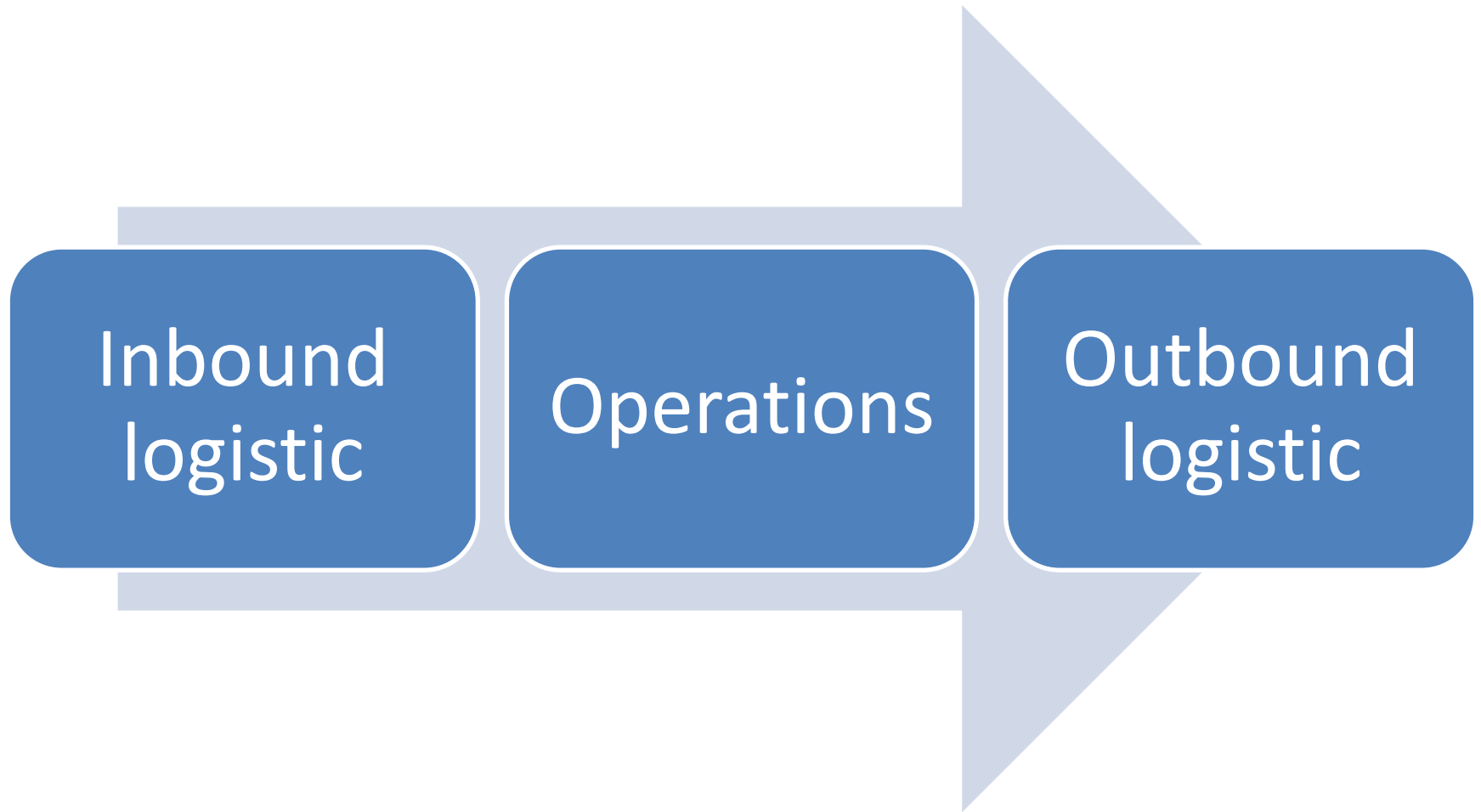


# PRIMARY ACTIVITIES - OPERATIONS



# Operations - production

- **Production** can simply be defined as the activity of transformation raw materials or components into finished products
- **Production strategy** is concerned with guiding investment decision. Decision made today provide guidelines for future production operations
- **Production policy** - Process of manufacture, machine requirements, factory layout, storage and handling systems, skills required in workmen and their method of training

# Basic questions connected with the production

- Should resources be placed in production rather than in other areas of a business?
- Decide capacity needed to meet agreed production and corporate objectives and when production should commence?
- Decide where plant should be located and the type of technology to use.

