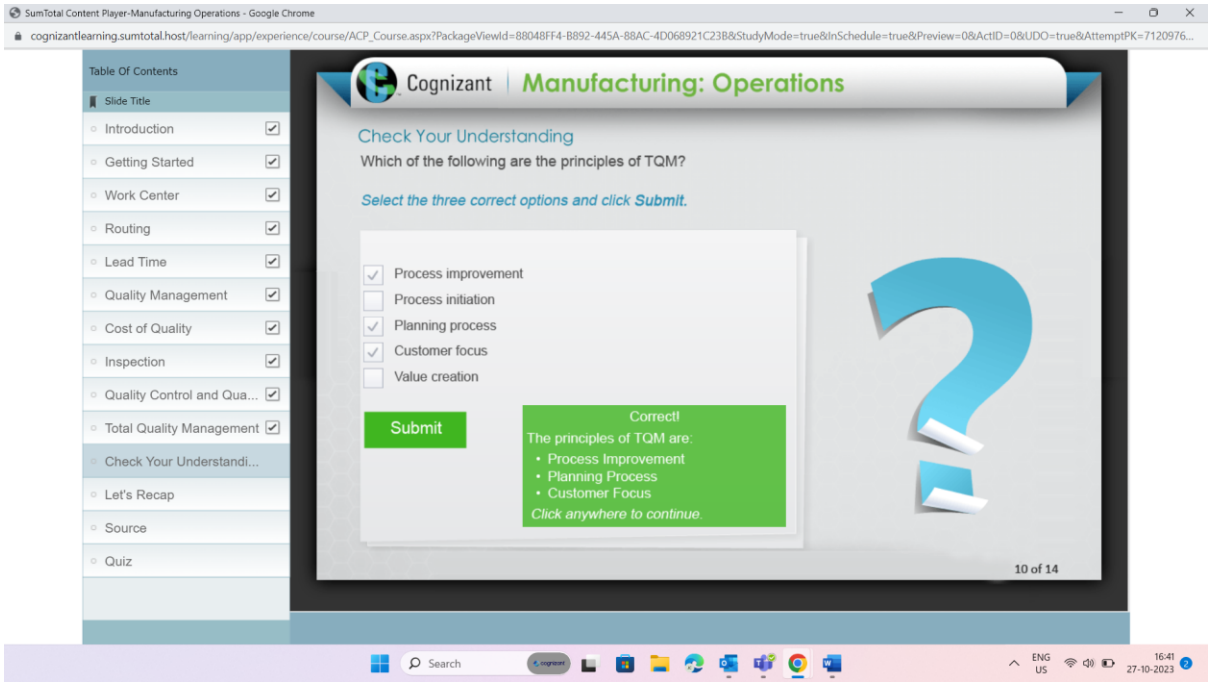
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Check Your Understanding
Which of the following are the principles of TQM?
Select the three correct options and click Submit.
Process improvement
Process initiation
Planning process
Customer focus
Value creation
Submit
Correct!
The principles of TQM are:
• Process Improvement
• Planning Process
• Customer Focus
Click anywhere to continue.
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Let's Recap
In this course you have learned the following:
Work Center is an organizational unit that defines where and when an operation must be performed.
Routing defines the sequence of operations for assembling or manufacturing an item at a Work Center.
Cost of quality can be of two types, cost of poor quality and cost of achieving good quality.
QC includes the operational techniques and activities that are used to fulfill requirements for quality, whereas, QA includes planned and systematic activities.
TQM is a process for managing quality.
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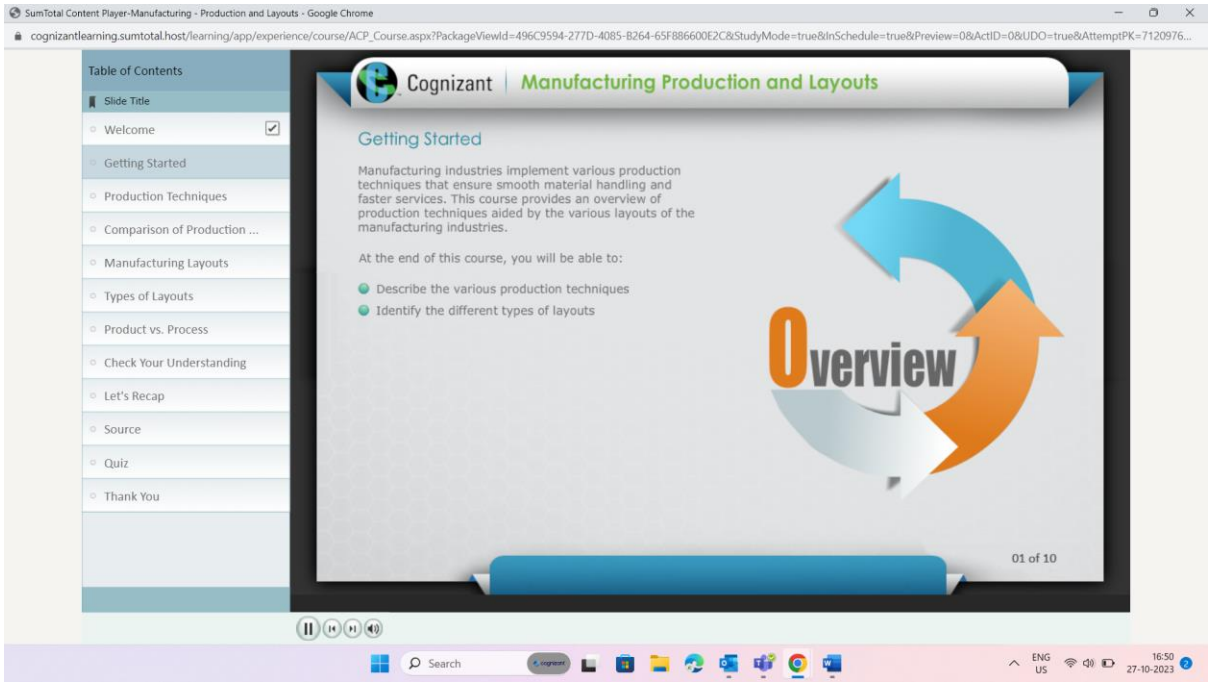
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Manufacturing Production and Layouts
Getting Started
Manufacturing industries implement various production techniques that ensure smooth material handling and faster services. This course provides an overview of production techniques aided by the various layouts of the manufacturing industries.
At the end of this course, you will be able to:
Describe the various production techniques
Identify the different types of layouts
Overview
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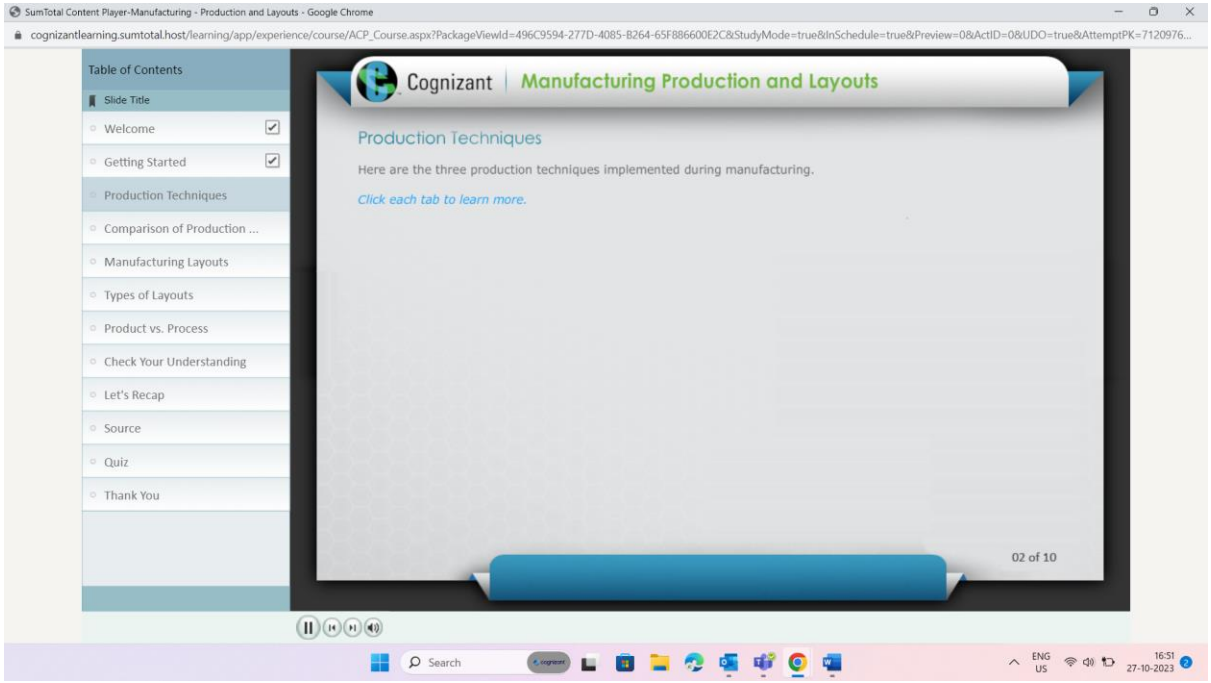
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Manufacturing Production and Layouts
Production Techniques
Here are the three production techniques implemented during manufacturing.
Click each tab to learn more.
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Cognizant | Manufacturing Production and Layouts

Production Techniques

Here are the three production techniques implemented during manufacturing.

Click each tab to learn more.

Job Production | Batch Production | Continuous Production

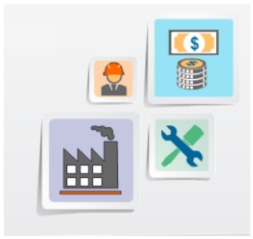
Job production is a technique of manufacturing a unique product for a specific customer.

Activities :

- Designing and implementing advertising campaigns
- Creating special tools
- Building a new factory well
- Installing new machinery

Characteristics:

- High quality work
- High level of customization to meet exact demands
- Flexibility in comparison to mass production
- Higher cost of production
- Specialized labor usage
- Slower production rate compared to other methods



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Production Techniques

Here are the three production techniques implemented during manufacturing.

Click each tab to learn more.

Job Production | Batch Production | Continuous Production

Batch production is a manufacturing technique in which products are created in stages, over a series of workstations, and in different batches.

Manufacturing Industries :

- Baked foods
- Sports shoes
- Active Pharmaceutical Ingredients (APIs)
- Water purification
- Inks
- Paints and adhesives

Characteristics:

- It ensures that all components are created at one work station, before they are moved on to the next.
- It benefits seasonal products where forecasting is difficult.
- It allows quick change of the production line to make varied products.
- It ensures that the production line runs for a certain amount Of time before changing the product.
- It produces less variety and moderate product quantity.

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Production Techniques

Here are the three production techniques implemented during manufacturing.

Click each tab to learn more.

Job Production | Batch Production | Continuous Production

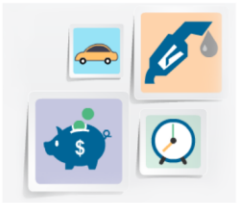
Continuous production is a technique by which large quantities of standardized products are manufactured and the same tasks are repeated with the same tool.

Manufacturing Industries:

- Automobiles
- Appliances
- Oil and gas
- Floating glass

Characteristics:

- It produces large quantities without interruption.
- It standardizes items and processes.
- It ensures continuous flow with high through-put.
- It involves low labor costs.
- It includes process and plant automation.
- It ensures reuse of the same tools for repeated tasks.
- It involves prolonged time period.



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Comparison of Production Methods

Here is a comparison of the three production methods, based on the parameters that are significant to the manufacturing industry.

