BUSI4496

Supply Chain Planning & Management

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Lecture 9

1. Demand- Driven Approaches Kanban/JIT/Lean
2. Theory of Constraints(TOC)
3. Variety & Postponement

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Nottingham University Business School
UNITED KINGDOM • CHINA • MALAYSIA

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Outline

1. Kanban, JIT and Lean - implications for planning and control
2. Theory of Constraints (TOC)
3. Product variety and postponement strategies

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Pre-Recorded Self Study Session on Moodle

4. Mass Customization
5. Quick Response Initiatives

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1. Kanban, JIT and Lean – planning and control implications

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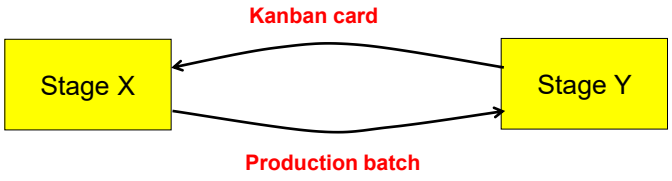
Kanban systems

- Two sequential processing stages



- Basic Kanban control: production at the upstream stage can commence **only** if in possession of a kanban (production card) issued by the downstream operation
- Stage Y **controls** the schedule of stage X
- In principle **could be a batch of one**, usually greater
- This is a **PULL control** system

Kanban use in bakery
https://tinyurl.com/kewyfvu

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Kanban systems

- **Many Kanban types** for different contexts
- **Materials handling** systems, transportation systems and storage containers important
- Enables **visibility of process flow** and precise production amounts
- These are **self-regulated** systems
- **Repetitive production** and hence repetitive demand?
- **Pareto analysis** to identify target parts and processes
- **System parameters** need to be specified and the number/size of kanbans can be estimated.

Kanban use in a hospital
https://tinyurl.com/m89dlu8

E- Kanban
https://tinyurl.com/kemfpa5

Just-in-Time (JIT) production

- Kanban type approaches underpin JIT systems but **JIT is much more!**
- Apply **two principles** throughout the organisation
  1. **Produce nothing until it is needed**
  2. **Produce precisely what is needed, when it is needed and no more**
- For true JIT apply these principles not just for internal operations but **across the extended enterprise**
  - **in-bound supply** channels
  - **outbound distribution** channels

Kanban between supplier and customer
https://tinyurl.com/l372elb

JIT & LEAN production

KANBAN ➡ JIT ➡ LEAN

- Lean emphasises all JIT concepts
- **+ Focus on creating customer VALUE**
- **+ Eliminate WASTE**

The **focus is on rapid flow** through the whole chain

Key Lean principles

1. **Specify 'value' from the perspective of the customer**
   - products should be designed to enhance customer value
2. **Identify the 'value stream'**
   - each operational process step should add value for the customer - eliminate all sources of waste
3. **Make value flow**
   - the process should flow efficiently towards the customer without significant intermediate storage, waiting or loopbacks
4. **Use pull not push**
   - the process should produce what customers need, when they need it, be flexible enough to change for current requirements
5. **Strive to perfect the process**
   - create an environment that encourages continual review, learning and improvement

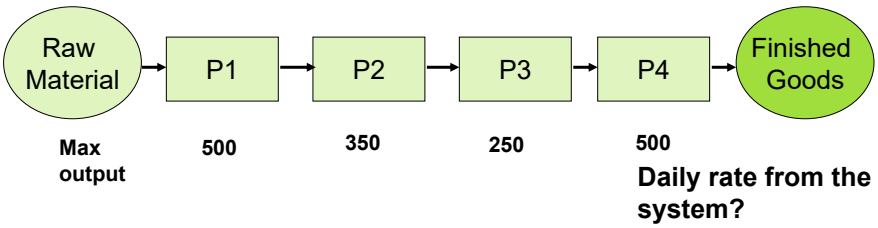
Lean production

- **Many benefits of leanness**
  - Allows great **visibility of operational systems**
  - **Simple visual control systems**
  - **Some aspects** of JIT/Lean **may be 'inserted'** into any operational system where circumstances allow (e.g. **Kanban control**)
  - Tries to implement '**DEMAND PULL**'
- But
  - Many lean industrial systems **require some level of MRP-control**
  - **Demand pull** may be **difficult to achieve**
  - Can lean systems **cope with high variety** and **unpredictable demand?**
  - May **export complexity** – often upstream

