PRODUCTION FUNCTION

TOPIC FIVE



LEARNING GOALS

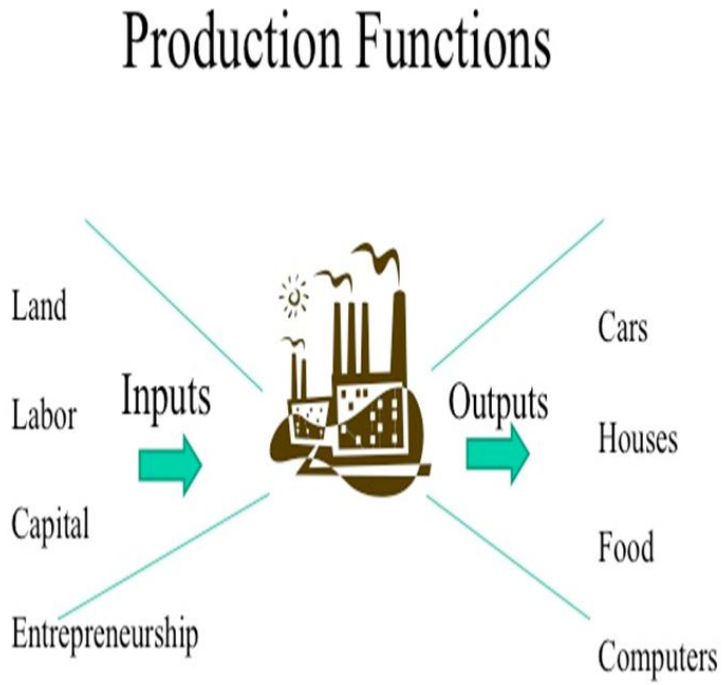
01	DEFINITION
02	SUB-FUNCTIONS / ROLES
03	TYPES OF PRODUCTION PROCESSES
04	KEY PRODUCTION DECISIONS
05	PRODUCTION PLANNING AND CONTROL

What is the Production Function?

- **Definition**: The process of combining land, labour, capital, and entrepreneurship to create goods and services that satisfy human needs."
- **Core idea**: Transforming inputs into outputs to add value.
- **Examples:**

✓ Uganda: Coffee beans processed into export-quality coffee in Bugisu.

✓Global: Crude oil refined into petrol in Saudi Arabia.



Key Sub-functions / Roles of Production Function

- **Production Planning**: Sets output targets, schedules, and allocates resources (e.g., Nile Breweries' beer production targets).
- **Purchasing:** Sources raw materials, components, and equipment to keep production continuous. *(e.g., a textile factory sourcing cotton from West Nile).*
- **Stores:** Manages inventories of raw materials, spare parts, and finished goods.
- **Design and Technical Support:** Develops new products or modifies existing ones and estimates costs for different production methods.
- **Works Department:** Handles actual manufacturing and service delivery.

KEY PRODUCTION DECISIONS

Critical for operational efficiency, cost optimisation, and competitive advantage

- **Product Design**
  Creating goods/services that meet customer needs
- **Plant Location**
  Selecting the optimal site for production
- **Plant Layout**
  Arranging facilities for smooth workflow

Product Design: Meeting Customer Needs

Product design refers to the process of defining a product's features, appearance, and functionality to meet customer needs, market trends, and production capabilities

Key Considerations:

- **User-centric design / understanding customer needs**: Meet customer preferences.
- **Functionality & usability**: Product must perform its intended purpose effectively & easy to use – enhance user experience.
- **Aesthetics /Appearance**: Visual appealing design attracts customers – shape, colour, texture should match user preferences.
- **Cost-benefit analysis**: Actual benefits (e.g., revenue) should outweigh the cost of production.
- **Sustainability**: Use Eco-friendly materials to appeal to eco-conscious customers
- **Regulatory compliance**: Meet industry, national & international standards (e.g., UNBS, EU standards.

Examples:

- Tesla Motors' electric vehicles that are functional, sustainable & environmentally friendly.
- Uganda Breweries Limited's incorporation of local cultural elements into packaging such as limited-edition designs celebrating festivals.