- **Types of production** are determined by amount of repetition, range of products, quality.
- **Factory location and layout** is determined by availability of land, labour, raw materials, climate, local regulations or by-laws, climate, social facilities
- **Production organization** is determined by RandD, estimating, standardization, simplification and specialization, quality control, purchasing, maintenance of plant, equipment and buildings, production control, management of energy.

# Factors of production to consider are:

- Amount of repetition
- Range of products
- Quality

# Types of production

- Job ( unit) production
- Batch production
- Flow production

# Job ( unit) production

- Customer oriented – customer requires single product made to his specifications e.g. Suit
- Demand can be only broadly forecasting
- No production stocks
- Wider variety of machines and equipment

# Batch production

- Quantity of products or components are made at the same time
- There is a repetition, but not continuous production
- Production often for stock
- Flow production

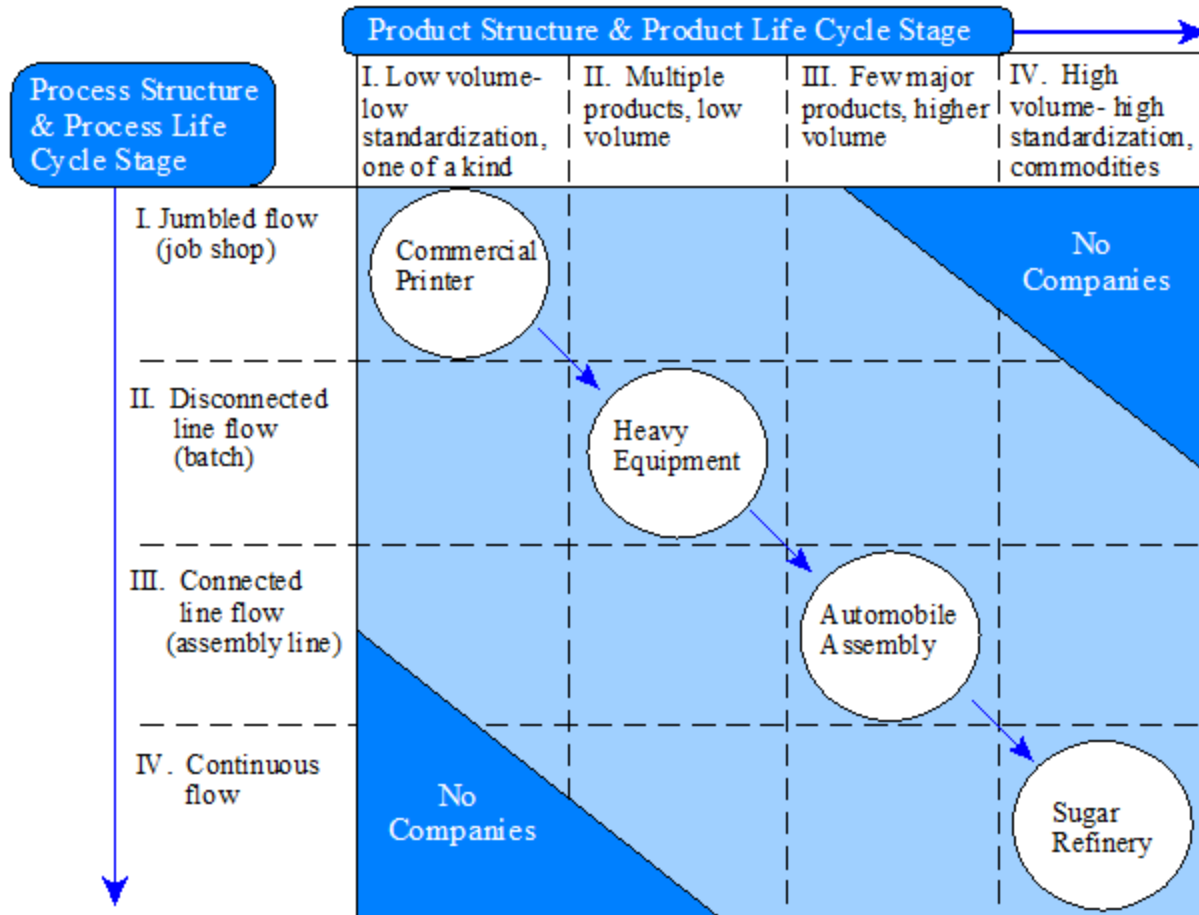


# Flow production

- Continuous production of products of a more or less identical nature
- Machine is continually used for one product
- Must be a continuous demand for the products

## Product-Process Matrix

Matching major stages of product & process life cycles\*



\* Adapted from Hayes & Wheelwright, Exhibit 1, p. 135.

# Types of production (Drucker)

- **Custom-order production** – production according the customer demand (units)
- **Rigid mass production** – is the manufacture of large quantities of standardized products, frequently utilizing assembly line technology. Mass production refers to the process of creating large numbers of similar products efficiently. Mass production is typically characterized by some type of mechanization, as with an assembly line, to achieve high volume, the detailed organization of materials flow, careful control of quality standards and division of labor.

- **Flexible mass production** Flexible mass production, however, uses standardization of parts to make possible diversity of end products.
- What both principles of mass production have in common is that the final product is assembled out of standardized parts
- **Process or flow production** - Flow production involves a continuous movement of items through the production process.
- The main disadvantage is that with so much machinery it is very difficult to alter the production process.
- This makes production **inflexible** and means that all products have to be very similar or standardised and cannot be tailored to individual tastes