2. Theory of Constraints (TOC)

https://tinyurl.com/pdq4sy7

Bottlenecks



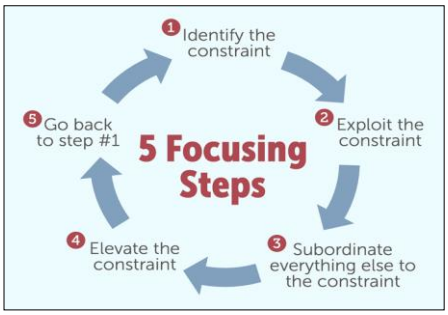
- **Bottleneck** - a constraint or limit on capacity at a processing stage that is less than some upstream or downstream processing stage –
- **System throughput** will be **less than 250 per day**
- **Upstream processes need to be controlled carefully** to ensure that 250 per day is realised
- **Downstream processes need to be able to process output from Stage 3 quickly** to ensure maximum throughput speed

Theory of Constraints

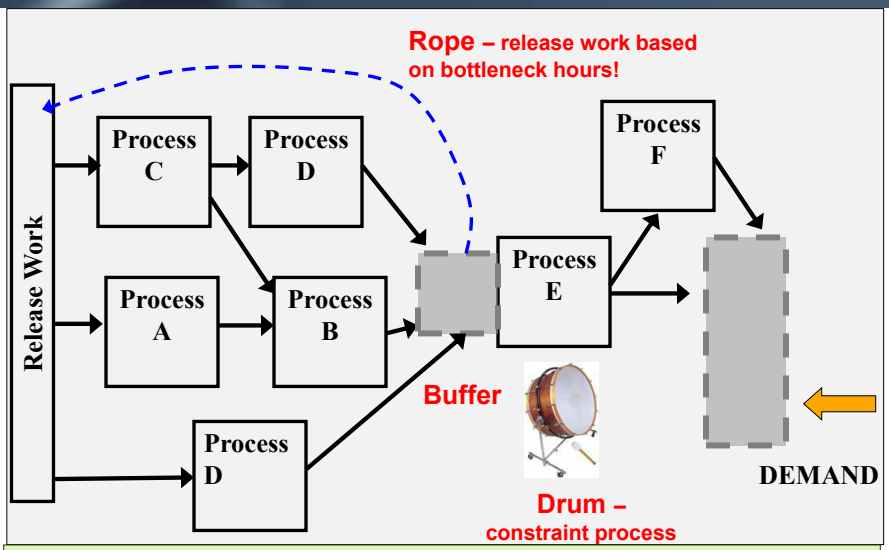
- A **bottleneck** may result from **any resource type** e.g. lack of skilled personnel, limited availability of materials as well as machine limits….
- **TOC stresses capacity limits + process variability** as the major causes of
  - poor delivery performance, scheduling problems, high costs in manufacturing plants
  - The combination of **dependent events** (e.g. steps in a production system) and **normal variation** (always present) makes it **impossible to ever fully balance a system**
  - **Identifying bottlenecks** + **maximising their capacity** to ensure that **overall system throughput is maximised**

TOC – the five 'focusing' steps

1. **Identify the constraint**
2. **Exploit the constraint**
3. **Subordinate to the constraint**
4. **Elevate the constraint**
5. **Prevent inertia – go back to step 1.**



TOC with Drum-Buffer-Rope scheduling - DBR



DBR attempts to maximise use of the constraint by **ensuring the correct work is released** into the system **at the proper time** to (i) **never starve** the constraint and (ii) **not overload** it