Parameter	Job	Batch	Continuous
Job Variety	Very High	Moderate	Very Low
Process Flexibility	Very High	Moderate	Very Low
Production Cost	Very High	Moderate	Very Low
Production Volume	One-off	Low	Very High
Workmen Skills	Highly Skilled	Skilled	Semi-skilled
Uniqueness	Very High	High	Low
Customer Base	Specific and Unknown	Moderate	Largest
Customization	Very High	High	Low
Set-up Time	NA	High	Very Low
Down Time	NA	High	Very Low
Process Automation	NA	Low	Very High
Capital Incentive	Low	Moderate	Very High
Product Demand	Unknown	Predictable	Very Stable
Forecast Basis	Unknown	Product Group	Variant

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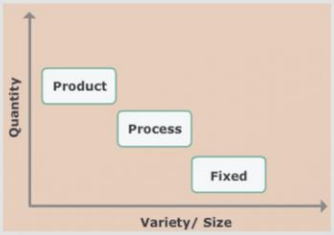
Cognizant | Manufacturing Production and Layouts

Manufacturing Layouts

Layout refers to the arrangement of various departments, work centers, and equipment. It emphasizes the movement of material, machine, and people in a production line.

Planning a layout is necessary for the manufacturing industry. The importance of planning a layout are listed below:

- Complies with safety, environmental, and legal requirements
- Eliminates unnecessary costs for space and material handling
- Reduces work-in-process inventory
- Produces goods
- Services faster
- Improves communication and morale
- Ensures smooth material handling and inventory flow
- Maintains future flexibility, expandability, and versatility



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Cognizant | Manufacturing Production and Layouts

Types of Layouts

Here is a detailed description of the three types of layouts in the manufacturing industry.

Click each tab to learn more.

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Cognizant | Manufacturing Production and Layouts

Types of Layouts

Here is a detailed description of the three types of layouts in the manufacturing industry.

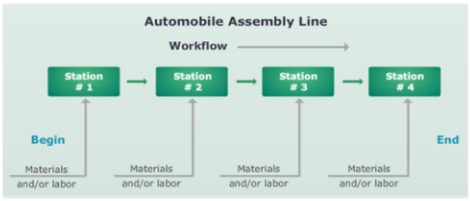
Click each tab to learn more.

Product Layout | Process Layout | Fixed Layout

Product Layout is designed to group similar resources together. All the materials, movements, and machines are arranged as per the sequence of operations on a particular product. It is also called the flow or line layout.

Characteristics:

- It standardizes product through standardized processing.
- It divides the jobs into a series of tasks.
- It uses specialized labor and equipment.
- It follows the same sequence of operations for each item.
- It ensures low WIP and set-up/run-time ratio.
- It maintains high production volume.
- It simplifies control.
- It restricts product changes due to inflexible systems. An example of Product Layout is an automobile assembly line.



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Cognizant | Manufacturing Production and Layouts

Types of Layouts

Here is a detailed description of the three types of layouts in the manufacturing industry.

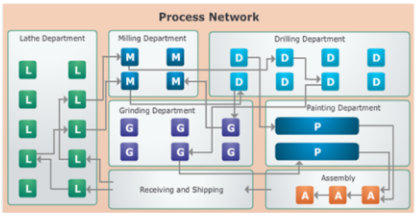
Click each tab to learn more.

Product Layout | **Process Layout** | Fixed Layout

Process Layout is designed to produce a specific product efficiently. All the materials and movements are arranged as per the processes carried out on a particular machine.

Characteristics:

- It maintains low volume and high variety with random routing.
- It includes frequent and long machine set-ups.
- It involves high WIP and material handling costs.
- It ensures high system flexibility.
- It involves complex scheduling.
- It includes project and batch manufacturing techniques.



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Cognizant | Manufacturing Production and Layouts

Types of Layouts

Here is a detailed description of the three types of layouts in the manufacturing industry.

Click each tab to learn more.

Product Layout | Process Layout | Fixed Layout

Fixed Layout is designed to manufacture products that are too large to move. The items that are worked on remain stationary, while the workers, materials, and equipment are moved as required.

Characteristics:

- It is used for huge and immovable products.
- It moves machines, materials, and workers to product.
- It ensures more continuity of assigned work.
- It leads to low equipment utilization.

The examples are ship building and aircraft manufacturing.

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Cognizant | Manufacturing Production and Layouts

Product vs. Process

Here is a comparison between the product and process/functional layout, based on the parameters that are significant to the manufacturing industry.

Parameter	Product	Process/Functional
Method	Continuous	Job/Batch
Rate of Output	High	Low
Production Volume	High	Low
Flexibility to Volume Changes	Very Low	High
Processing	Standardized Operations	Variety of Operations
Labor/Equipment Utilization	High	Low
Material Handling Cost	Low	High
Unit Production Cost	Low	High
Labor Specializations	Skilled	Semi-skilled
Individual Incentive Plan	Impractical	Possible