Plant Location: Optimal site for production

- **Definition:** The process of choosing the most appropriate geographical site for a manufacturing or production facility.
- **Why is it a critical decision?**
  - Involves **long-term commitment** and high investment.
  - Directly impacts **operating costs, efficiency, and competitive advantage**.
  - Difficult and expensive to reverse.







Key Factors Influencing Plant Location





- **Proximity to Raw Materials**: Reduces transport costs, ensures steady supply.
- **Proximity to Markets**: Minimises delivery costs for finished goods, enables faster delivery to customers & is crucial for perishable goods or just-in-time delivery systems
- **Transportation Infrastructure**: Need for reliable roads, rail, ports, and airports.
- **Utilities** (Power, Water, Communication): Reliable, affordable utilities are fundamental for operations.
- **Labour Availability & Cost**: Access to skilled and affordable workers is essential.
- **Economic & Political Stability**: A stable environment ensures uninterrupted operations.



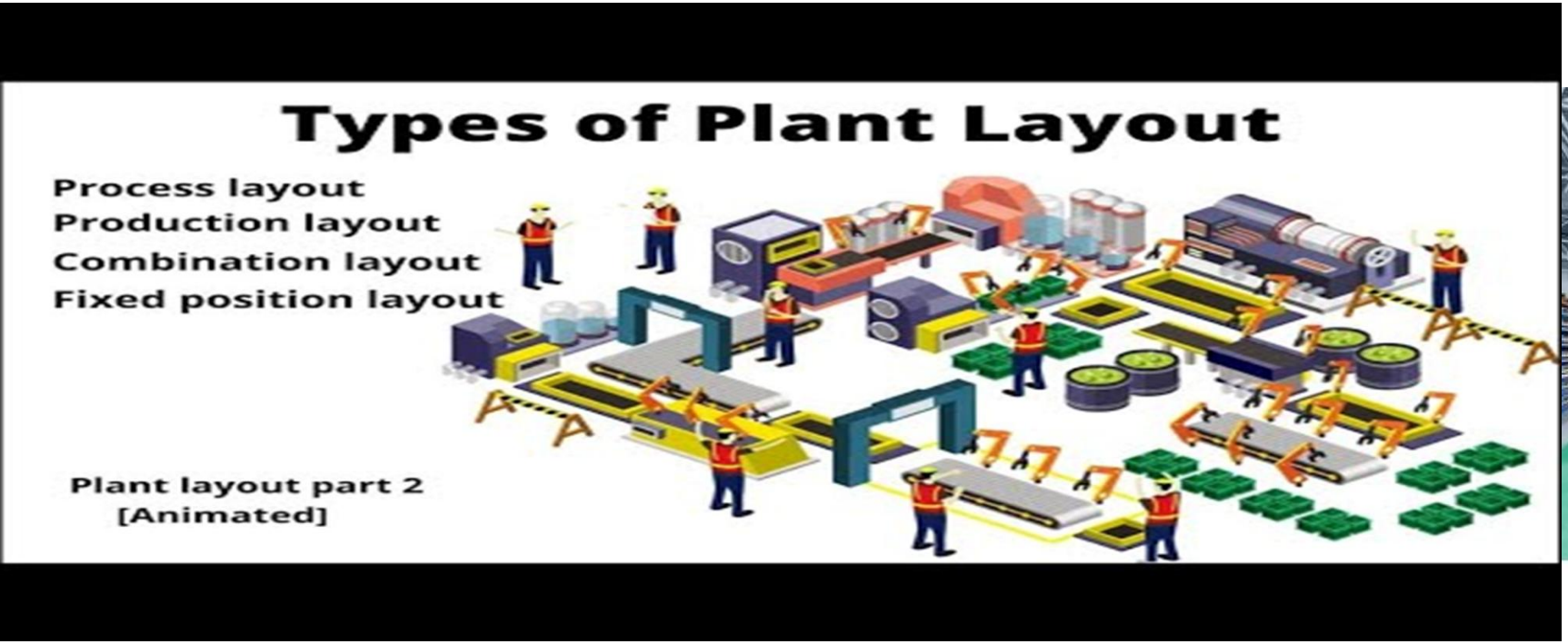
Key Factors Influencing Plant Location



- **Government Policies and Incentives**: Tax holidays, subsidies, and grants can attract investment.
- **Environmental and Community Impact**: Adherence to environmental laws may require additional investment in pollution control.
- **Land Availability & Cost**: Current price of the land & Space for current operations and future expansion.
- **Community Factors:** Availability of housing, schools, and social amenities for employee well-being.
- **Site-Specific Factors:**: Topography, soil quality, and flood risks are critical, especially for Agro-based industries.
- **Industrial Inertia:** The tendency to locate near similar industries to share infrastructure, suppliers, and skilled labour.

