Lancaster University Management School

Introduction to Operations Management

ERP, JIT & Lean

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Stuff you need to know

- 2 Lectures / week x 6 weeks (17 – 22) as per your timetable
- 1 Seminar /week as usual
- Overheads posted on Moodle as usual
- Slack *et. al*, Operations Management, Pearson xx (20xx) edition
- Contacts:
  - For CWA, Exam, and overall module queries: Dr Iftikhar a.iftikhar@
  - For content related queries wks 17 -22: Contact me, s.banga@
  - For all other queries: Helena Greenwood h.greenwood@

More stuff you need to know

- Post questions on discussion forum on Moodle for the week
- Tell me if you find lectures hard to follow: Do ask if you need help, but always make an attempt first
- Contact me only on email
  - Use your Lancaster email account
  - Include subject heading
  - Include content in email – don’t just send an attachment
  - Check spelling

Three important things…

- Please arrive for lectures on time
- Please don't talk during the lecture – raise your hand if you have a question
- Don't game attendance – you will face misconduct if caught

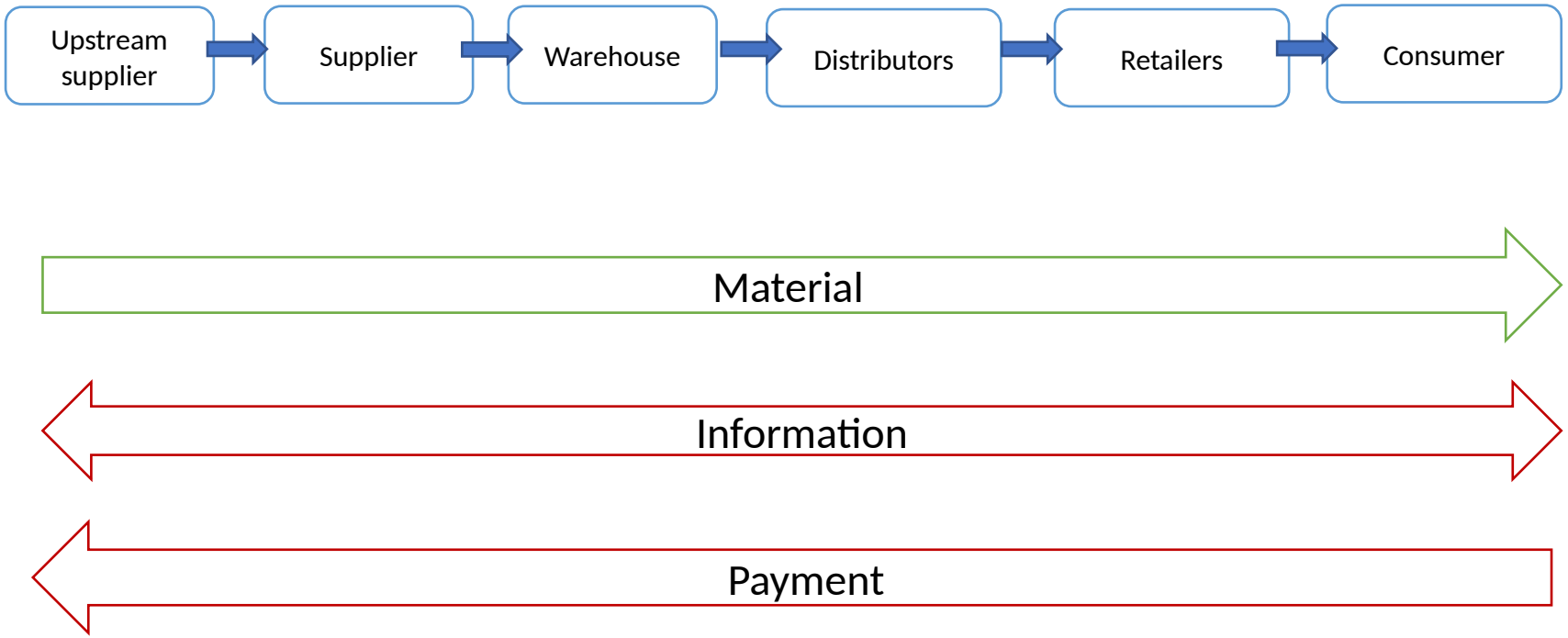
Schedule: Wks 17 – 22

Week	Topic	Taught by
11	Operations as a System	AI
12	SCM	AI
13	Inventory	AI
14	Capacity	AI
15	CWA	
16	Forecasting	AI
17	ERP / Lean / JIT	SB
18	Project management	SB
19	SPC / Quality Assurance	SB
20	Risk Analysis	SB
21	Perishable Inventory	SB
22	Humanitarian Operations	SB
23	Sustainable Operations	AI
24	Research in OM	AI
25	Exam	

ERP and Lean

- The logic of MRP / MRP II
- The generalization into ERP
- The contrasting logic of Just-in-time systems
- The generalization into Lean Production

Supply Chain flows



The basic problem

The narrow problem

- How do you coordinate a complex activity?