# Tradition production system vs. JIT system

- The traditional approach adopts a functional organization designed to minimize manufacturing costs for the particular component. A JIT system organizes the intermediate processes to respond directly to demands from later stages of production. This distinction can be referred to as the difference between 'cost-push' and 'demand-pull'. (Edmond D'Ouville, T. Hillman Willis & C. Richard Huston Production Planning & Control Vol. 9 , Iss. 5,1998 )

# Tradition production system vs. Lean manufacturing

|                        | <b>Traditional Manufacturing</b> | <b>Lean Manufacturing</b>   |
|------------------------|----------------------------------|-----------------------------|
| <b>Scheduling</b>      | Forecast – push                  | Customer Order – pull       |
| <b>Production</b>      | Stock                            | Customer Order              |
| <b>Lead Time</b>       | Long                             | Short                       |
| <b>Batch Size</b>      | Large – Batch & Queue            | Small – Continuous Flow     |
| <b>Inspection</b>      | Sampling – by inspectors         | 100% – at source by workers |
| <b>Layout</b>          | Functional                       | Product Flow                |
| <b>Empowerment</b>     | Low                              | High                        |
| <b>Inventory Turns</b> | Low – <7 turns                   | High – 10+                  |
| <b>→ Flexibility</b>   | Low                              | High                        |

# Tradition production system

- Rely on the accuracy of the schedules based on MPS (Master Production Schedule) including the information about the customers, demand and lead times. These information are based on the
- Short planning system called RRPS (Resource requirement planning system). RRPS is the plan for requirements of productive resources including machine/equipment, workers, fund based on the Production Plan. It is to calculate the requirements of each resource by period, referring to the product load profile, based on the planned production by month.
- Especially used for job production.

# Lean manufacturing

- Known as pull system, it works the opposite way as the traditional production system
- everything is focused on the following stage of production and its needs (Customer Order Driven). It is used for producing the goods at the same rate as customers use it.
- This system is also known as: Toyota Production System (Toyota), Stockless Production, Action Workout (GE), the commonly accepted name is Just In Time (JIT) manufacturing.