Drum-Buffer-Rope (DBR) scheduling 1

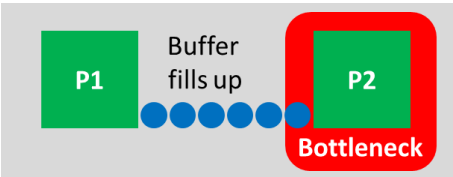
1. The **Drum** is the processing capability of the constraint, **determining overall system throughput** - provides the **drumbeat** for the entire plant, based on **market demand**

2. The **Rope** transmits information from the **Drum** to release of work into the system - material release is **tied to the rate of the constraint(s).**

   - Information is transmitted to release additional work into the system by measuring the size of buffers and to limit the build-up of inventory

Drum-Buffer-Rope (DBR) scheduling 2

3. Insert **Buffers**
   - **Deliberate** placement of in-process inventories to protect the constraint – inventory/capacity/time **buffers**
   - **strategically located** to ensure **maximum constraint utilization**,
     - The constraint should **never be starved**,
     - The constraint should be **protected from any disturbances** in the system



Together, 1+ 2 + 3 act as a DBR plant scheduling system

TOC in perspective – when does it work?

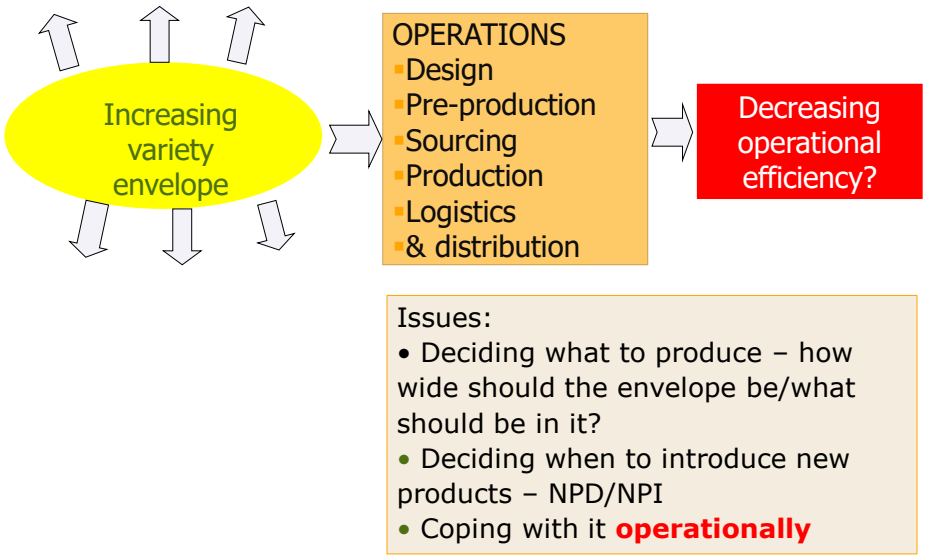
- **TOC** tries to bring **synchronous production** to unbalanced systems
- **DBR** claims to allow scheduling that is **immune to disruption**, **avoids excess inventory**, and use **small batches** to **minimize overall lead time**
- It seems to work best where the **emphasis is on continuity of output** and **where capacity bottlenecks** are clear but difficult to change, see www.goldratt.co.uk
- **Considerable dispute about how widely the ideas can be successfully deployed** - applications now extend to project management and to administrative systems
- Has implications for accounting, see: https://tinyurl.com/y7zbxey8

3. Product variety and postponement

Product variety continues to increase

- Product **variety has increased** in almost all sectors
- Markets are being **'diced and sliced'** in ever evolving/ interesting ways
- Growth in product variety is **accelerating**
- Product variety increased by 1% per year over the last 40 years to 2000
  - MacCarthy (2013), International Journal of Production Research
- Has **operational implications** across the supply chain

Product variety and operations



Issues:
- Deciding what to produce – how wide should the envelope be/what should be in it?
- Deciding when to introduce new products – NPD/NPI
- Coping with it **operationally**