Plant Layout: Optimising Manufacturing Efficiency

- **Definition:** Plant layout is the physical arrangement of production facilities, including **machines, workstations, departments, and material handling equipment** within a factory.
- **Goal:** To achieve the most efficient flow of materials and work.





Product Layout (Line Layout)

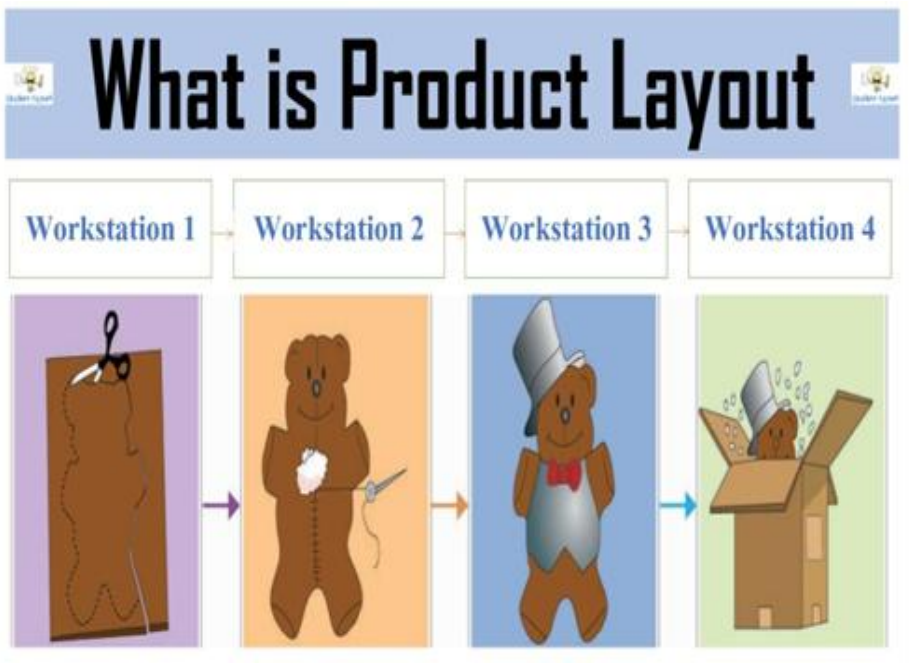
- Machines and workstations are arranged sequentially based on manufacturing steps for a specific product.
- Often used for mass production of standardised products.

Characteristics

- High volume, low variety
- Specialized equipment, smooth material flow
- Low work-in-process

Applications

- Automobile assembly (e.g., Toyota, BMW)
- Beverage bottling, cement production (e.g., Hima Cement,