# Production scheduling

- have a major impact on the productivity of a process. In manufacturing, the purpose of scheduling is to minimize the production time and costs, by telling a production facility when to make, with which staff, and on which equipment. Production scheduling aims to maximize the efficiency of the operation and reduce costs.
- is the process of arranging, controlling and optimizing work and workloads in a production process([wikipedie.org](https://en.wikipedia.org))

# Regulized schedules and linear output

- High –volume assembly industries
- Tendency to schedule in work shifts – interval between production runs, or units.

# Irregular schedules and output

- Sales are uncertain about how much product to expect from operations, it tries to keep protective- and costly- buffer stocks in the distribution system.

# Planning the Production Program

- Based on demand forecasts and orders plan the production quantities for the (main) products for the „next“ periods
- 2 variants:
- **Aggregate Planning**  
(aggregated view, tactical planning, medium run)  
few product groups for the next (months), quarters, or years  
capacities can be adjusted (hiring/firing, overtime, holidays, subcontracting ...)
- **Master Production Scheduling**  
(more detailed view, operational planning, short run)  
all main end products for next few shifts, days, or weeks (or months)  
capacities more or less fixed (except for overtime)
- Typically solved as an LP model

# Aggregate Planning

## 2 extreme scenarios in case of seasonal demand:

- Always produce the demand (forecast)  
„**Synchronisation**“ (zero inventory plan)  
→ cost of hiring/firing, overtime, subcontracting, idle time, ...
- Always produce average yearly demand (high utilization)  
„**Emancipation**“ (level workforce plan)  
→ inventory holding cost

## Goal:

- **Trade-off** between these costs  $\Rightarrow$  minimize total costs
- Solution by column minimum procedure

# Synchronisation

## Synchronisation:

No active planning, just reaction on demand (forecasts)

Always produce the demand (forecast)

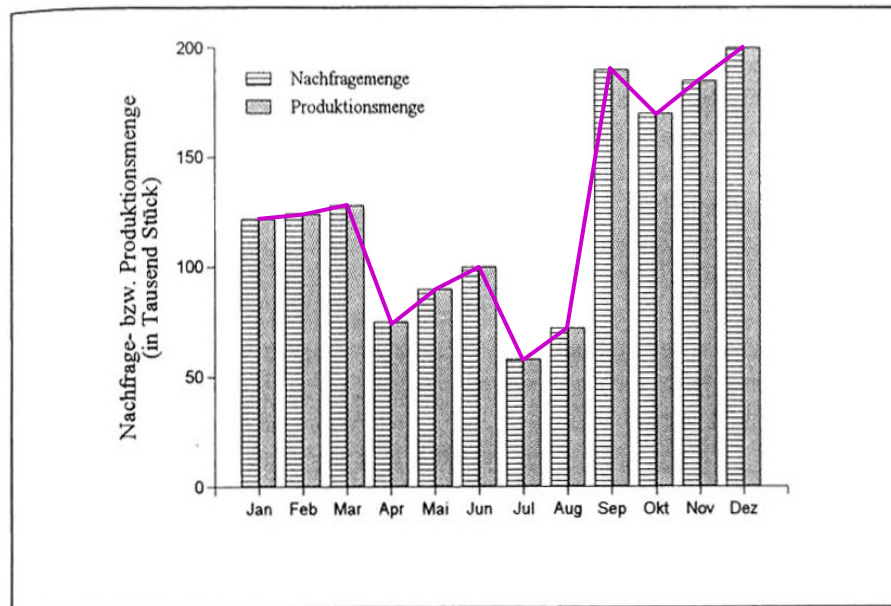


Bild 56: Synchronisation von Produktion und Nachfrage

# Emancipation

## Emancipation:

More or less constant demand, constant (high) resource utilization, fluctuating demand is fulfilled by building up and depleting inventory.