The postponement principle

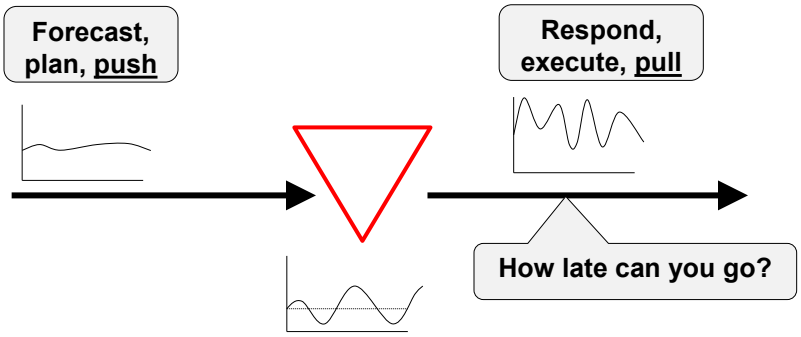
Postponement

- **Delaying** the **commitment** to final product attributes until, or **close to**, the **point of real demand**
  - **later information** (hopefully) more reliable/more certain/less risky
  - **avoids the risk** and costs of carrying large inventories
  - may be **achieved in a number of ways**
  - simple concepts with **hidden complexity** but also has risks and costs
- Postponement trades economies of scale for economies of scope - **may lose out on volume opportunities!**

Types of postponement

- **Form***
  - delaying commitment to **some key physical product attributes** until real demand signal received
- **Time**
  - delaying commitment to **any** product attributes until real demand signal received
- **Place/Location**
  - delaying commitment to the specific **final location** of an inventory item until real demand signal received
  - **Postponement types may be combined** – see Van Hoek (2001), Yang et al. (2004)

Using the decoupling point for postponement - ATO?



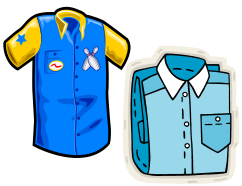
- Maintain the product in a **'neutral'** state until as late as possible in the production process
- Separates **upstream predictable/stable** operations from **responsive downstream operations** close to real demand
- Should **lower finished goods inventory .** WIP inventory may need to be high but with **lower risks** as it is more generic

Customising 'in the channel'

Place and form postponement – exemplar case HP printers (Feitzinger and Lee 1997)

Postponement and modularity

- Designing **modular products** has many motivations
- **Modularity** in product design means having **standard interfaces** across different parts of the product- can be costly and difficult
- **Postponement using modularity** works well when the attributes fulfil **functional requirements**
- Works **less well** for **aesthetic/design attributes**
- Garments are inherently modular – standard interfaces - but do they help in form postponement?



Key Learning points 1

1. **Kanban is a building block** of JIT, which is a building block of JIT and lean production operations
2. **Kanban** control can be **introduced into many operations** if the circumstances are appropriate
3. **JIT is difficult achieve** and may still need MRP-control at some level
4. **Theory of Constraints (TOC) is based on managing bottleneck operations** to ensure maximum 'continuous' throughput – has implications for the whole of the operation
5. **Drum-Buffer-Rope (DBR) is way of scheduling** a set of operation where control is **dictated by the bottleneck**
6. Workload control (WLC) tries to ensure optimum release of work into a shop to avoid overload

Key Learning points 2

7. Increases in **product variety** cause many operational **problems**
8. **Postponement** may in some circumstances be used to produce customer-focused variety efficiently
   - Place, **Form**, and Time postponement
   - Form postponement the most common – may need **modular products**

Pre-Recorded Self Study Session on Moodle……..

- **Mass Customization** uses mass production principles to produce customized products – may gain **high rewards** without increasing costs but is **difficult to do**
- A **spectrum of methods** to deliver variety and customization depending on supply and demand factors
- **Quick Response (QR)** requires a combination of good production, information, and decision practices