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Manufacturing Production and Layouts
Let's Recap
In this course, you have learned the following:
Manufacturing industries adopt production techniques based on the volume and uniqueness of their product requirements.
Layout refers to the arrangement of various departments, work centers, and equipment.
Plant layouts for production lines are classified into Product Layout, Process Layout, and Fixed Layout.
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Manufacturing: Scenarios
Getting Started
Manufacturing industries implement various business processes to ensure production of quality products.
This course provides a detailed description of the different processes adopted by the manufacturing industries.
At the end of this course, you will be able to:
Describe the manufacturing scenarios
Differentiate between the various manufacturing scenarios
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Manufacturing: Scenarios
Manufacturing Scenarios and their Variants
Manufacturing is classified in to four scenarios based on the market eco-system and product requirements. They are:
Make-to-Stock (MTS)
Assemble-to-Order (ATO) also known as Configured-to-Order (CTO)
Make-to-Order (MTO)
Engineer-to-Order (ETO)
Discrete manufacturing often adopts one of the above business models.
Process manufacturing on the other hand adopts a combination of business models such as MTS and MTO.
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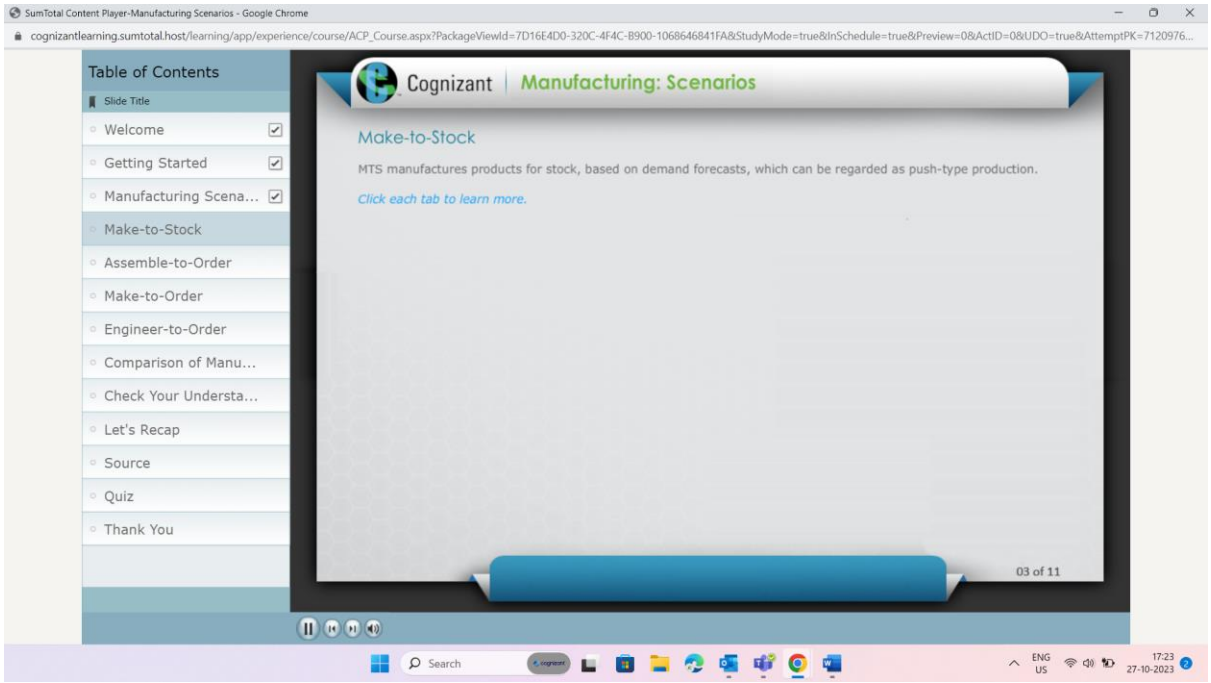
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Manufacturing: Scenarios
Make-to-Stock
MTS manufactures products for stock, based on demand forecasts, which can be regarded as push-type production.
Click each tab to learn more.
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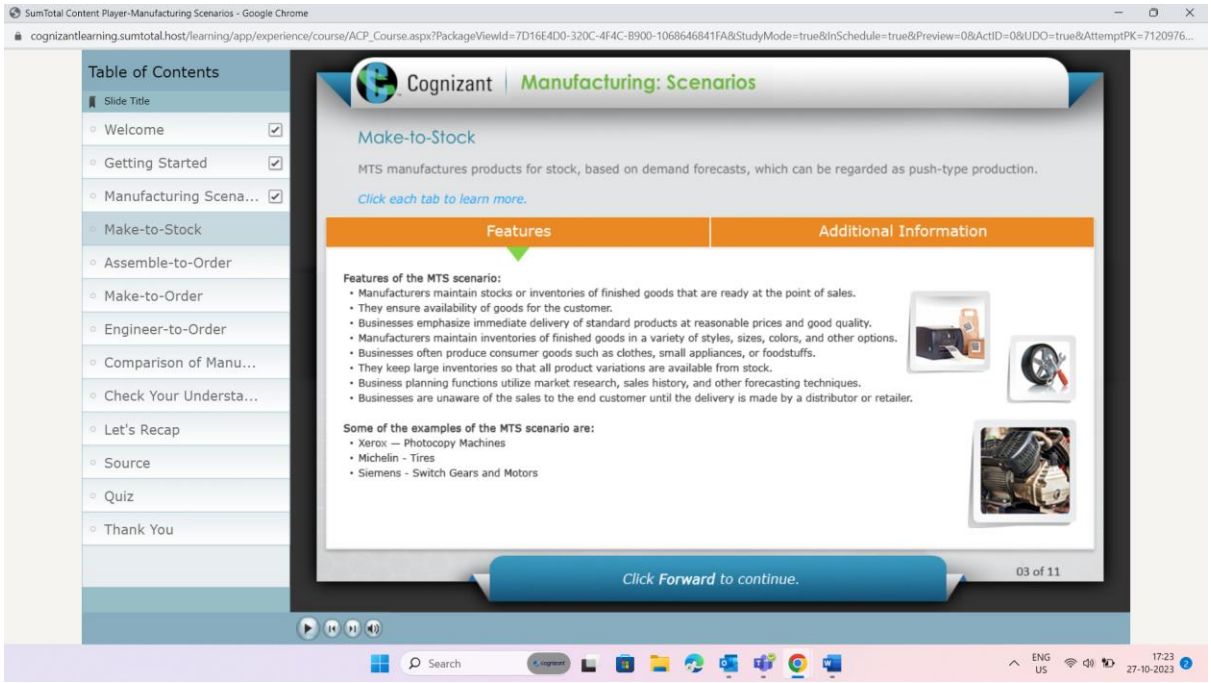
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Manufacturing: Scenarios
Make-to-Stock
MTS manufactures products for stock, based on demand forecasts, which can be regarded as push-type production.
Click each tab to learn more.
Features
Additional Information
Features of the MTS scenario:
• Manufacturers maintain stocks or inventories of finished goods that are ready at the point of sales.
• They ensure availability of goods for the customer.
• Businesses emphasize immediate delivery of standard products at reasonable prices and good quality.
• Manufacturers maintain inventories of finished goods in a variety of styles, sizes, colors, and other options.
• Businesses often produce consumer goods such as clothes, small appliances, or foodstuffs.
• They keep large inventories so that all product variations are available from stock.
• Business planning functions utilize market research, sales history, and other forecasting techniques.
• Businesses are unaware of the sales to the end customer until the delivery is made by a distributor or retailer.
Some of the examples of the MTS scenario are:
• Xerox — Photocopy Machines
• Michelin - Tires
• Siemens - Switch Gears and Motors
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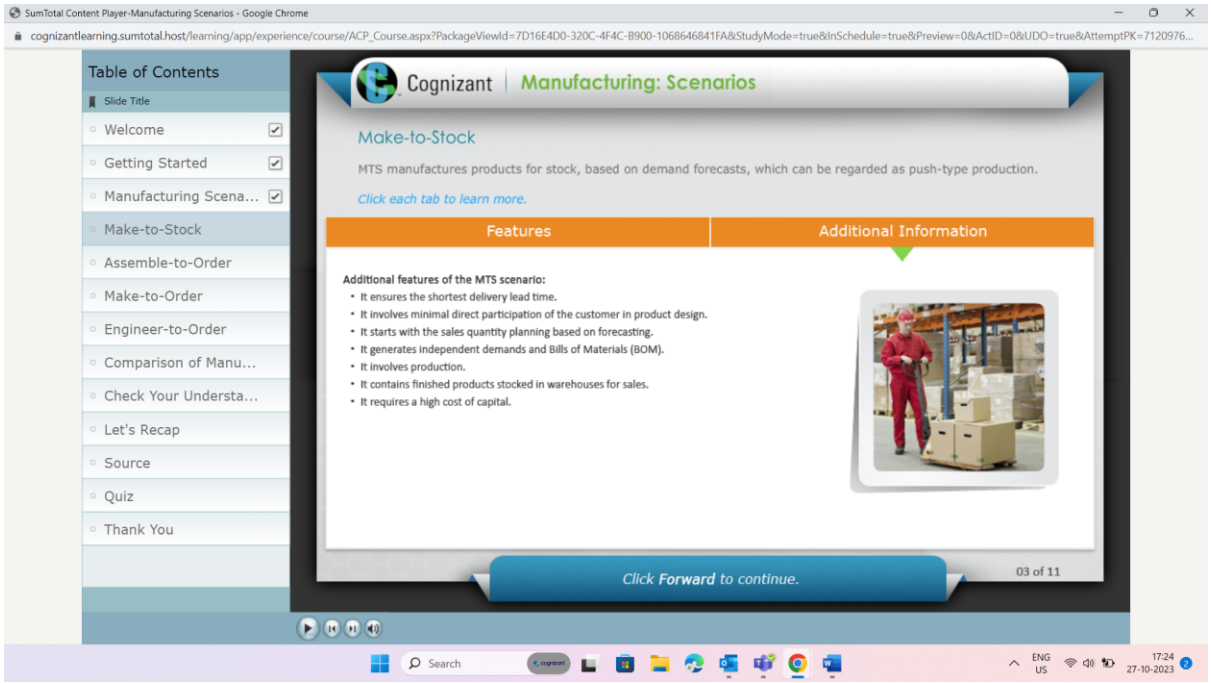
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Cognizant
Manufacturing: Scenarios
Make-to-Stock
MTS manufactures products for stock, based on demand forecasts, which can be regarded as push-type production.
Click each tab to learn more.
Features
Additional Information
Additional features of the MTS scenario:
• It ensures the shortest delivery lead time.
• It involves minimal direct participation of the customer in product design.
• It starts with the sales quantity planning based on forecasting.
• It generates independent demands and Bills of Materials (BOM).
• It involves production.
• It contains finished products stocked in warehouses for sales.
• It requires a high cost of capital.
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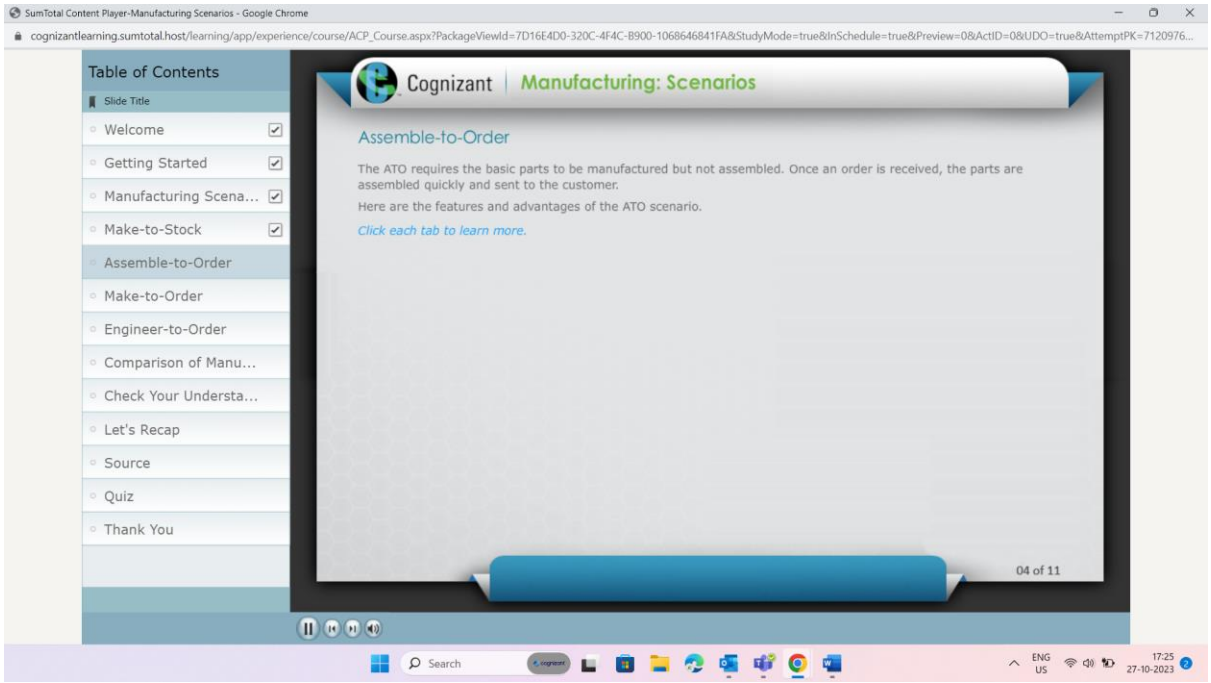
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Cognizant | Manufacturing: Scenarios
Assemble-to-Order
The ATO requires the basic parts to be manufactured but not assembled. Once an order is received, the parts are assembled quickly and sent to the customer.
Here are the features and advantages of the ATO scenario.
Click each tab to learn more.
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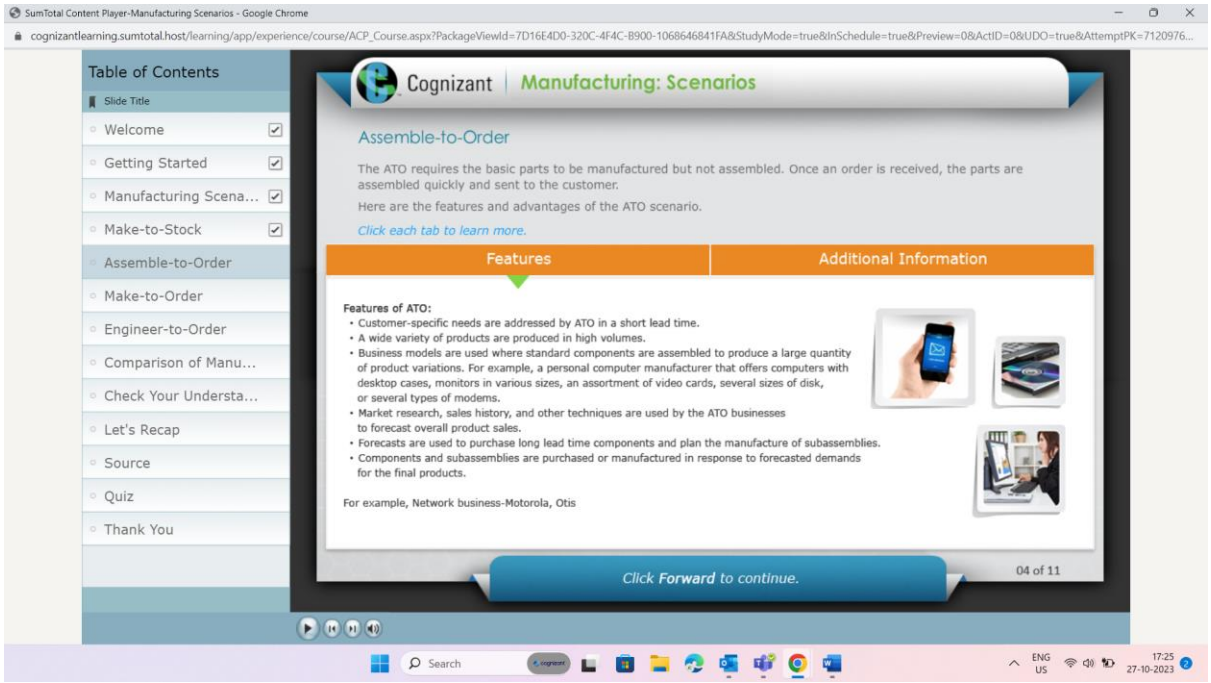
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Assemble-to-Order
The ATO requires the basic parts to be manufactured but not assembled. Once an order is received, the parts are assembled quickly and sent to the customer.
Here are the features and advantages of the ATO scenario.
Click each tab to learn more.
Features
Additional Information
Features of ATO:
• Customer-specific needs are addressed by ATO in a short lead time.
• A wide variety of products are produced in high volumes.
• Business models are used where standard components are assembled to produce a large quantity of product variations. For example, a personal computer manufacturer that offers computers with desktop cases, monitors in various sizes, an assortment of video cards, several sizes of disk, or several types of modems.
• Market research, sales history, and other techniques are used by the ATO businesses to forecast overall product sales.
• Forecasts are used to purchase long lead time components and plan the manufacture of subassemblies.
• Components and subassemblies are purchased or manufactured in response to forecasted demands for the final products.
For example, Network business-Motorola, Otis
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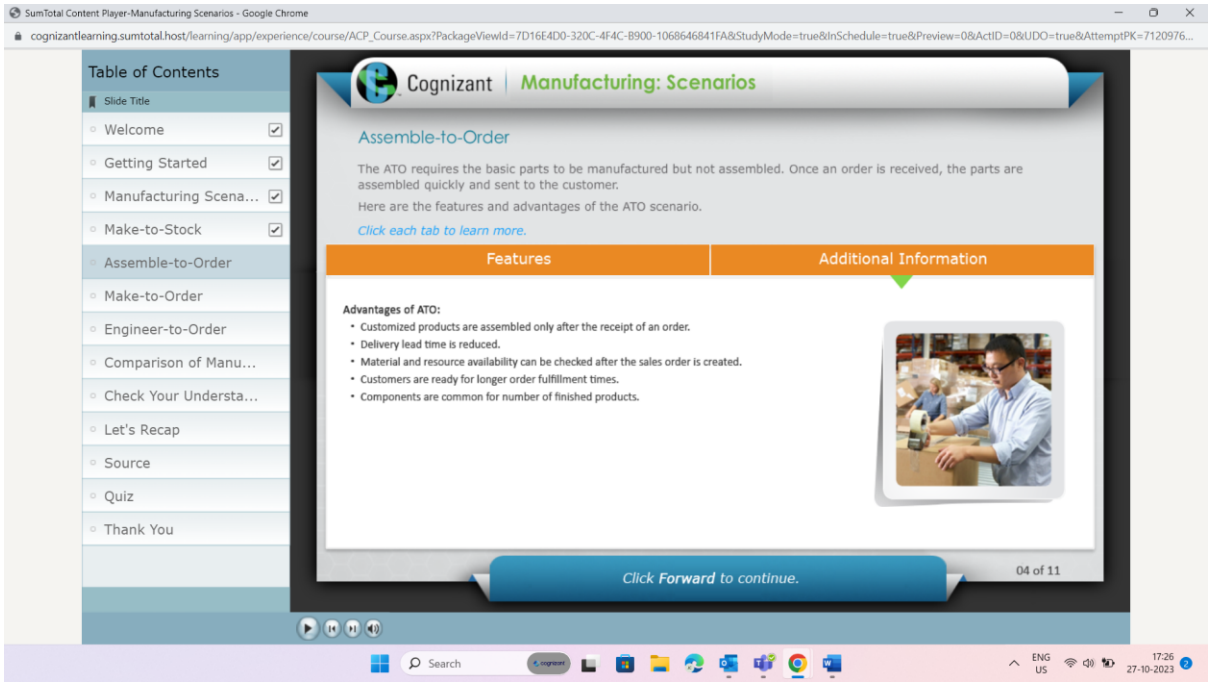
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Assemble-to-Order
The ATO requires the basic parts to be manufactured but not assembled. Once an order is received, the parts are assembled quickly and sent to the customer.
Here are the features and advantages of the ATO scenario.
Click each tab to learn more.
Features
Additional Information
Advantages of ATO:
Customized products are assembled only after the receipt of an order.
Delivery lead time is reduced.
Material and resource availability can be checked after the sales order is created.
Customers are ready for longer order fulfillment times.
Components are common for number of finished products.
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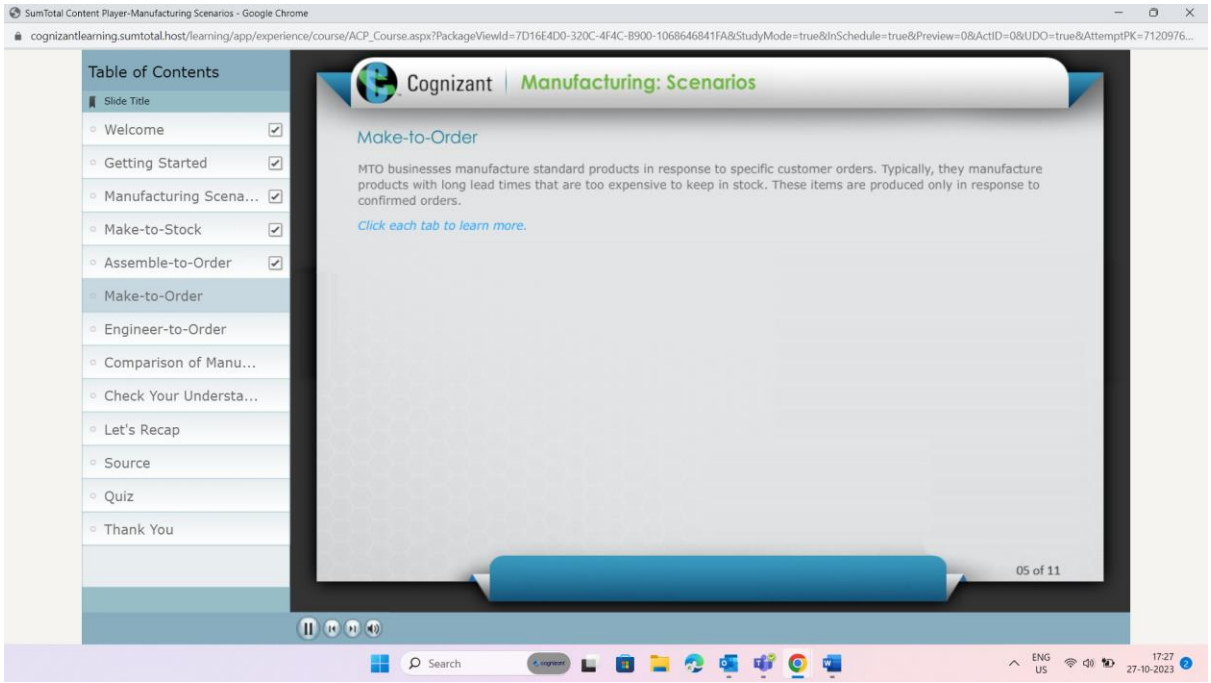
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Manufacturing: Scenarios
Make-to-Order
MTO businesses manufacture standard products in response to specific customer orders. Typically, they manufacture products with long lead times that are too expensive to keep in stock. These items are produced only in response to confirmed orders.
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Cognizant | Manufacturing: Scenarios