The wider problem

- How does this affect the operation more generally?

Philosophy 1

- Consistent activity requires central control
- Dependable outcomes requires deep planning

Philosophy 2

- Responsive activity requires local control
- Appropriate outcomes require direct interactions

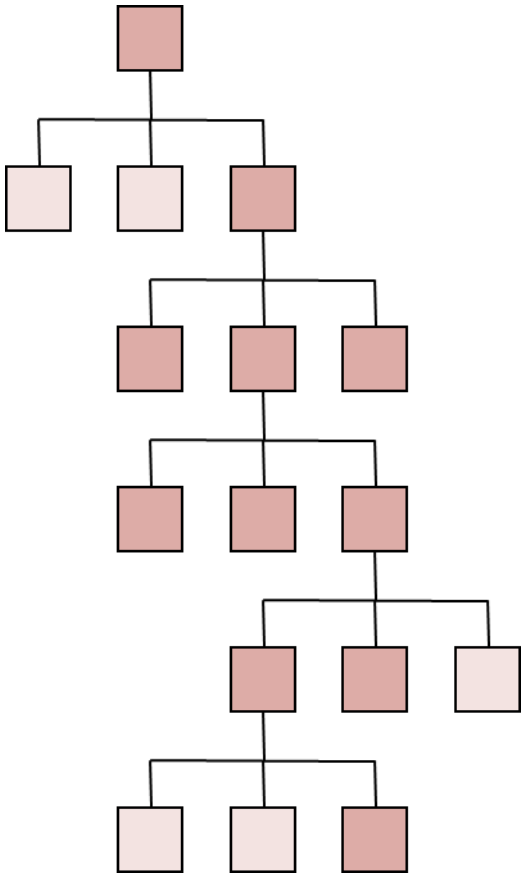
Material Requirements Planning (MRP)

- Advance order for 500 tuna mayo sandwiches
- Delivery needed 11:00, delivery time 40 minutes
- Packing, dispatching and loading time 50 minutes
- Fresh bread procurement time 2 hours from order
  - Sandwich assembly from bread casing and filling 10 mins
  - Filling preparation from tuna mayo mix and salads 10 mins
  - Mixing of filling from tuna, mayo and seasoning 10 mins
  - Preparation and cooking of fresh tuna 60 mins
  - Preparation and mixing of fresh mayonnaise 30 mins
  - Washing and preparation of salad 20 mins
  - Bread preparation and buttering 30 mins
- When should the tuna be taken out of the ‘fridge?
- What process have you followed?

Material Requirements Planning (MRP)

The essential process

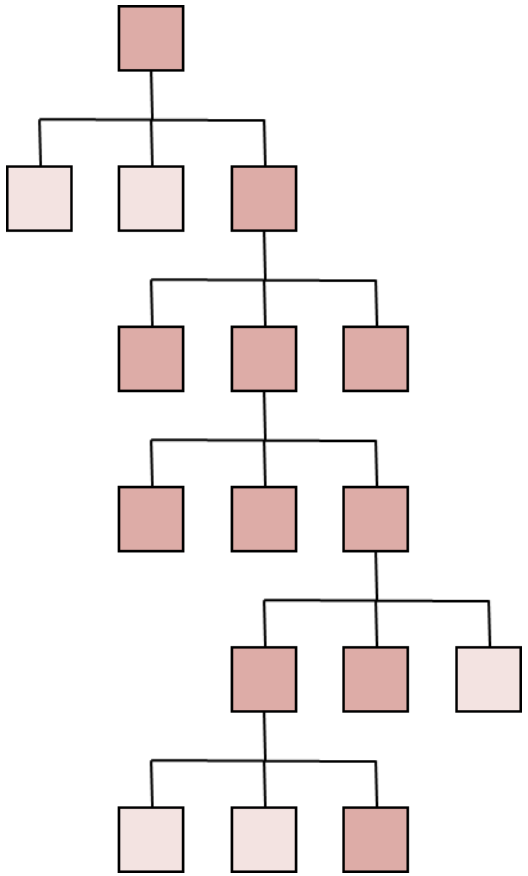
1. Decompose final output hierarchically into components
2. Associate process times with each node in hierarchy
3. Work back from due time to get process start times
4. Generate production and procurement instructions
5. Aggregate across all outputs in the organisation
6. Checking plans against resources