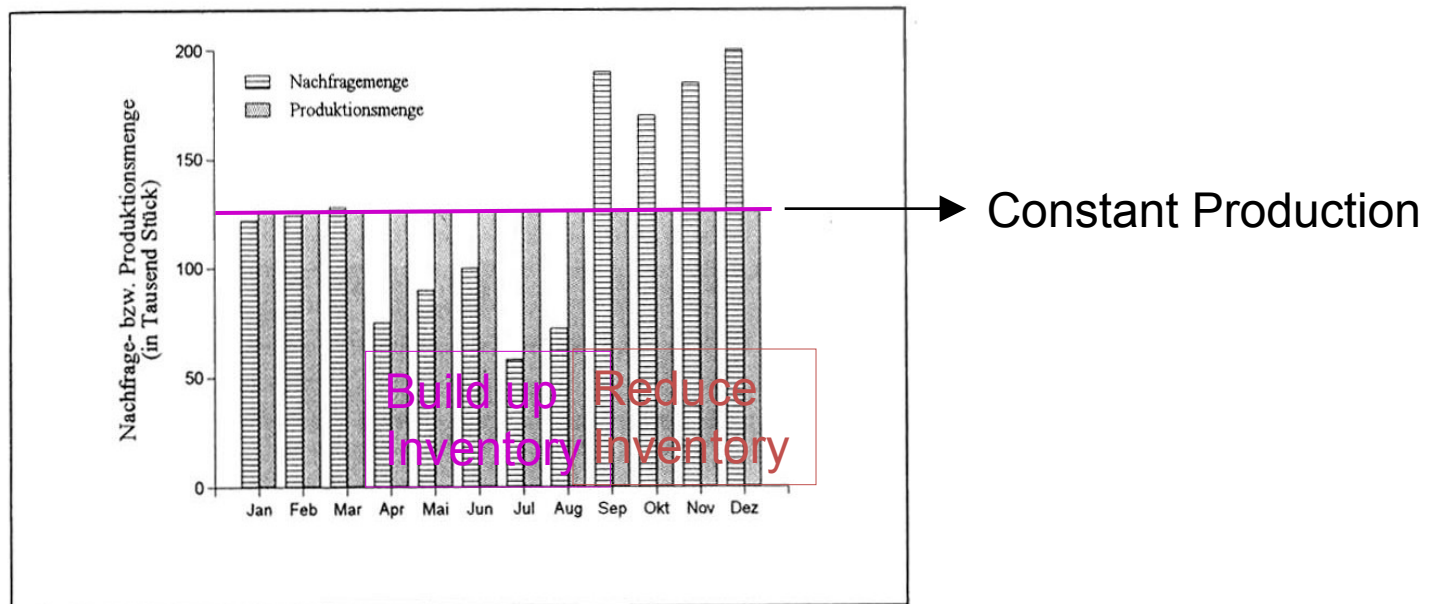


Bild 57: Emanzipation der Produktion von der Nachfrage

# Column Minimum Procedure

- In each period regular capacity can be extended at extra cost (overtime, subcontracting, ...)

Cope with fluctuating demand (capacity shortages):

- Produce more than demand – build up inventory, OR
- Use extra capacity

## Solution a special case (just one product group) as a TP

In each cell (**row**  $t$  ... production period, half row  $k$  ... capacity type, and **column**  $\tau$  ... demand period) the unit extra cost are:

$$c_{tk\tau} = u_k + h(\tau - t)$$

where:  $u_k$  ... Extra cost (per unit) of production using **extra capacity**  $k$  (e.g. overtime)

$h$  ... Inventory holding cost per unit and per period,

$h(\tau - t)$  ... Inventory holding per unit if produced  $\tau - t$  periods early

Solve as transportation problem using **Column Minimum Procedure**



# Calculation optimal batch size

- **The optimal batch size is at the minimum of the aggregation of transformation and holding costs.** The aggregated values form a kind of *U-shape*, hence the name: *U-Curve optimisation*.
- The more items I *transfer* at once the lower the overall transaction cost is. On the other hand, the more items I have in a batch the larger my inventories are, which increases the holding cost