Make-to-Order

MTO businesses manufacture standard products in response to specific customer orders. Typically, they manufacture products with long lead times that are too expensive to keep in stock. These items are produced only in response to confirmed orders.

Click each tab to learn more.

Features | Additional Information

MTO products are often standard designs with many variations and low sales volumes.

An example of MTO business is the manufacture of commercial aircrafts. Commercial aircrafts are produced in response to specific customer orders. Railroad locomotives are another example of an MTO product. While the manufacturer of locomotives may engineer and offer standard designs, production normally begins in response to a specific order.

For example,

- Aircraft manufacturer-Boeing
- Steel products manufacturer

This process is used to manufacture products, which have unique specifications as per customer requirement.

Salient features of MTO:

- Customer order triggers the manufacturing process.
- Customer demand is difficult to accurately forecast.

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Cognizant | Manufacturing: Scenarios

Make-to-Order

MTO businesses manufacture standard products in response to specific customer orders. Typically, they manufacture products with long lead times that are too expensive to keep in stock. These items are produced only in response to confirmed orders.

Click each tab to learn more.

Features | **Additional Information**

Benefits of MTO in the manufacturing industry:

- It maintains reduced inventories.
- It ensures effective resource utilization.
- It ensures efficient customer order tracking.
- It tracks profitability of sales order.
- It reduces quality defects.
- It involves customer specific quality control.

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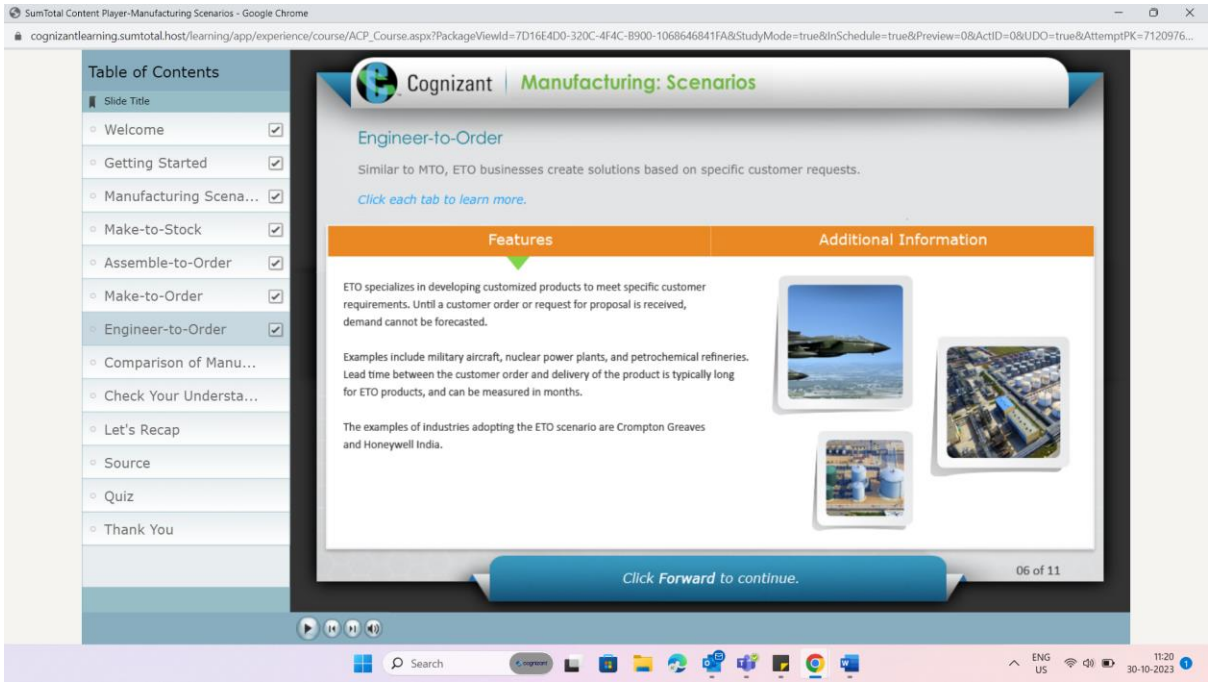
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Manufacturing: Scenarios
Engineer-to-Order
Similar to MTO, ETO businesses create solutions based on specific customer requests.
Click each tab to learn more.
Features
Additional Information
ETO specializes in developing customized products to meet specific customer requirements. Until a customer order or request for proposal is received, demand cannot be forecasted.
Examples include military aircraft, nuclear power plants, and petrochemical refineries. Lead time between the customer order and delivery of the product is typically long for ETO products, and can be measured in months.
The examples of industries adopting the ETO scenario are Crompton Greaves and Honeywell India.
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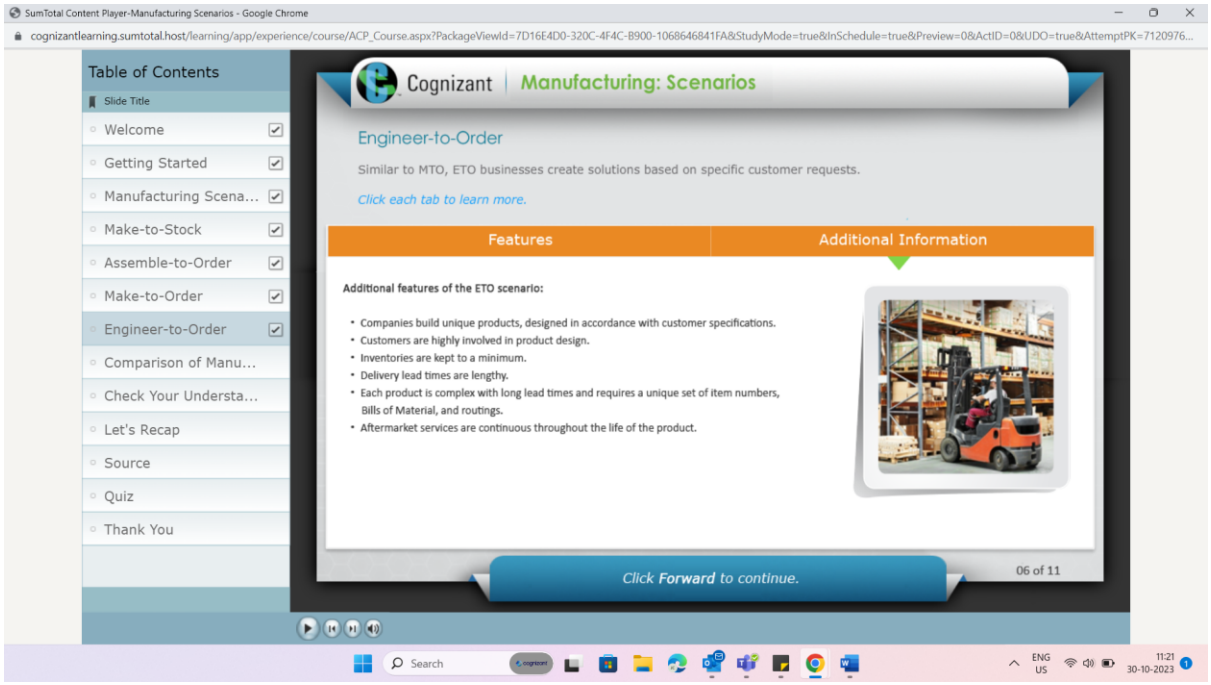
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Manufacturing: Scenarios
Engineer-to-Order
Similar to MTO, ETO businesses create solutions based on specific customer requests.
Click each tab to learn more.
Features
Additional Information
Additional features of the ETO scenario:
Companies build unique products, designed in accordance with customer specifications.
Customers are highly involved in product design.
Inventories are kept to a minimum.
Delivery lead times are lengthy.
Each product is complex with long lead times and requires a unique set of item numbers, Bills of Material, and routings.
Aftermarket services are continuous throughout the life of the product.
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Cognizant | Manufacturing: Scenarios

Comparison of Manufacturing Scenarios

Here is a detailed comparison between the four manufacturing scenarios that are adopted by the different manufacturing industries.