Material Requirements Planning (MRP)

Main objectives:

1. What to order
2. How much to order
3. When to order
4. When to schedule deliveries



Material Requirements Planning (MRP)

- Achieve complexity by repeated application of simple rules:
  - Schedule back from due time
  - Decompose into components
  - For each component
    - Schedule back from due time
    - Decompose into components

Manufacturing resource planning (MRP II)

The basic system

- Combines forecast and known orders into the

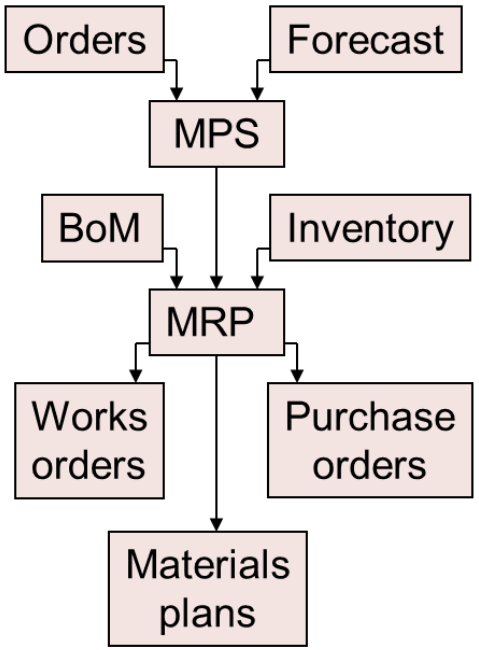
Master Production Schedule **(MPS)** (how much will you need per unit in a specified time)

- Uses the Bill of Materials **(BoM)**

(**Product Structure** – shows different levels at which input materials are put together in sequence) and **Inventory** (items in stock)

- Generate **Works orders**

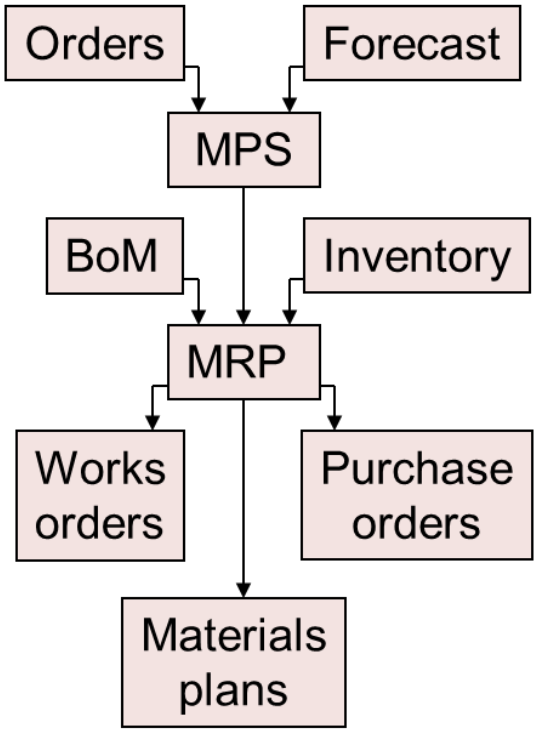
(instructions to make), **Purchase orders** (instructions to buy), and **Materials plans** (instructions to take out of stock)



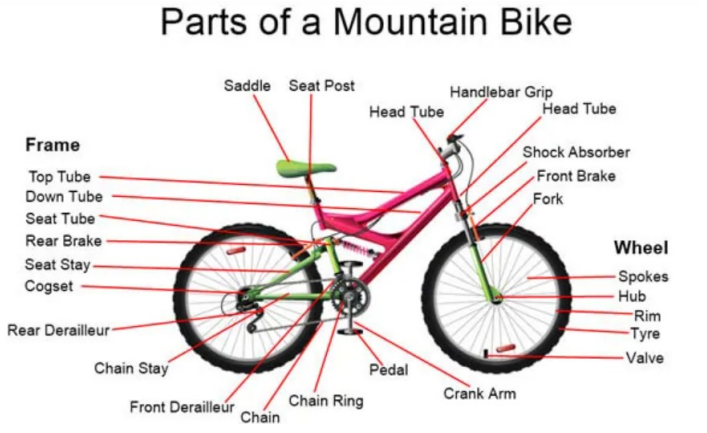
Manufacturing resource planning (MRP II)