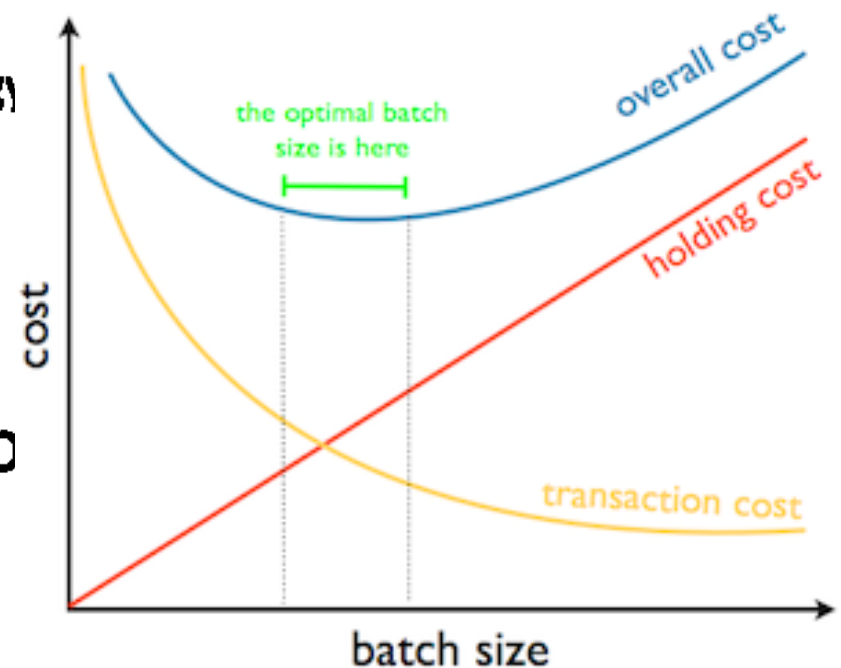
- **Cost and minimalization**

- K = cost of machine setup or order settings
- D = sales in time
- F = holding costs (technology)
- P = production in time
- Q = stock inventory
- $x = D/P$