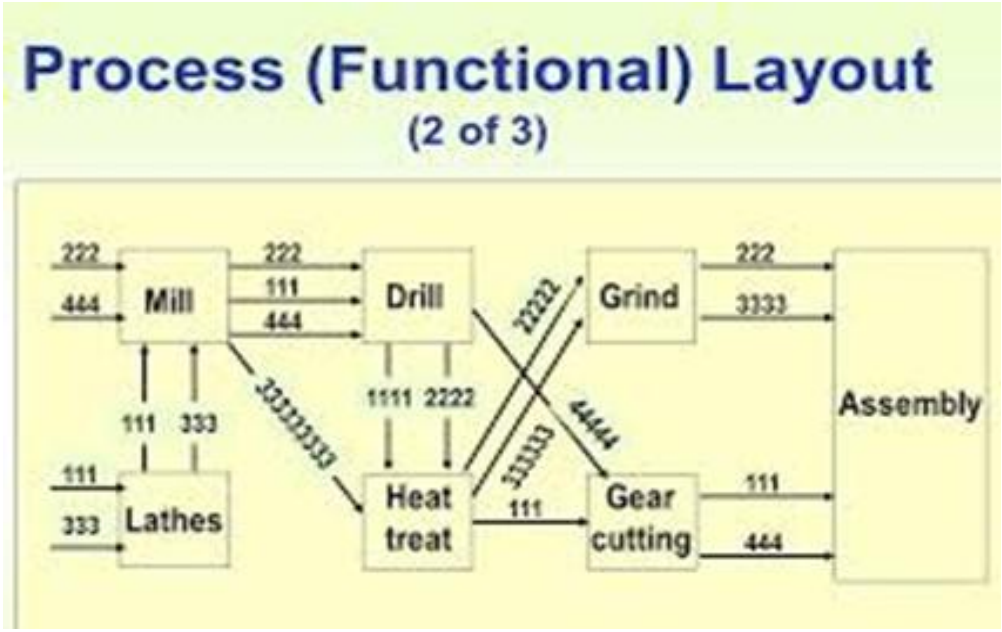


Process Layout (Functional Layout)

- Similar machines or functions are grouped together, each performing a specific task/ activity (e.g., all painting stations in one area).

Characteristics

- Low volume, high variety
- Flexible, higher work-in-process



Applications

- Hospitals (e.g., X-ray, surgery wards)
- Educational institutions (e.g., science lab, library)

Fixed-Position Layout

Definition

- Product remains stationary; workers and equipment move to it.

Characteristics

- Low volume, unique products
- Highly skilled labor, project management focus

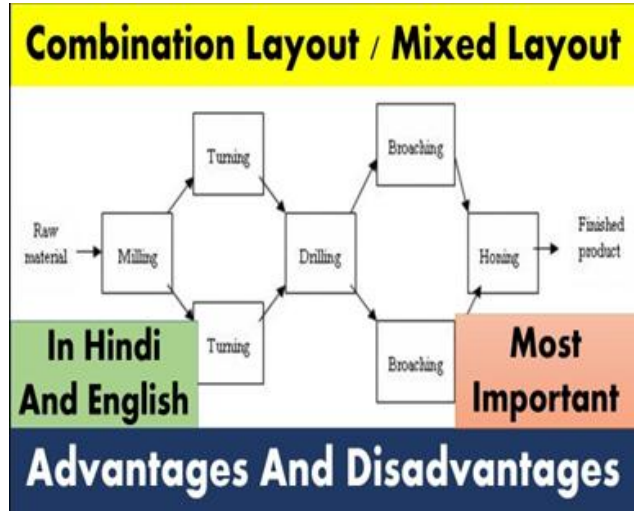
Applications

- Construction (e.g., Parliament of Uganda)
- Shipbuilding (e.g., large oil tankers),
- Aircraft manufacturing (e.g., Boeing)



Combination Layout (Mixed Layout)

- Combines features of two or more layout types for manufacturing complex processes



Characteristics

- Flexible arrangement for both mass and batch production.
- Suitable for products requiring multiple processes.

Applications

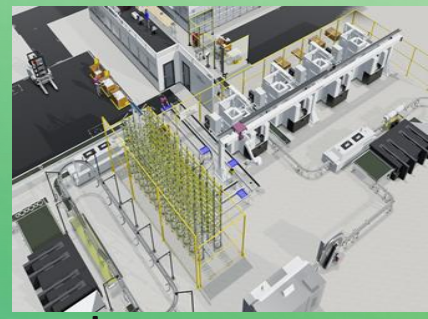
- Heavy engineering industries (e.g., shipbuilding and car manufacturing)

Other types of Layouts (Processes)

- Job (Unit) production
- Batch production
- Mas production
- Continuous production

Read about them

Qualities of a Good Plant Layout



- **Efficient Workflow** ➡️ minimises movement and unnecessary backward movement
- **Flexibility** ➡️ adapts to changes in products or volume.
- **Optimal Space Use** ➡️ no overcrowding, good space usage.
- **Employee Safety** ➡️ clear pathways, emergency provisions, protects injuries and diseases.
- **Ease of Supervision** ➡️ good visibility and access.
- **Cost Efficiency** ➡️ reduces waste and lowers expenses.
- **Employee Comfort** ➡️ uses ergonomics to reduce physical strain and enhance well-being.

Quality Control ➡️ includes inspection points to maintain standards.

- **Communication** ➡️ promotes information sharing and coordination between departments.
- **Maintenance** ➡️ ensures easy access to equipment for upkeep and repairs.