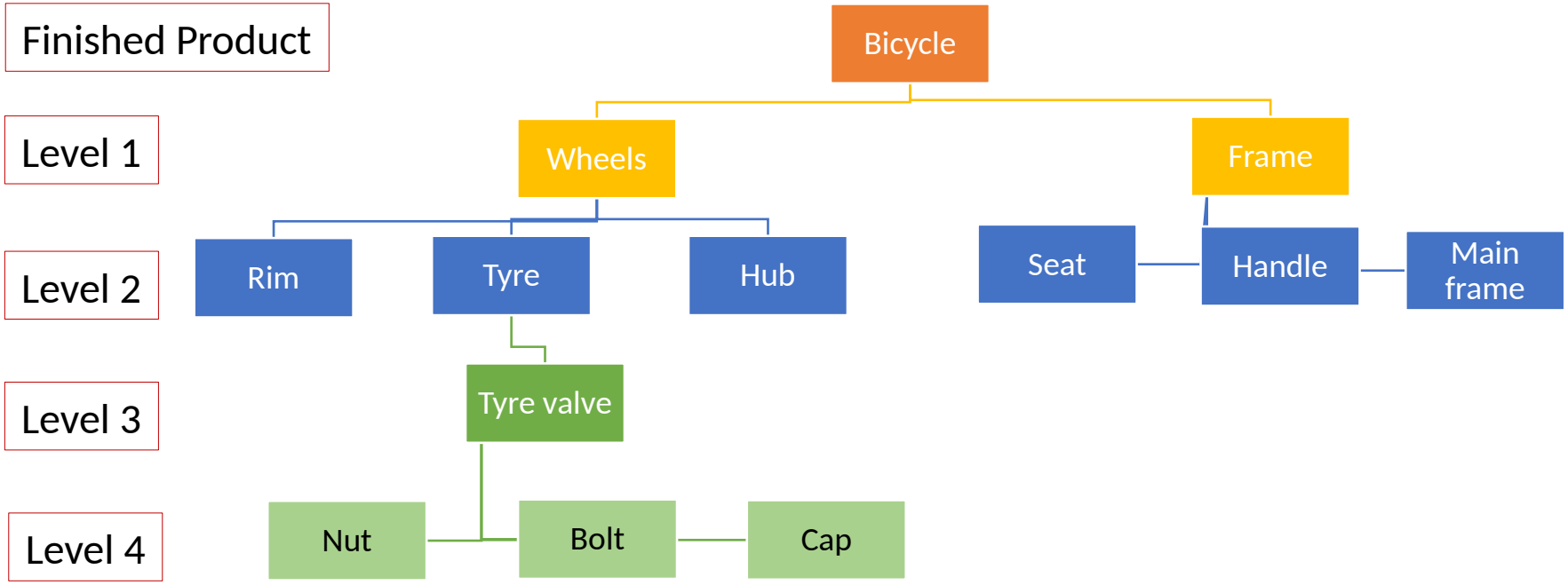
A comprehensive system that –

- Covers all aspects of manufacturing – demand forecasts, materials planning, capacity planning, inventory, scheduling, financials
- Closing the loop : Checking plans against resources at various levels