Click each tab to learn more.

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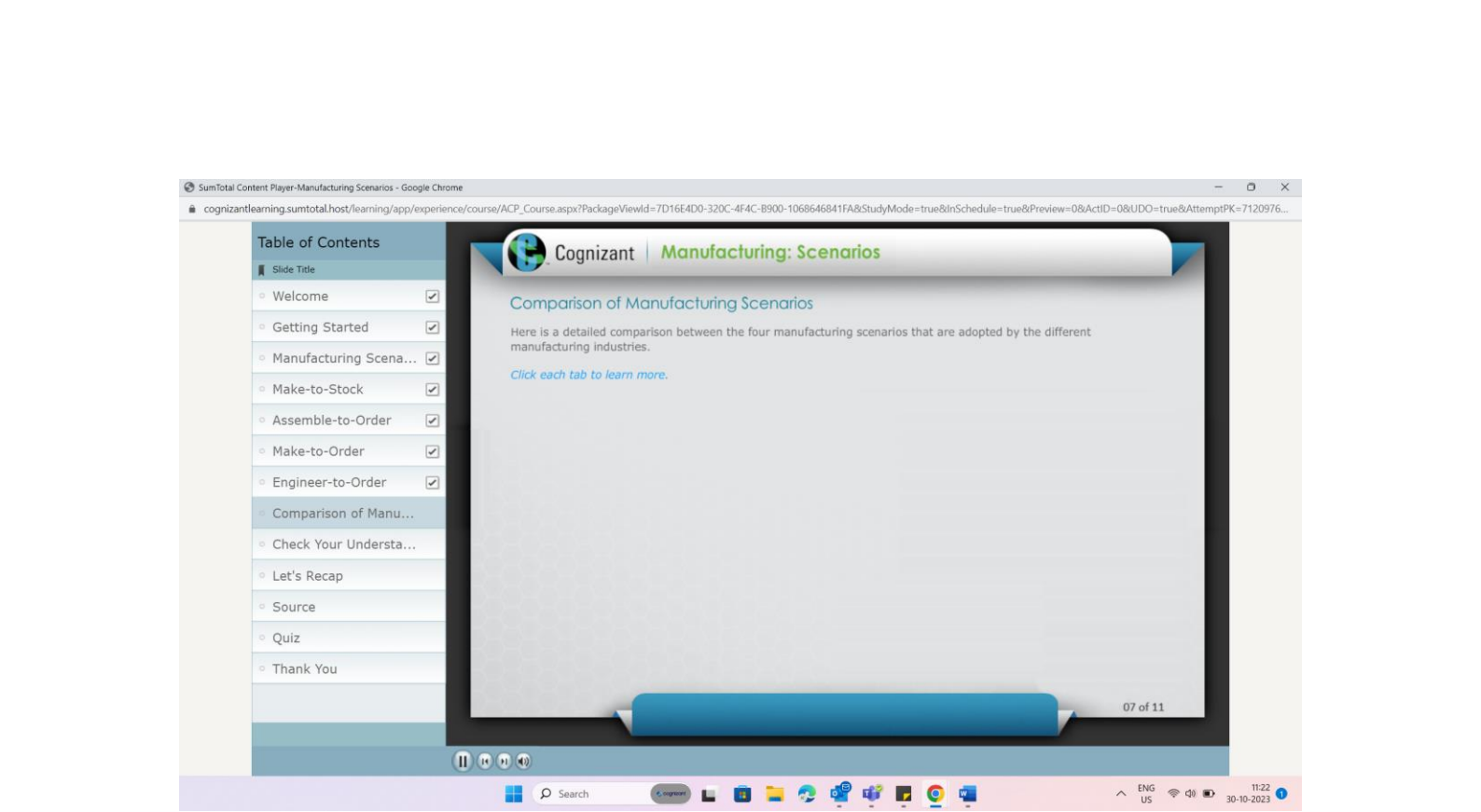

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Cognizant | Manufacturing: Scenarios

Comparison of Manufacturing Scenarios

Here is a detailed comparison between the four manufacturing scenarios that are adopted by the different manufacturing industries.

Click each tab to learn more.

MTS | MTO | CTO | ETO

Features of MTS:

- Build to forecast
- Rapid delivery
- Standard products
- High volumes
- Low variety
- Typically lower profit margins per unit

Business environments required by MTS:

- Stocks finished goods
- Forecasts error that costs money

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Cognizant | Manufacturing: Scenarios
Comparison of Manufacturing Scenarios
Here is a detailed comparison between the four manufacturing scenarios that are adopted by the different manufacturing industries.
Click each tab to learn more.
MTS
MTO
CTO
ETO
Features of MTO:
More variety than MTS
Some repeat products
Long lead times
Low volumes
High end item variety
Large profit margins
The business environment requires the raw material to be stocked in anticipation of future sales.
Click Forward to continue.
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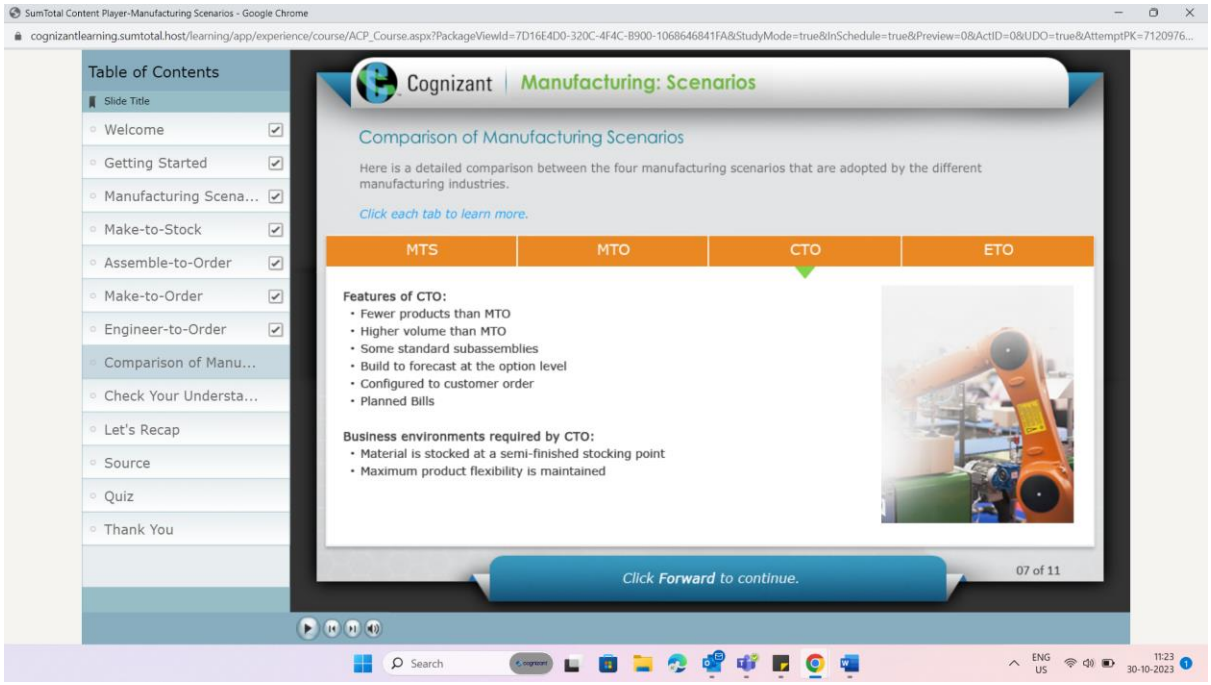
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Comparison of Manufacturing Scenarios
Here is a detailed comparison between the four manufacturing scenarios that are adopted by the different manufacturing industries.
Click each tab to learn more.
MTS
MTO
CTO
ETO
Features of CTO:
Fewer products than MTO
Higher volume than MTO
Some standard subassemblies
Build to forecast at the option level
Configured to customer order
Planned Bills
Business environments required by CTO:
Material is stocked at a semi-finished stocking point
Maximum product flexibility is maintained
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Comparison of Manufacturing Scenarios
Here is a detailed comparison between the four manufacturing scenarios that are adopted by the different manufacturing industries.
Click each tab to learn more.
MTS
MTO
CTO
ETO
Features of ETO:
• Custom designed products
• unique BOM
• Unique item numbers
• Very long lead times
• Low volumes
• High product variety
Business environments required by ETO:
• No finished goods are stocked
• It is difficult to forecast the requirements
Click Forward to continue.
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Let's Recap
Source
Quiz
Thank You
Cognizant | Manufacturing: Scenarios
Let's Recap
In this course, you have learned the following:
Manufacturing industries implement different business models that ensure proper manufacturing processes.
Manufacturing scenarios are based on the market eco-system and product requirements of all manufacturing industries.
The four manufacturing scenarios are MTS, ATO, MTO, and ETO.
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Manufacturing: Strategies
Getting Started
The strategies of Manufacturing and Logistics include Push and Pull Manufacturing, Flexible, Adaptive, and Cellular Manufacturing, Group Technology, Cell Structure, and Bill of Materials.
At the end of this course, you will be able to:
Describe the correlation of Push and Pull Manufacturing
Define Flexible Manufacturing
Describe Adaptive Manufacturing
Describe Cellular Manufacturing
Identify Group Technology
Identify Cell Structure
Define Bill of Materials
Overview
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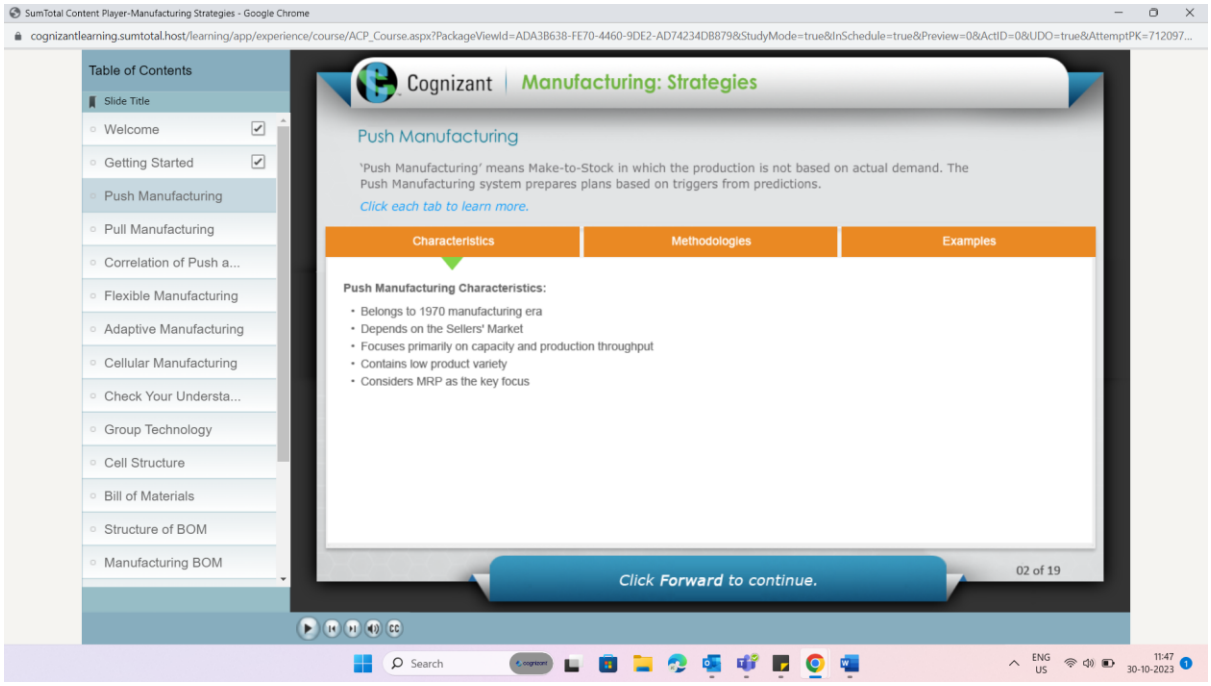
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Push Manufacturing
'Push Manufacturing' means Make-to-Stock in which the production is not based on actual demand. The Push Manufacturing system prepares plans based on triggers from predictions.
Click each tab to learn more.
Characteristics
Methodologies
Examples
Push Manufacturing Characteristics:
Belongs to 1970 manufacturing era
Depends on the Sellers' Market
Focuses primarily on capacity and production throughput
Contains low product variety
Considers MRP as the key focus
Click Forward to continue.
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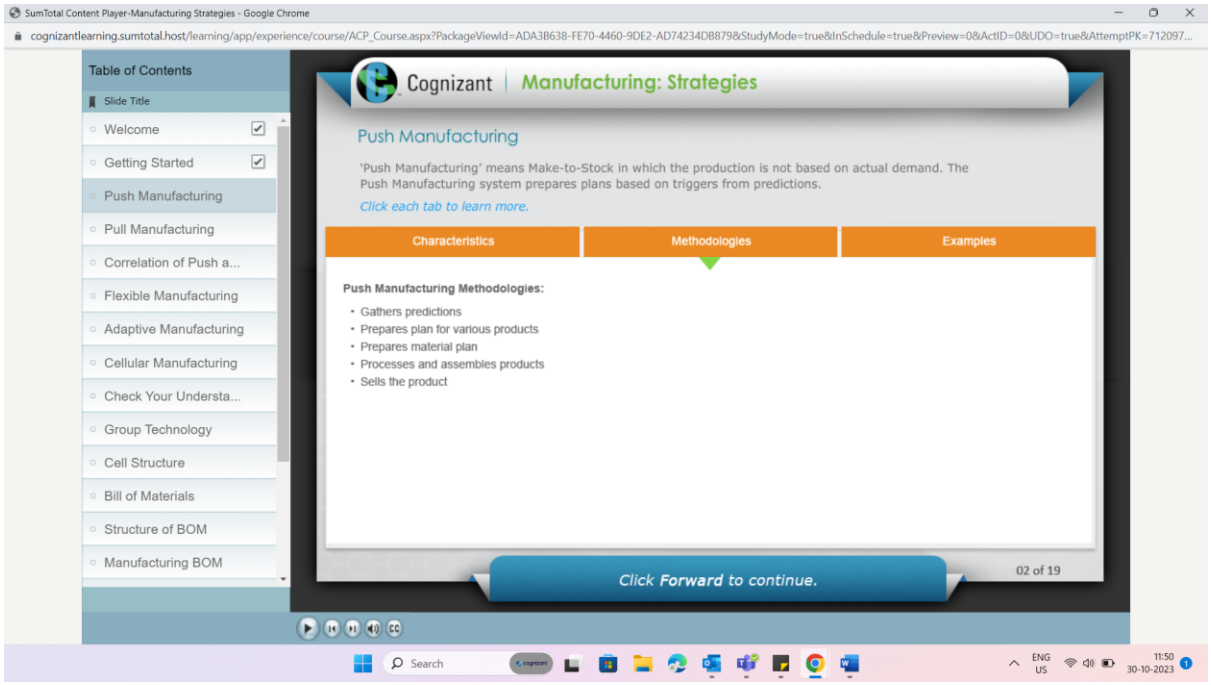
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Cognizant | Manufacturing: Strategies
Push Manufacturing
'Push Manufacturing' means Make-to-Stock in which the production is not based on actual demand. The Push Manufacturing system prepares plans based on triggers from predictions.
Click each tab to learn more.
Characteristics
Methodologies
Examples
Push Manufacturing Methodologies:
Gathers predictions
Prepares plan for various products
Prepares material plan
Processes and assembles products
Sells the product
Click Forward to continue.
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Manufacturing: Strategies
Push Manufacturing
'Push Manufacturing' means Make-to-Stock in which the production is not based on actual demand. The Push Manufacturing system prepares plans based on triggers from predictions.
Click each tab to learn more.
Characteristics
Methodologies
Examples
Push Manufacturing Examples:
Fig 1: This is a traditional manufacturing process, where based on inventory of parts and production line, capacity products are manufactured. These finished products are stored in warehouses, and based on customer need are supplied to the market.
Manufacturing Push Process
The Plant
Suppliers
PART A
PART B
PART C
Distribution Network
Parts
Production Line
Warehouse (Parts)
Warehouse (Products or Components)
Click Forward to continue.
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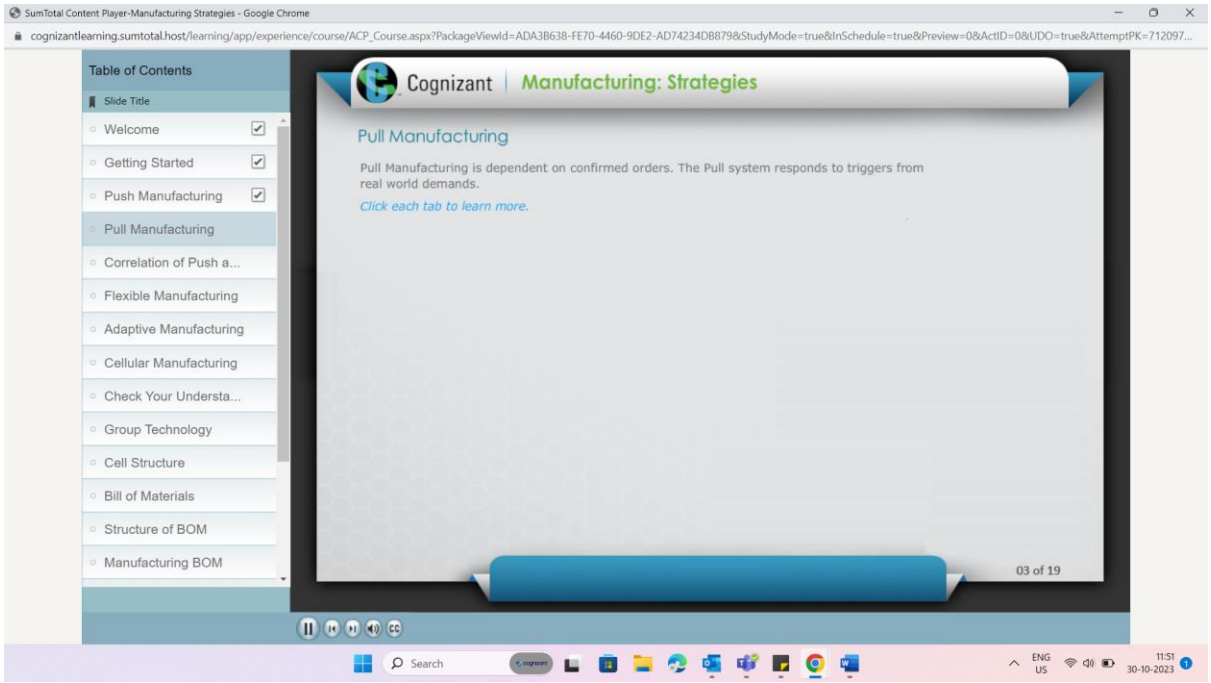
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Manufacturing: Strategies
Pull Manufacturing
Pull Manufacturing is dependent on confirmed orders. The Pull system responds to triggers from real world demands.
Click each tab to learn more.
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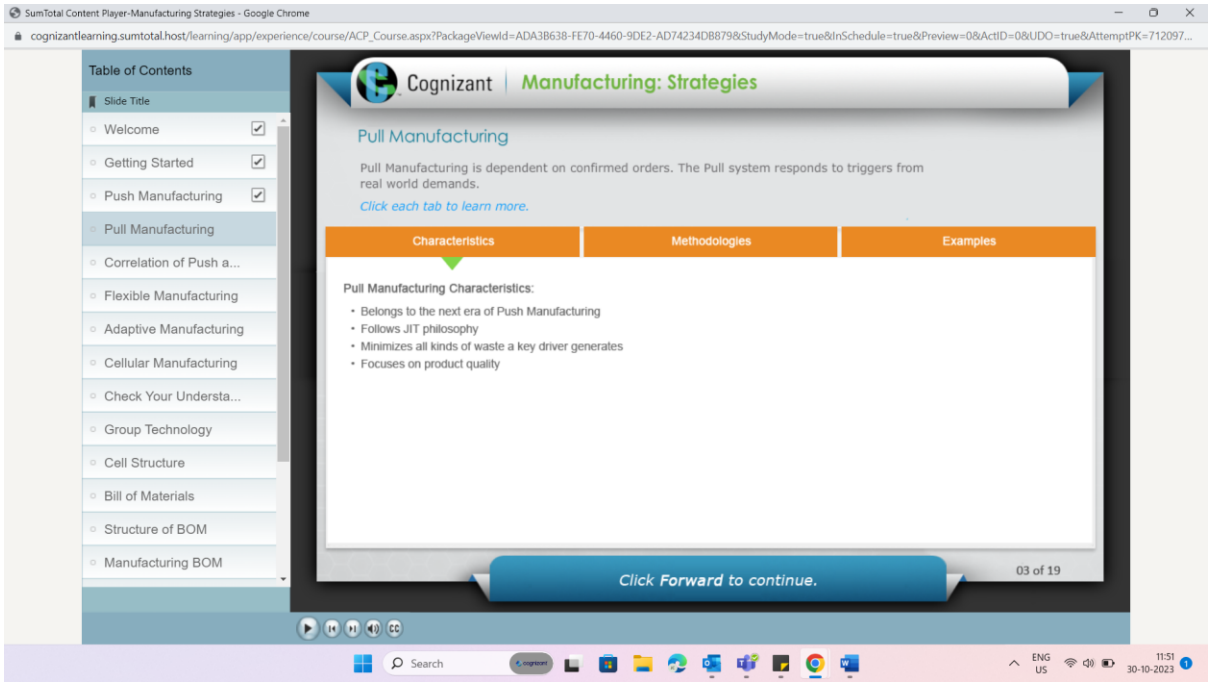
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Manufacturing: Strategies
Pull Manufacturing
Pull Manufacturing is dependent on confirmed orders. The Pull system responds to triggers from real world demands.
Click each tab to learn more.
Characteristics
Methodologies
Examples
Pull Manufacturing Characteristics:
Belongs to the next era of Push Manufacturing
Follows JIT philosophy
Minimizes all kinds of waste a key driver generates
Focuses on product quality
Click Forward to continue.
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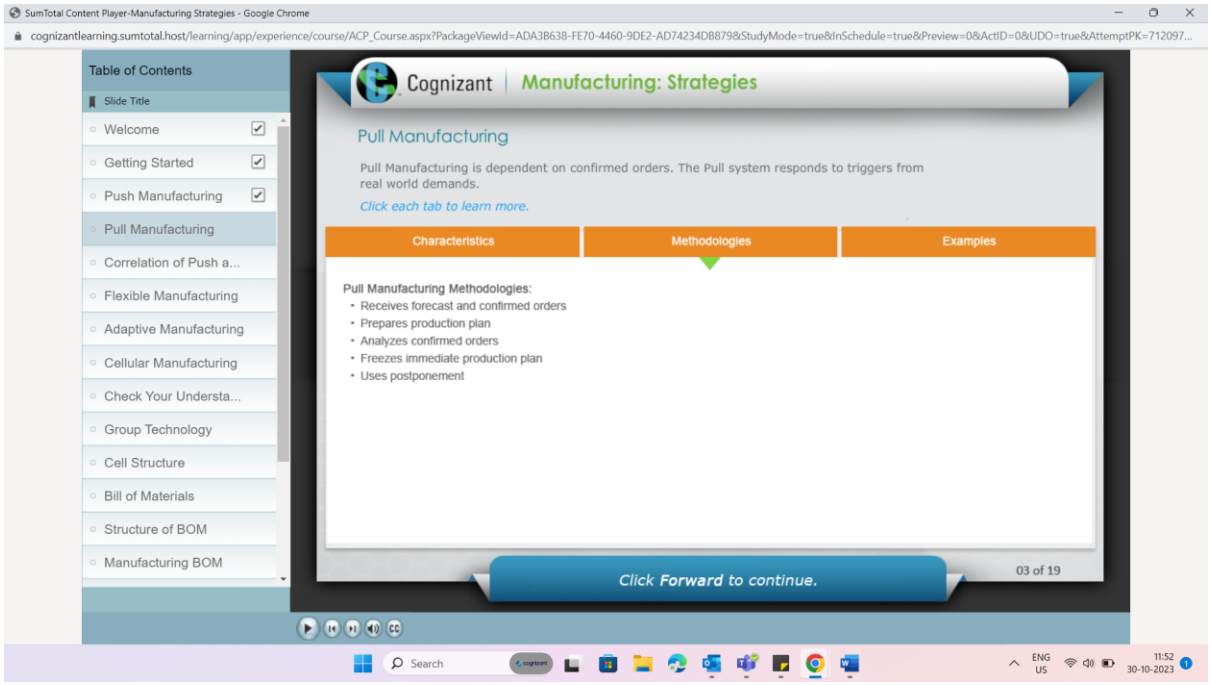
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Manufacturing: Strategies
Pull Manufacturing
Pull Manufacturing is dependent on confirmed orders. The Pull system responds to triggers from real world demands.
Click each tab to learn more.
Characteristics
Methodologies
Examples
Pull Manufacturing Methodologies:
Receives forecast and confirmed orders
Prepares production plan
Analyzes confirmed orders
Freezes immediate production plan
Uses postponement
Click Forward to continue.
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Cognizant | Manufacturing: Strategies