Factors Determining Plant Layout



- **Nature of the Product** ➡️ The product's size, type and variety
- **Production Process** ➡️ Batch, mass, or continuous processes dictate arrangement
- **Volume of Production** ➡️ High volume suits product layouts, low volume suits process layouts and very low volume usually fixed-position layout.
- **Space Availability** ➡️ The size, shape, and structural limits of the building directly impact layout options (e.g., columns, walls must be considered for structural limits).
- **Material Handling** ➡️ Minimises movement of raw materials, work-in-progress, and finished goods with efficient equipment.
- **Labor and Workforce** ➡️ Considers ergonomics for comfort and & comply with labour laws

Factors Determining Plant Layout



- **Employee Health and Safety** ➡️ Minimises the risk of workplace accidents and illnesses.
- **Utilities and Services** ➡️ **Provides** essential utilities like electricity and water, as well as maintenance, storage and staff facilities
- **Regulatory and Environmental Compliance** ➡️ Must follow all industry standards, safety rules, and environmental laws (e.g., waste management & emissions).
- **Technology and Automation** ➡️ Should integrate advanced machinery and leave space for future upgrades.
- **Flexibility and Adaptability** ➡️ Should easily adjust to changes in product design, production process or customer demand.

Factors Determining Plant Layout



- **Economic Considerations** ➡️ Must balance efficiency with the overall cost of implementation – must be within the budget of the business organisation.
- **Maintenance and Upkeep** ➡️ Should ensure that all equipment is easily accessible for maintenance to reduce downtime.
- **Environmental Conditions** ➡️ Account for factors like climate control for sensitive products e.g., storage facilities or store buildings for delicate products are in the cooler areas of the production facility and vice-versa.

Production Planning and Control (PPC)

A core operations management function ensuring the right products are produced in the right quantity, at the right time and at the lowest cost while maintaining quality.

Definition of production planning

- Determining future production levels and required resources

It involves:

- Setting production targets
- Determining labour needs
- Planning for raw materials and inventory
- Allocating machine and equipment capacity

Production Control

Definition

- Monitoring actual production against the planned production and taking corrective actions where necessary.

Key Activities

- Tracking performance
- Identifying deviations from the plan
- Implementing corrective measures

Examples

- **Uganda**: Uganda Breweries monitors daily output to align with market demand.
- **Global**: Toyota's Just-in-Time (JIT) system minimises inventory costs by delivering components as needed.

Importance of Production Planning and Control (PPC)

Effective PPC helps organisations

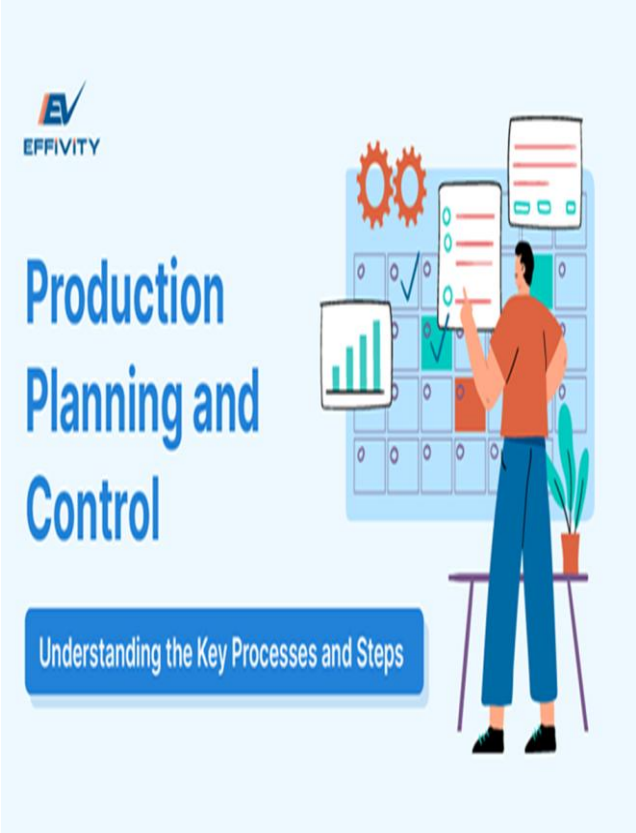
- Use resources efficiently.
- Reduce costs and delays.
- Improve customer satisfaction.
- Maintain consistent product quality.
- Respond quickly to market changes.