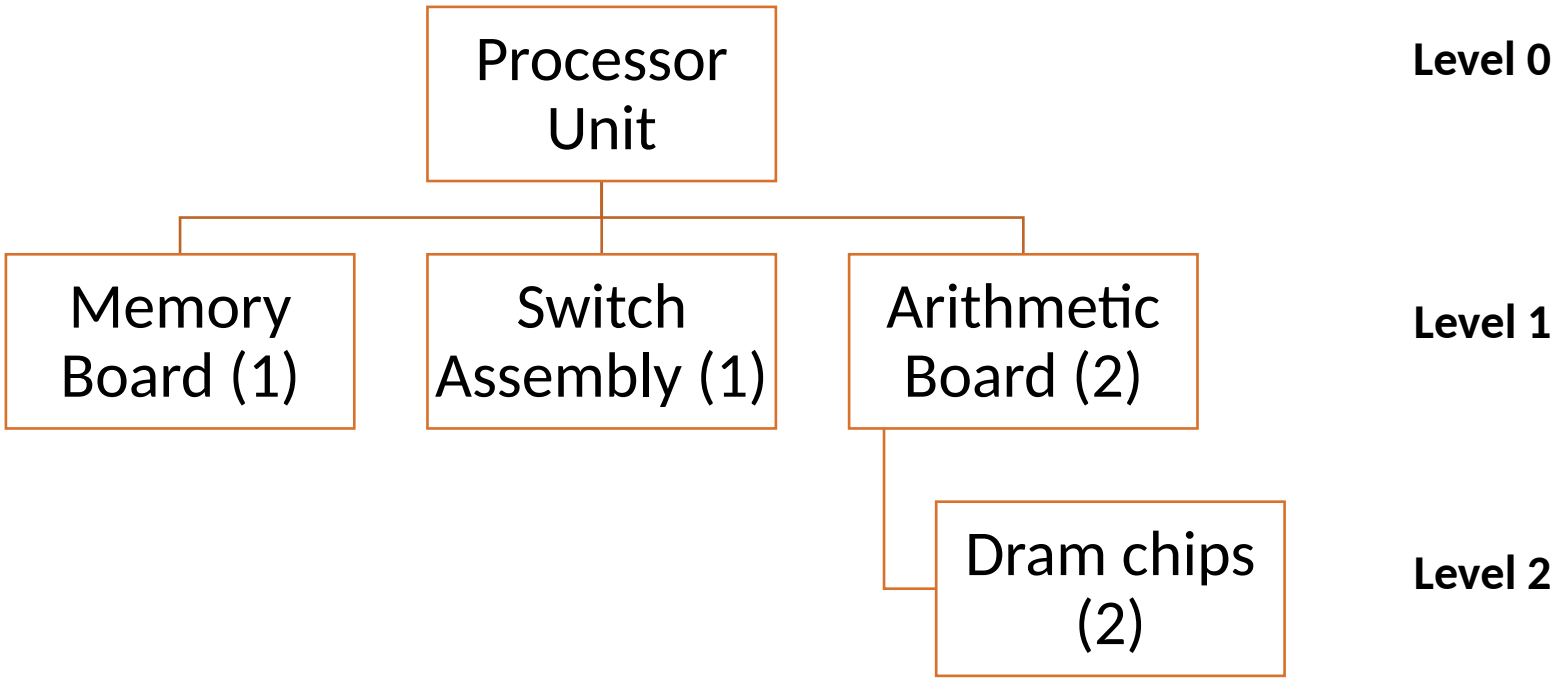


Bills of material (BoM)





Product Structure



MRP: Example: Processor

Item: Processor	Level: 0	Lot Size: LFL (or L4L)			LT: 1 week	
Period		1	2	3	4	5
Gross requirements		85	95	120	100	100
Scheduled receipts		175	0			
Projected on hand	25	115	20	0	0	0
Net requirements		0	0	100	100	100
Planned order receipts				100	100	100
Planned order releases			100	100	100	

MRP: Example: Mother board

Item : Mother board	Level: 1		Lot Size: 50			LT: 1 week	
		Period	1	2	3	4	5
Gross requirements			0	60	0	60	0
Scheduled receipts							
Projected on hand		20	20	10	0	0	0
Net requirements			0	40	0	50	0
Planned order receipts				50		50	
Planned order releases			50		50		

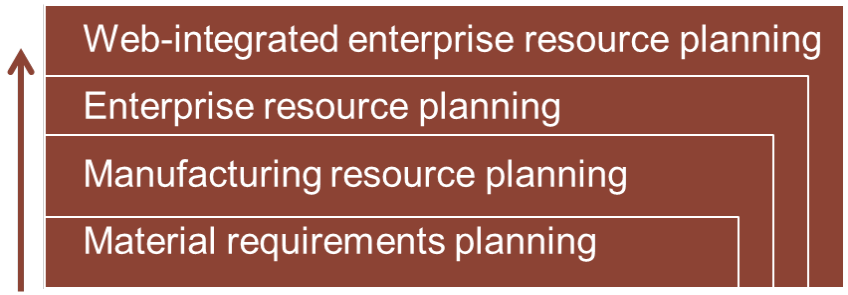
Enterprise resource planning (ERP)

The extension of MRP into ERP

- Controlling workflow & transactions in many functions
- Throughout organizations and possibly supply chains
- Organized around single central data store

Expected payoff

- Complete visibility & explicitness of processes
- Discipline from making the firm fit the system
- Sense of control & complete knowledge



Enterprise resource planning (ERP)

Enterprise resource planning (ERP)

- *But* requires extensive adaptation by consultants & vendors

And has critical dependencies on e.g.

- Compliant behaviour
- Acceptance of imposed systems
- Compatibility of legacy systems
- Good data

Enterprise resource planning (ERP)

‘NIKE: ERP Implementation, from failure to success (Paton et al, pp 298-9)
Late 2001 saw an uncharacteristic 30% fall in profits, which Nike attributed to problems with a new ERP system introduced with i2 Technologies... One major issue that emerged was the high degree of customisation Nike made to the i2 system, making it slow to update entries, and difficult to track down and rectify errors. The customisation problems were compounded by i2’s lack of experience in clothes and shoes, and Nike’s changing operating conditions, which forced the adoption of the system before it was ready... Nike and i2 quickly found solutions to the problems, but had already over-ordered on some products, leading to heavy discounting, and under-ordered on others, leading to shortages of some top sellers... Nike now has a single-instance, apparel-industry focussed SAP/R3 system (ie all data is held only once in the database)...’