- $TC = Q/2 * F (1-x) + D/Q * K$

- Derivation per Q...equal to

- $EPQ = Q = \sqrt{\frac{2 * K * D}{F * (1-x)}}$



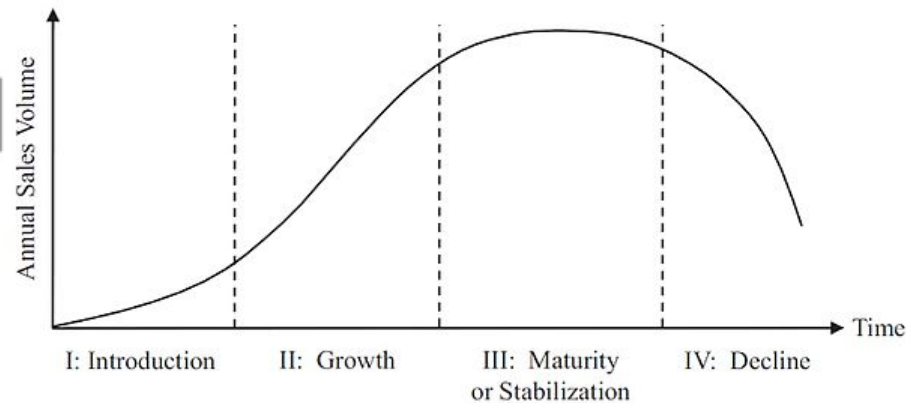
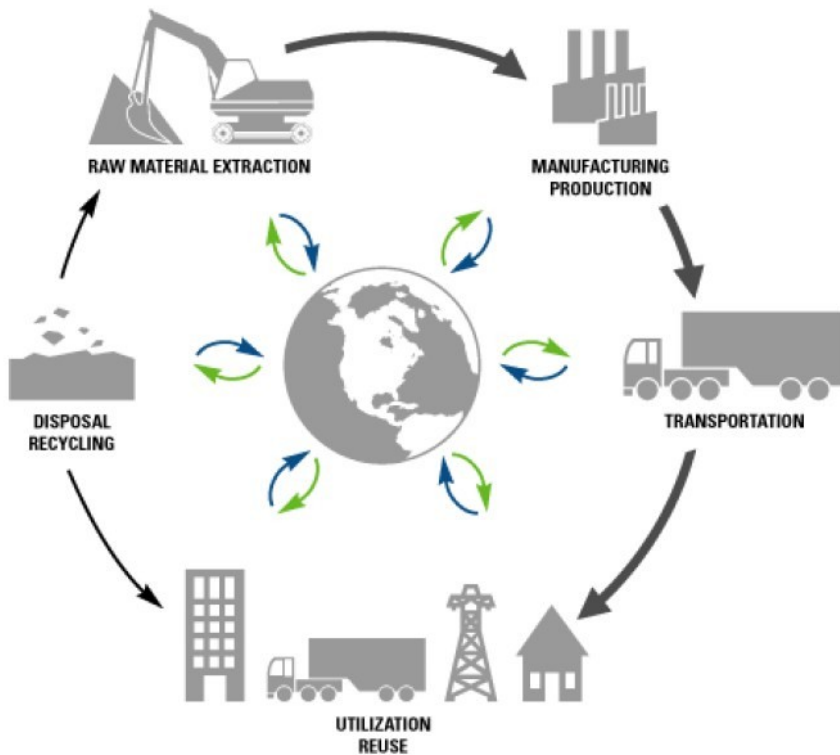
(c) Donald Reinertsen

# Production organization

- Mass (line, flow) production – layout of machines according to production process
- Workshop production – machines in workshops according to their function
- Grouped production – mix of above
- On-site production – production factors are travelling to product ( construction industry)
- Production nest – unified production centres
  - Job enrichment – increased control power
  - Job enlargement – increased range of jobs

# Product lifecycle

- 2 ways of knowledge: management approach vs. Marketing approach



# Product lifecycle management (Source:

wikipedia.org)

- PLM there are five primary areas:
- **Systems engineering (SE)** is focused on meeting all requirements, primarily meeting customer needs, and coordinating the systems design process by involving all relevant disciplines. An important aspect for life cycle management is a subset within Systems Engineering called Reliability Engineering.
- **Product and portfolio management (PPM)** is focused on managing resource allocation, tracking progress, plan for new product development projects that are in process (or in a holding status). Portfolio management is a tool that assists management in tracking progress on new products and making trade-off decisions when allocating scarce resources.
- **Product design** is the process of creating a new product to be sold by a business to its customers.
- **Manufacturing process management (MPM)** is a collection of technologies and methods used to define how products are to be manufactured.
- **Product data management (PDM)** is focused on capturing and maintaining information on products and/or services through their development and useful life. Change management is an important part of PDM/PLM.

# Product lifecycle marketing

- 4 stages:
- Introduction to the market
- Growth stage
- Maturity stage
- Saturation and decline stage

# Introduction to the market

- This is the stage in which the product has been introduced first time in the market and the sales of the product starts to grow slowly and gradually and the profit received from the product is nominal and non-attained. The market for the product is not competitive initially and also the company spends initially on the advertisement and uses various other tools for promotion in order to motivate and produce awareness among the consumers, therefore generating discerning demands for particular brand. The products start to gain distribution as the product is initially new in the market and in this stage the quality of the product is not assured and the price of the product will also be determined as low or high. (*Anderson & Zeithaml, Carl R. & Carl P., 1984*). )
- costs are very high
- slow sales volumes to start
- little or no competition
- demand has to be created
- customers have to be prompted to try the product
- makes little money at this stage

# Growth stage (wikipedie.org)

In the growth stage, the product is present already in the market and the consumers of the products are habitual of the product and also there is quick growth in the product sales as more new and new customers are using and trying and are becoming aware of the product. The customers are becoming satisfied from the product and they bought it again and again. The ratio of the product repetition for the trial procurement risen and also at this level, the competitors have started to overflow the market with more appealing and attractive inventions. This helps in creating increased competition in the market and also results in decreasing the product price.