Pull Manufacturing

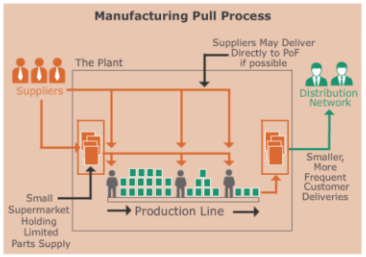
Pull Manufacturing is dependent on confirmed orders. The Pull system responds to triggers from real world demands.

Click each tab to learn more.

Characteristics | Methodologies | Examples

Pull Manufacturing Examples:

Fig 1: In this, the key input is a confirmed order. The raw material is stored in less quantity and is supplied by the supplier when and where it is required to reduce cost. Deliveries to customer are done in smaller and frequent cycles.



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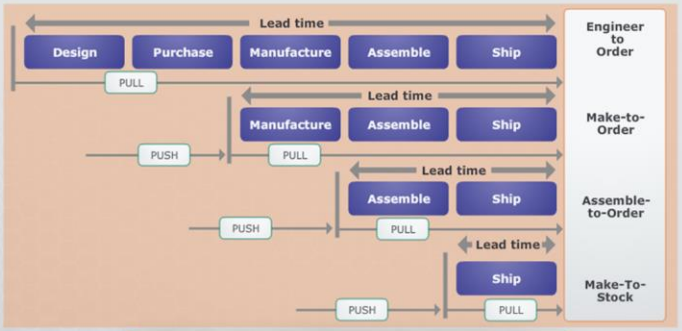
Correlation of Push and Pull

In Assemble-to-Order (ATO), the entire production happens based on customer order while in Make-to-Stock (MTS), the shipping happens as per product consumption.

The diagram below depicts the correlation of Push and Pull triggers with various manufacturing scenarios.



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Flexible Manufacturing

Flexible Manufacturing is a form of flexible automation in which several machine tools are linked together by a material-handling system. All aspects of the system are controlled by a central computer.

The system is flexible and can react to changes.

Classification of System Flexibility:

- Machine flexibility: Ability to change product types and sequence of operations
- Routing flexibility: Ability to absorb major changes in volume, capacity, and capability

Three Main Systems of Flexible Manufacturing Systems (FMSs):

- Work machines
- Material handling system
- Central control computer

The best application is found in the production of small sets of products like those from a mass production.

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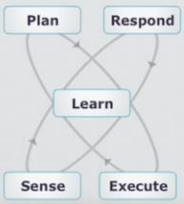
Cognizant | Manufacturing: Strategies

Adaptive Manufacturing

In Adaptive Manufacturing, groups of business partners assemble to produce, deliver, and support a product. It addresses a defined market need throughout its life cycle.

Adaptive Manufacturing Characteristics:

- Flexibility with velocity
- High integration of technology into production
- Rapid production operation switch such as high volume or low mix and high volume or high mix product loadings



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Cellular Manufacturing

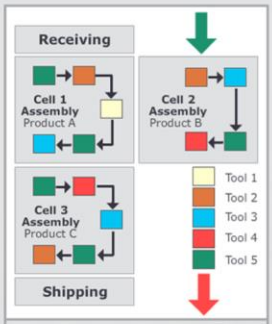
Cellular Manufacturing is a model for workplace design. It is a part of Lean manufacturing systems.

The factory floor is arranged into semi-autonomous and multi-skilled teams who manufacture complete products based on group technology.

Cellular Manufacturing Characteristics:

- Complete product is developed in a single process flow
- Equipment or workstations are in a proper sequence
- Transport or waiting time is minimal
- Manufacturing cell is created for each part of the family

The diagram onscreen explains how various tools are selected to create a cell assembly to manufacture the complete product in a single flow. Cells 1, 2, and 3 have tools assembled in the sequence required to produce product A, B, and C respectively.



An example of a cellular manufacturing layout, each product is manufactured in its own work cell.

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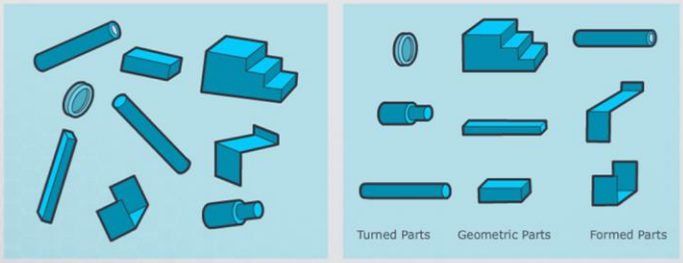
Cognizant | Manufacturing: Strategies

Group Technology

Group Technology is the method of organizing parts into families with similar manufacturing requirements. Let's take a look at a few examples.



Unorganized Parts

Parts Organized by Families

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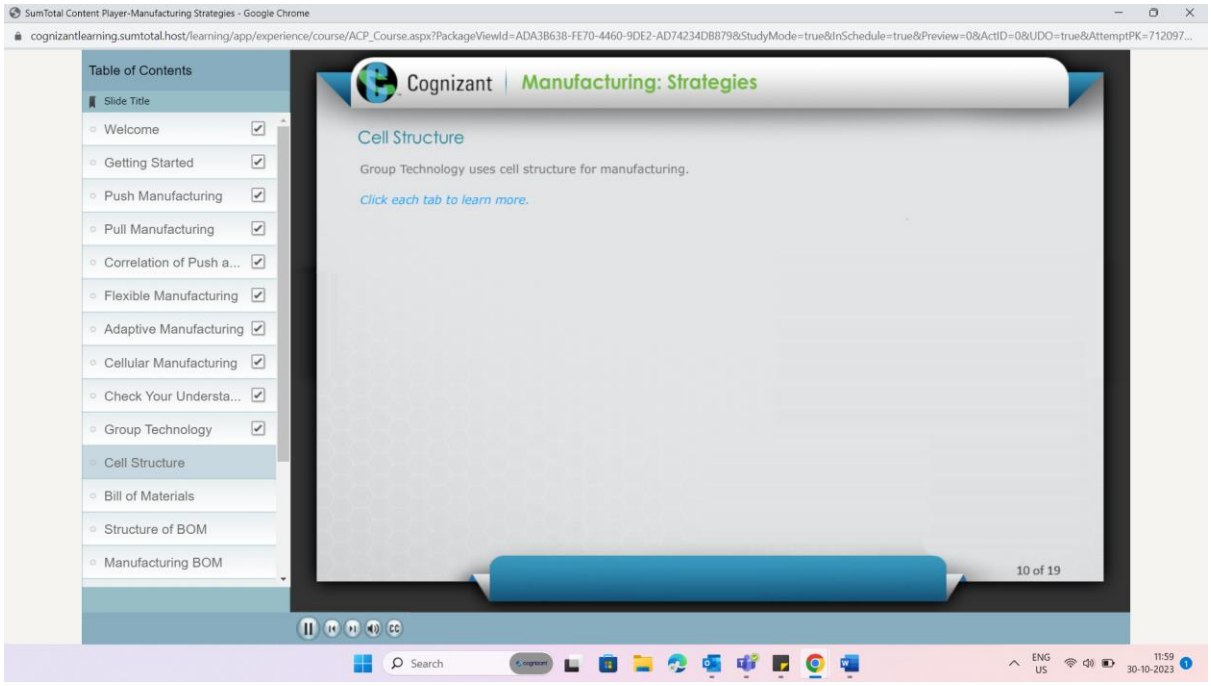
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Cell Structure
Group Technology uses cell structure for manufacturing.
Click each tab to learn more.
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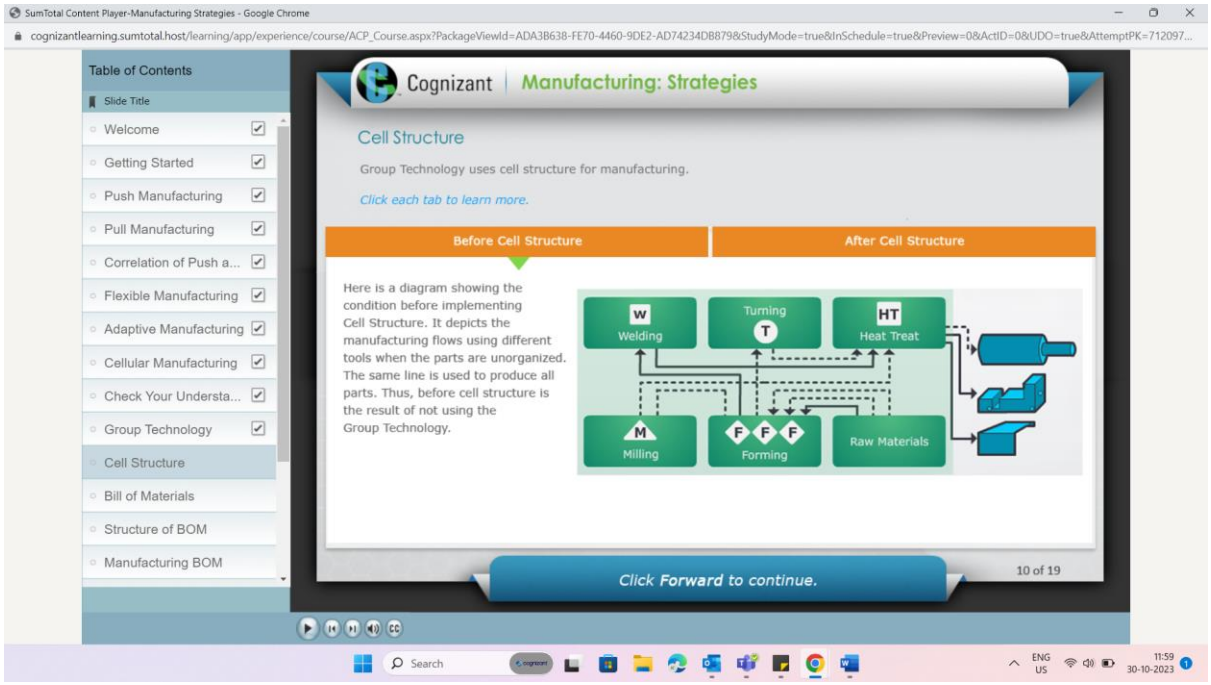
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Cell Structure
Group Technology uses cell structure for manufacturing.
Click each tab to learn more.
Before Cell Structure
After Cell Structure
Here is a diagram showing the condition before implementing Cell Structure. It depicts the manufacturing flows using different tools when the parts are unorganized. The same line is used to produce all parts. Thus, before cell structure is the result of not using the Group Technology.
W
Welding
Turning
T
HT
Heat Treat
M
Milling
F F F
Forming
Raw Materials
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Cognizant | Manufacturing: Strategies