IT Systems changes at Dell (Hill and Hill, p 271)
Dell spent two years implementing SAP’s R3 to run its manufacturing operations and then found that its ERP system did not fit its new decentralised management structure. SAP was found to be ‘too monolithic’ to be altered for its changing organizational needs when its business model changed from a worldwide focus to a regional focus. Some time later, Dell chose an i2 Technologies system to manage raw materials...’

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Lecture_ERP, JIT & Lean

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Reminder: The basic problem

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Just-in-time approach

Suppose you were *prevented* from planning

- And *prevented* from holding inventory

How would you operate?

- What would be the preconditions?
- What would be the consequence?

Just-in-time approach

"The lean production of sandwiches at Subway is driven directly by the customer, who first chooses the bread, then chooses a filling and choice of cheese, and the selects the 'veggies' and sauces. The sandwich is assembled along a counter, and at busy times is passed from employee to employee ... who cut the bread, add one of the three elements, and wrap the finished sandwich... The choice on the menu may seem complicated, but it is actually simple and well thought out. For example, the bread is one of just five options... These are made of two base doughs, but with different toppings added before backing... The bread is always fresh, not just because it is baked locally, but also because it is allowed to stand for (at most) only three hours before being discarded... The meat... comes pre-proportioned in paper trays. This ensures the correct quantity, and also speeds up the preparation process and the employee does not need to count the slices... When meat stocks runs low, another container is fetched from the cold store... The system is kept free of complexity... material flow is fast, regular and very visible... there is no scope to make mistakes..."

(Paton et al 2011)

Just-in-time approach

- JIT philosophy: doing only what is necessary when it is necessary and with the amount that is necessary.

As a control system: Pull instead of push

- By downstream process, not a central plan
- Focusing on reducing inventory levels
- Producing only what is needed and when it is needed.

Substantial pre-requisites & vulnerabilities

- Extensive communication and integration
- Freedom from error and flaws
- Vulnerable to failure
- High reliance on suppliers

Just-in-time approach

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Substantial pre-requisites & vulnerabilities

- Extensive communication and integration
- Freedom from error and flaws
- Vulnerable to failure
- High reliance on suppliers

But substantial benefits

- Minimal inventory
- Up-to-date outputs
- Responsiveness
- *And* the prerequisites

PUSH: Cost efficiency through high-capacity utilisation
PULL: Cost efficiency through low inventory holding

Just-in-time approach

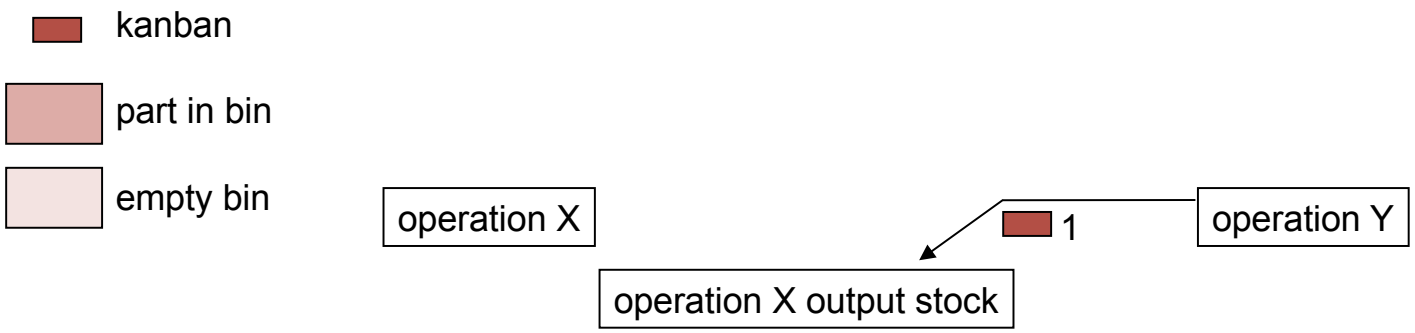
In practice:

- Need to avoid lead-time accumulation
- Allow very small stocks between operations
- Use visible communication systems, e.g. Kanban
- A tool to match supply and demand
  - A “Kanban” is a visual signal (card) that triggers the movement, production or supply of one unit of product or one standard amount of service activity
- 3 functions of Kanban:
  - An instruction for the preceding process
  - Visualising workflow, to track the progress of tasks and monitor
  - Limit work in progress, to avoid overload, limit the number of tasks that can be in progress at any one time