- costs reduced due to economies of scale
- sales volume increases significantly
- profitability begins to rise
- public awareness increases
- competition begins to increase with a few new players in establishing market
- increased competition leads to price decreases



# Maturity stage

- In maturity stage, the cost of the product has been decreased because of the increased volume of the product and the product started to experience the curve effects. Also, more and more competitors have seen to be leaving the market. In this way very few buyers have been left for the product and this results in less sales of the product. The decline of the product and cost of attaining new buyers in this level is more as compare to the resulted profit. The brand or the product differentiation via rebating and discounts in price supports in recalling the outlet distribution. Also, there is a decline in the entire cost of marketing through enhancing the distribution and promotional efficiency with switching brand and segmentation. (*Griffin, Abbie , 1997*)
- costs are decreased as a result of production volumes increasing and experience curve effects
- sales volume peaks and market saturation is reached
- increase in competitors entering the market
- prices tend to drop due to the proliferation of competing products
- brand differentiation and feature diversification is emphasized to maintain or increase market share
- industrial profits go down

# Saturation and decline

- In this stage, the profit as well as the sales of the product has started to decline because of the deletion of the product from the market. The market for the product in this stage, started to show negative rate of growth and corroding cash flows. The product, at this stage may be kept but there should be less adverts.  
(*Steffens, Paul, 2002*)
- costs become counter-optimal
- sales volume decline
- prices, profitability diminish
- profit becomes more a challenge of production/distribution efficiency than increased sales

# BCG matrix

- *BCG matrix* (or growth-share matrix) is a corporate planning tool, which is used to portray firm's brand portfolio or SBUs on a quadrant along relative market share axis (horizontal axis) and speed of market growth (vertical axis) axis.
- (<https://www.strategicmanagementinsight.com/tools/bcg-matrix-growth-share.html>)

- BCG matrix is a framework created by Boston Consulting Group to evaluate the strategic position of the business brand portfolio and its potential. It classifies business portfolio into four categories based on industry attractiveness (growth rate of that industry) and competitive position (relative market share). These two dimensions reveal likely profitability of the business portfolio in terms of cash needed to support that unit and cash generated by it. The general purpose of the analysis is to help understand, which brands the firm should invest in and which ones should be divested.
- (<https://www.strategicmanagementinsight.com/tools/bcg-matrix-growth-share.html>)

- **Market growth rate.** High market growth rate means higher earnings and sometimes profits but it also consumes lots of cash, which is used as investment to stimulate further growth. Therefore, business units that operate in rapid growth industries are cash users and are worth investing in only when they are expected to grow or maintain market share in the future.
- (<https://www.strategicmanagementinsight.com/tools/bcg-matrix-growth-share.html>)

- **Relative market share.** One of the dimensions used to evaluate business portfolio is relative market share. Higher corporate's market share results in higher cash returns. This is because a firm that produces more, benefits from higher economies of scale and experience curve, which results in higher profits. Nonetheless, it is worth to note that some firms may experience the same benefits with lower production outputs and lower market share.
- (<https://www.strategicmanagementinsight.com/tools/bcg-matrix-growth-share.html>)

# There are four quadrants into which firms brands are classified:

- Dogs: Strategic choices: Retrenchment, divestiture, liquidation
- Stars: Strategic choices: Vertical integration, horizontal integration, market penetration, market development, product development
- Question marks: Strategic choices: Market penetration, market development, product development, divestiture
- Cows: Strategic choices: Product development, diversification, divestiture, retrenchment

# BCG matrix and product life cycle