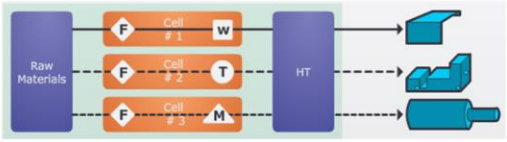
Cell Structure

Group Technology uses cell structure for manufacturing.

Click each tab to learn more.

Before Cell Structure | **After Cell Structure**

Here is a diagram showing the condition after implementing Cell Structure. It depicts manufacturing lines after the introduction of cells to manufacture similar product families. The tools are organized as per requirements in different cells. After cell structure comes into play when the learner uses the Group technology.



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Bill of Materials

A Bill of Materials (BOM) lists all the assemblies, intermediates, parts, and raw materials that go into making the parent assembly; showing quantities of each required to make an assembly.

Important Features of a BOM:

- Each part shows all required parts to make one item
- Each part has a unique part number
- Each part is defined by its form, fit, or function

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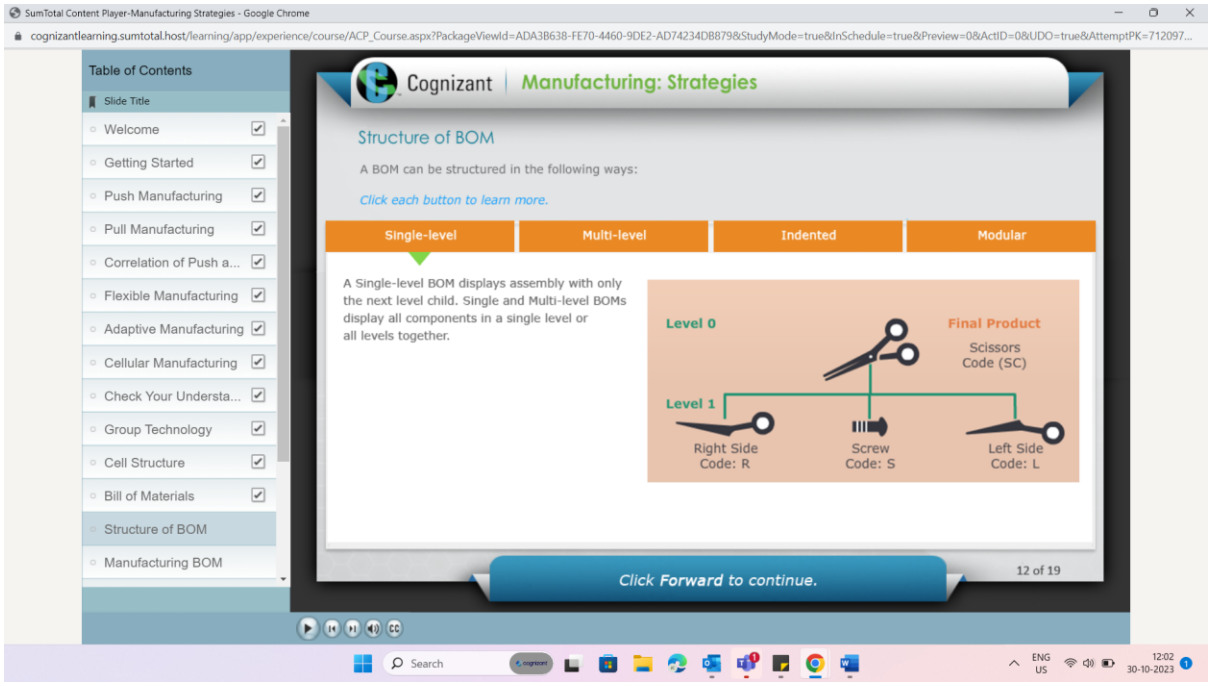
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Structure of BOM
A BOM can be structured in the following ways:
Click each button to learn more.
Single-level
Multi-level
Indented
Modular
A Single-level BOM displays assembly with only the next level child. Single and Multi-level BOMs display all components in a single level or all levels together.
Level 0
Final Product
Scissors
Code (SC)
Level 1
Right Side
Code: R
Screw
Code: S
Left Side
Code: L
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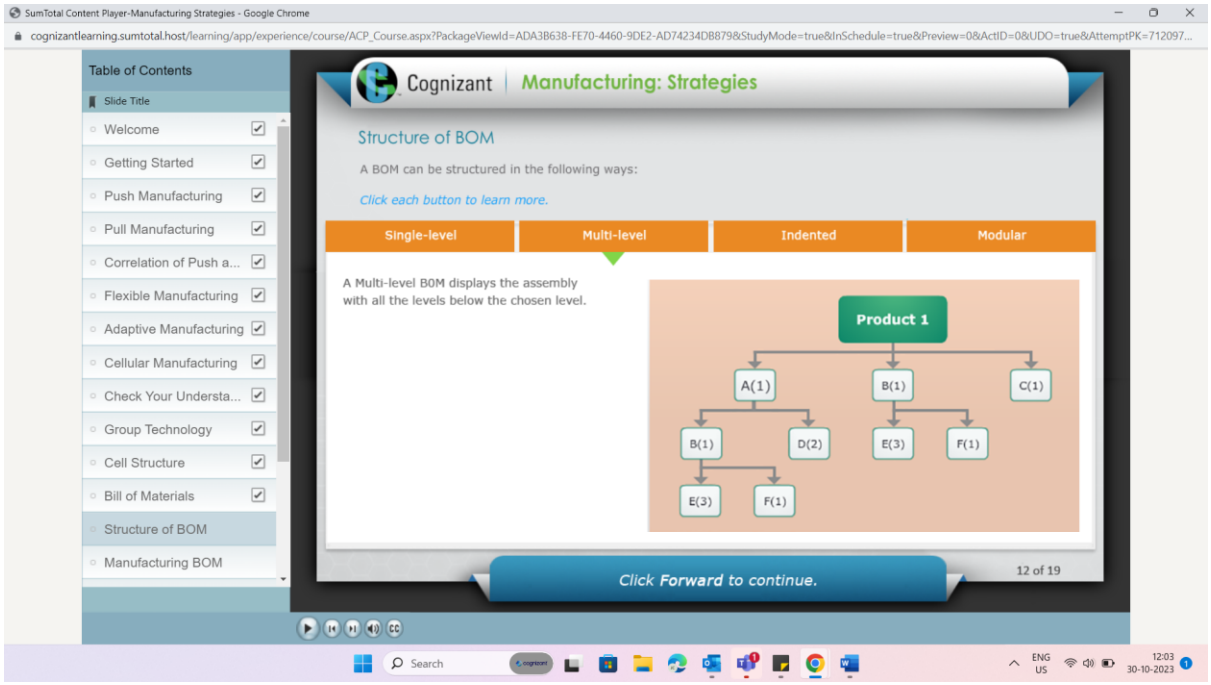
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Structure of BOM
A BOM can be structured in the following ways:
Click each button to learn more.
Single-level
Multi-level
Indented
Modular
A Multi-level BOM displays the assembly with all the levels below the chosen level.
Product 1
A(1)
B(1)
C(1)
B(1)
D(2)
E(3)
F(1)
E(3)
F(1)
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Structure of BOM

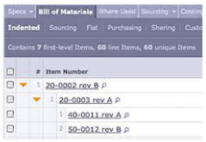
A BOM can be structured in the following ways:

Click each button to learn more.

Single-level | Multi-level | Indented | Modular

Indented BOM Characteristics:

- An Indented BOM displays the assembly with rightward indentation as the BOM-level increases.
- It differs from a single-level bill of material, in that it includes the lower level components of the sub-assemblies of a product.
- It lists all components of the product from the finished article to the raw materials.
- It is structured in such a way that the highest level parents are closest to the left margin, with their components indented to the right. Indented BOM is where it is represented from left to right.



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Structure of BOM

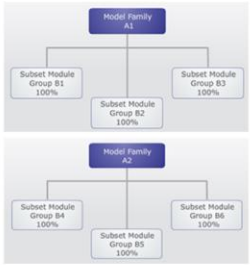
A BOM can be structured in the following ways:

Click each button to learn more.

Single-level | Multi-level | Indented | Modular

Modular BOM Characteristics:

- Modular BOM is an artificial grouping of product groups, with the finished product at the lowest level.
- It is a type of planning bill that is arranged in product modules or options.
- It is often used in companies where the product has many optional features; for example, ATO companies such as automobile manufacturers.
- It is generated at a modular level.
- The modules can be combined to create the next product level, where each module can be a single or multi-level BOM.



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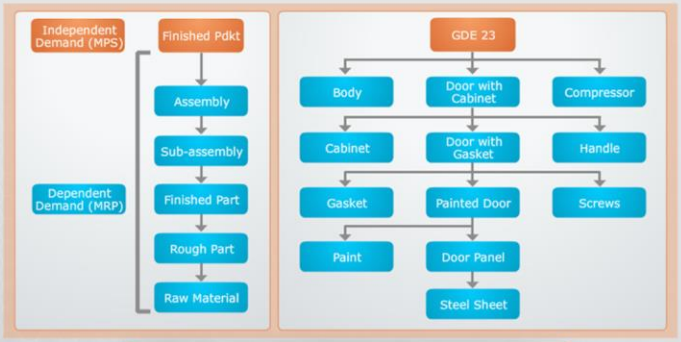
Manufacturing BOM

The diagram below depicts the demand pattern for components of a BOM. The demand of all the items in blue depends on finished product demand. For example, GDE 23



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Let's Recap

In this course you have learned the following:

- Push Manufacturing is where the production process continues based on the demand forecast while Pull Manufacturing is dependent on confirmed orders.
- Flexible Manufacturing controls all system aspects through a central computer.
- Adaptive Manufacturing addresses a defined market need throughout its life cycle.
- Cellular Manufacturing is a part of Lean manufacturing systems.
- Group Technology is the method of organizing the parts into families with similar manufacturing requirements.
- Cell structure is used by group technology for manufacturing.
- BOM can be structured into Single-level, Multi-level, Indented, and Modular.

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