Just-in-time (JIT)

1-card kanban mechanism

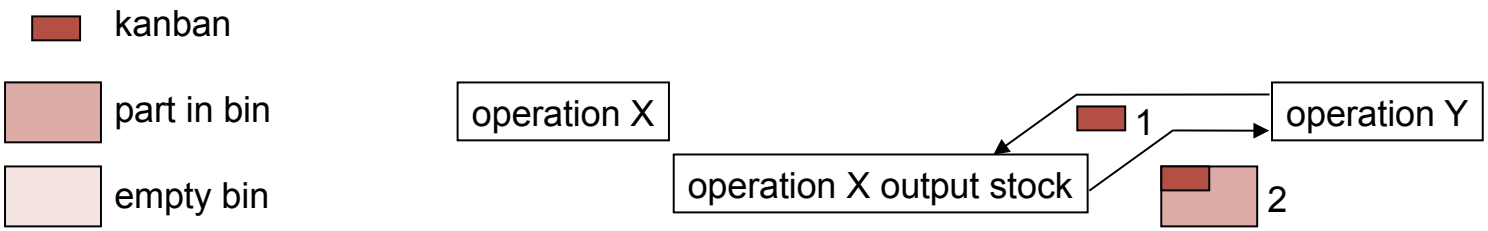
- When need part…
  - Take ‘move’ kanban to prior operation’s *stock*



Just-in-time (JIT)

1-card kanban mechanism

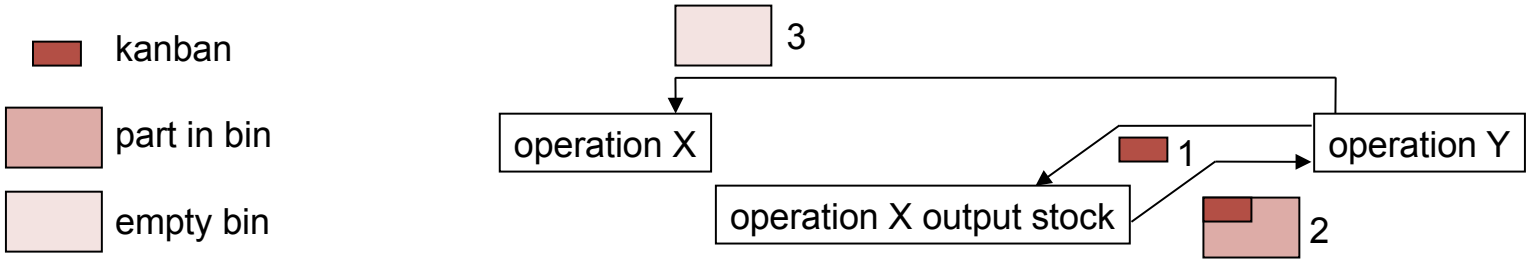
- When need part…
  - Take ‘move’ kanban to prior operation’s *stock*
  - Bring a part in a bin with kanban



Just-in-time (JIT)

1-card kanban mechanism

- When need part…
  - Take ‘move’ kanban to prior operation’s *stock*
  - Bring a part in a bin with kanban
  - Use part
  - Return bin to prior operation