Activities in Production Planning and Control (PPC)

Production Planning

- Routing
- Scheduling
- Loading
- Materials Handling
- Quality Control
- Plant Maintenance



Production Control

- Dispatching
- Follow-up (or expediting)
- Inspection
- Corrective Action

Key Production Planning Activities



➢ **Routing:**

- Determines the best path for a product from start to finish.
- Specifies **what** will be done, **where**, and by **which** machine.

➢ **Loading:**

- Assigns specific work to specific machines.
- The goal is to avoid both **overloading** (causing delays and machine wear) and **underloading** (leads to idle time and inefficiency).



Key Production Planning Activities

➢**Scheduling:**

- Establishes the timetable for production tasks.
- Specifies **when** each operation will start and end.



➢**Materials Handling:**

- The efficient movement of raw materials and products to minimise costs (typically 20% of production expenses).

Rules:

- Minimise handling - preferable to move workers rather than materials
- Keep distances short - Keep the distance between operations as short as possible
- Use appropriate equipment (e.g., robots, conveyors, forklifts).
- Make the most effective use of handling equipment - Avoid machine overload and under load.

Key Production Planning Activities



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Key Production Planning Activities



➢ **Quality Control (QC):**

- Ensures products specified quality standards.

Example: Mukwano Industries' quality checks for cooking oil and soap manufacturing at various stages.

➢**Plant Maintenance:**

- Keeping equipment in good working order to reduce downtime.

Objectives: Maximise equipment lifespan, ensure operational safety, minimise downtime, and maintain product quality.

- **Types of Maintenance:**
  - **Breakdown (Corrective):** Repairing equipment after it fails.
  - **Preventive:** Regular, scheduled inspections to **prevent** failures.
  - **Predictive:** Using data analytics, Internet of Things sensors to predict failures before they happen.

Key Production Control Activities



➢ **Dispatching:**

- The official release of production orders, instructions, materials, and tools to the factory floor as per the schedule .
- This is the **execution** phase where the plan is put in motion.



➢ **Follow-up (Expediting):**

- Tracking the progress of work against the schedule.
- Involves monitoring, reporting, and identifying delays, bottlenecks, or other issues that disrupt the plan.

Key Production Control Activities



➢**Inspection:**

- Checking output at various stages to ensure it meets predefined quality standards.
- Crucial for corrective action.



➢**Corrective Action:**

- The core function of production control.
- Analysing deviations from the plan(e.g., machine breakdowns, delays) and taking steps to fix them (e.g., re-routing or re-scheduling).

General Global and Ugandan Perspective



Global:

- Companies like **Amazon** use sophisticated PPC systems to manage vast supply chains and ensure timely global deliveries.



Uganda:

- Firms like **Roofings Group** and **Uganda Baati** use production planning to balance fluctuating demand with raw material availability.
- In agriculture, **coffee cooperatives** plan production around seasonal harvests while controlling quality for export.

Online Video Resources

- Plant layout
  https://www.youtube.com/watch?v=qKca93vGPho
- Types of Plant Layout, Explanation with Advantages and Dis-advantages
  https://www.youtube.com/watch?v=DrO5sS51Yk8
- What is production planning and control?
  https://www.youtube.com/watch?v=0x6A3YXOAtY
- Production Planning and Control (Step by Step Process | Key …)
  https://www.youtube.com/watch?v=HBiUsN_2nJM
- Elements of Production Planning and Control (PPC)
  https://www.youtube.com/watch?v=ygFTjc8foeI
- Plant Location in Production and Operations Management
  https://www.youtube.com/watch?v=Cz7PLXNkMYA
- Plant Location: A Strategic Decision for Business Success
  https://www.youtube.com/watch?v=kmi7WsRPIBc

PRODUCTION FUNCTION - CASE STUDY ANALYSIS

- In groups of 5-10, analyse "**: Kampala Agro Processors Ltd.: Navigating Production Challenges in Uganda's Food Industry**" and "**The Perfect Blend Café Expansion"** case studies provided at the end of the section on Production Function in the handout. You will present your findings in class.




Thank You!