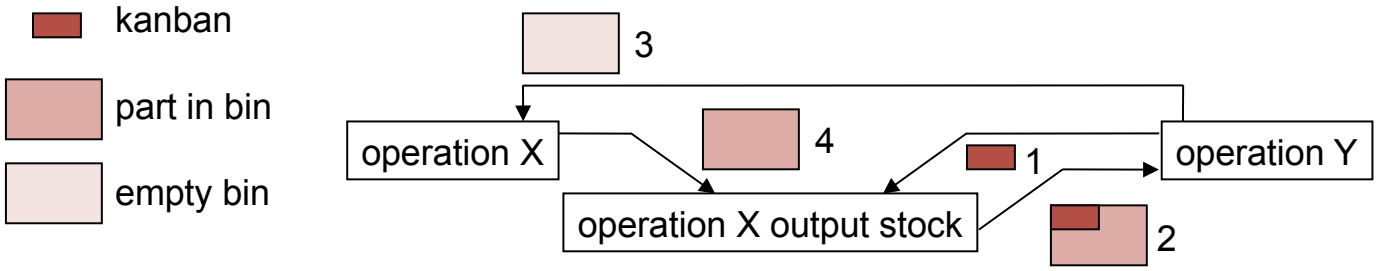


1-card kanban mechanism

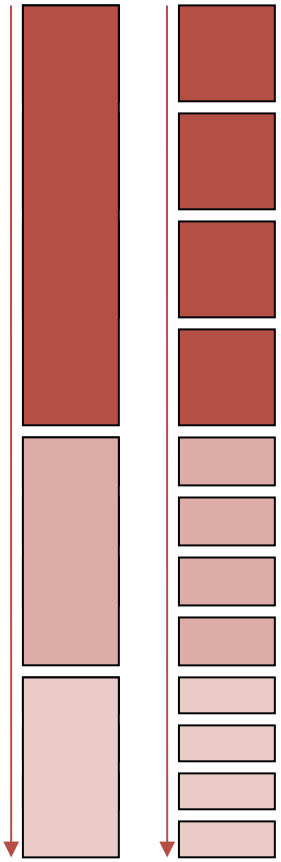
- When need part…
  - Take ‘move’ kanban to prior operation’s *stock*
  - Bring a part in a bin with kanban
  - Use part
  - Return bin to prior operation
  - Prior operation makes new part for its stock
- Repeat when next need component

Again, achieve complexity by repeated application of simple rule:

- Execute task N only when new demand at task N+1
- Execute task N-1 only when new demand at task N etc



A typical kanban display at a car mfg line



large batches

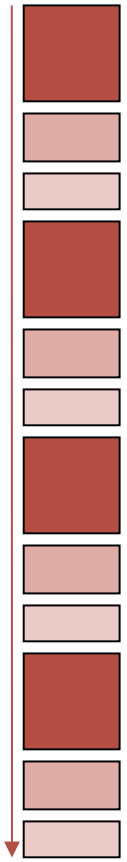
small batches

Just-in-time (JIT)

Levelled scheduling

- Keep even mix and volume where possible
- By replacing large batches with regular mixes
- Which requires short changeovers

See Jamie Oliver case (Slack, 10th ed., p.568)



levelled schedule

Large batches: Lower cost per unit, higher production volume, less frequent changeovers, but, higher inventory, less responsive, longer lead times

•Small batches: Responsiveness, faster feedback loops for quality control, reduced waste, lower obsolescence and inventory costs, but higher cost per unit, potentially lower volumes

Toyota's 'production system'

Just-in-time

- Levelling and smoothing flow (*heijunka*)
- *Kanban*
- Laying out processes to smooth flow (*nagare*)

'Humanizing' operator-machine interface (*jidoka*)

- Fail-safeing
- Visual, at-a-glance status
- Line-stop authority

The development into ‘lean’ production

A generalisation of JIT

- Not just eliminating the waste of unnecessary inventory
- But eliminating waste more generally

And doing so by also emphasising…

- Involvement of everyone
- Continuous improvement

Based on…

- The 7 forms of waste

Identifying 7 waste types

T

TRANSPORTATION

Moving items or information

I

INVENTORY

Items or information that customer has not received

M

MOTION

Excessive movement within workspace

W

WAITING

Waiting for information or items to arrive

O

OVERPROCESSING

Doing more work than necessary

O

OVERPRODUCTION

Doing work before it is needed

D

DEFECTS

Mistakes and errors that need to be reworked

Identifying 7 waste types

Type of waste	Examples	Remedies
Transporting	Excessive handling of product / inefficient delivery routes	Co-locate processes or consider trasnport method change
Unnecessary Inventory	WIP / excess stock	Synchronise processes
Unnecessary Motion	Poor ergonomics & design	Co-locate workers, job-redesign
Waiting	Queues / customer service waiting times	Couple processes
Over-processing	Multiple approvals for spend / features which few people use	Work-cells, low-cost process improvements
Over-production	Printing / filing of unnecessary documents / acc. before bottlenecks	Consider JIT
Defects		Continuous improvement, employee involvement

How does Lean differ from traditional approach?

Lean thinking:

- Continuous improvement
- Reducing waste
- Quality and customer satisfaction
- Consistency, perfection and excellence across the organization
- Collaborative and flexible organization structure
- Bottom-up decision-making and not top-down decision-making

How does Lean differ from traditional approach?

A Westernised approach: analyse value as the opposite to waste

The 5 steps to adding value (Womack and Jones)…

- Identify value by specific product
- Identify the value stream for each product

(by ‘Value stream mapping’: Slack et al p.509/510)

- Make value flow without interruption
- Let the customer pull value from the producer
- Pursue perfection

Lean versus traditional approach

Considering the role of people

Because of the behavioural change required to make lean work, lean stresses on the role of people:

- Team-based problem-solving
- Job enrichment (by including maintenance and setup tasks in operators' jobs)
- Job rotation and multi-skilling.

⇒ Aim to encourage a high degree of personal responsibility, engagement and 'ownership' of the job.

Implementation of Lean

- Lean is not only for manufacturing!
- Watch this video

Questions?