JIT/KANBAN, ONE PIECE FLOW, HEIJUNKA

LLA

LEAN LEARNING ACADEMY

Education and Culture DG
Lifelong Learning Programme

JIT/KANBAN, ONE PIECE FLOW, HEIJUNKA

Project Title: Lean Learning Academies (LLA)

Project Number: 503663-LLP-1-2009-1-BE-ERASMUS-ECUE

Grant Agreement: 2009 – 3308 / 001 - 001

Sub-programme or KA: ERASMUS

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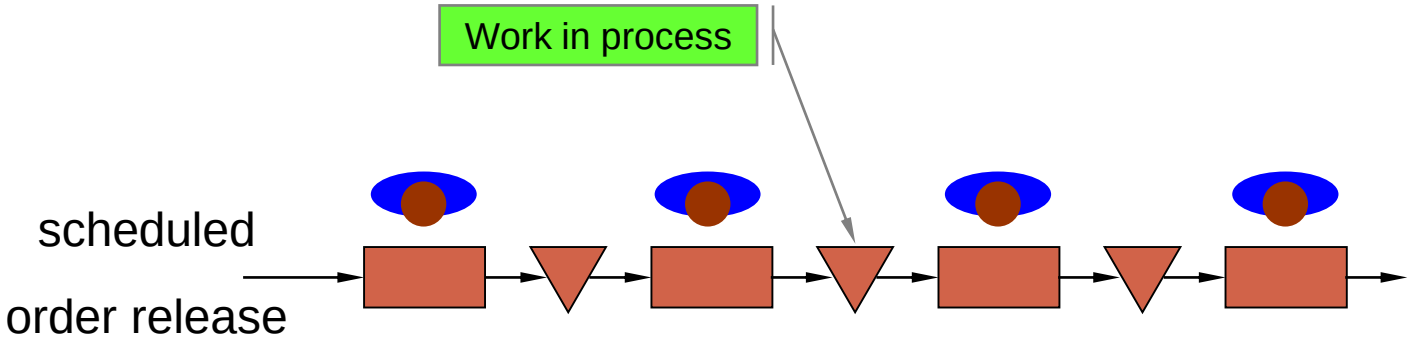
Course content

1. Push and pull production
2. JIT/kanban: definition
3. How JIT/kanban works
4. Inventory reduction
5. One piece flow
6. Heijunka
7. References

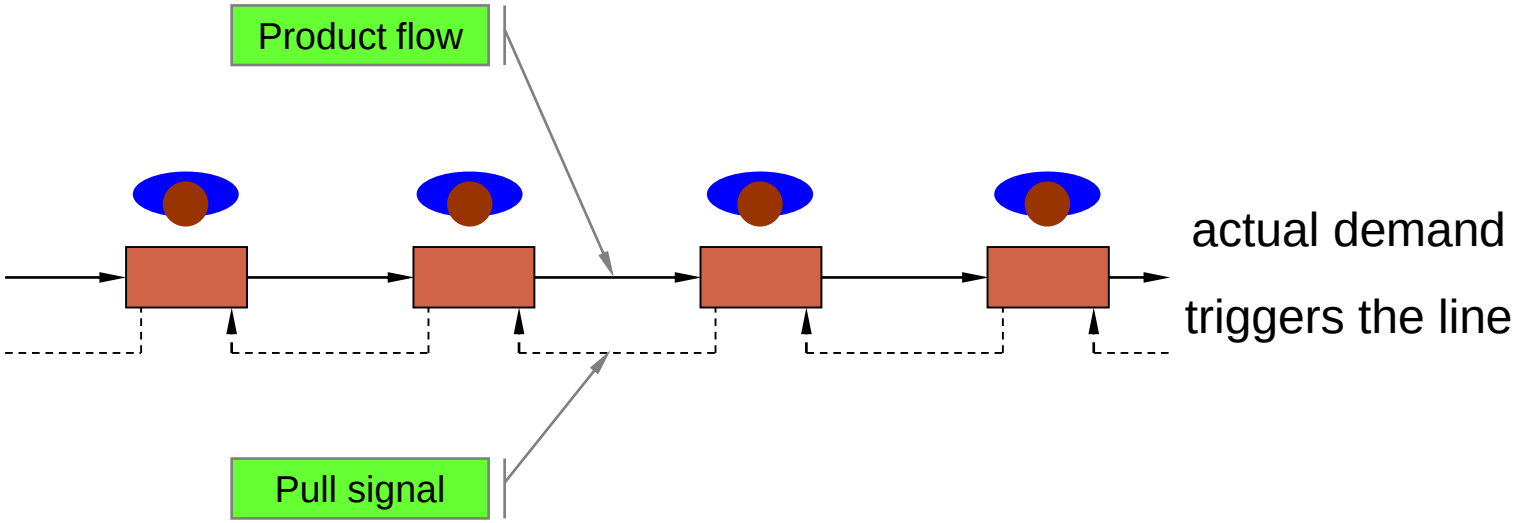
1. Push and pull production

1.1. Push production



1. Push and pull production

1.2. Pull production



2. JIT/kanban: definition

‘kanban’ is Japanese for ‘card’

2.1. Two kinds of cards are used

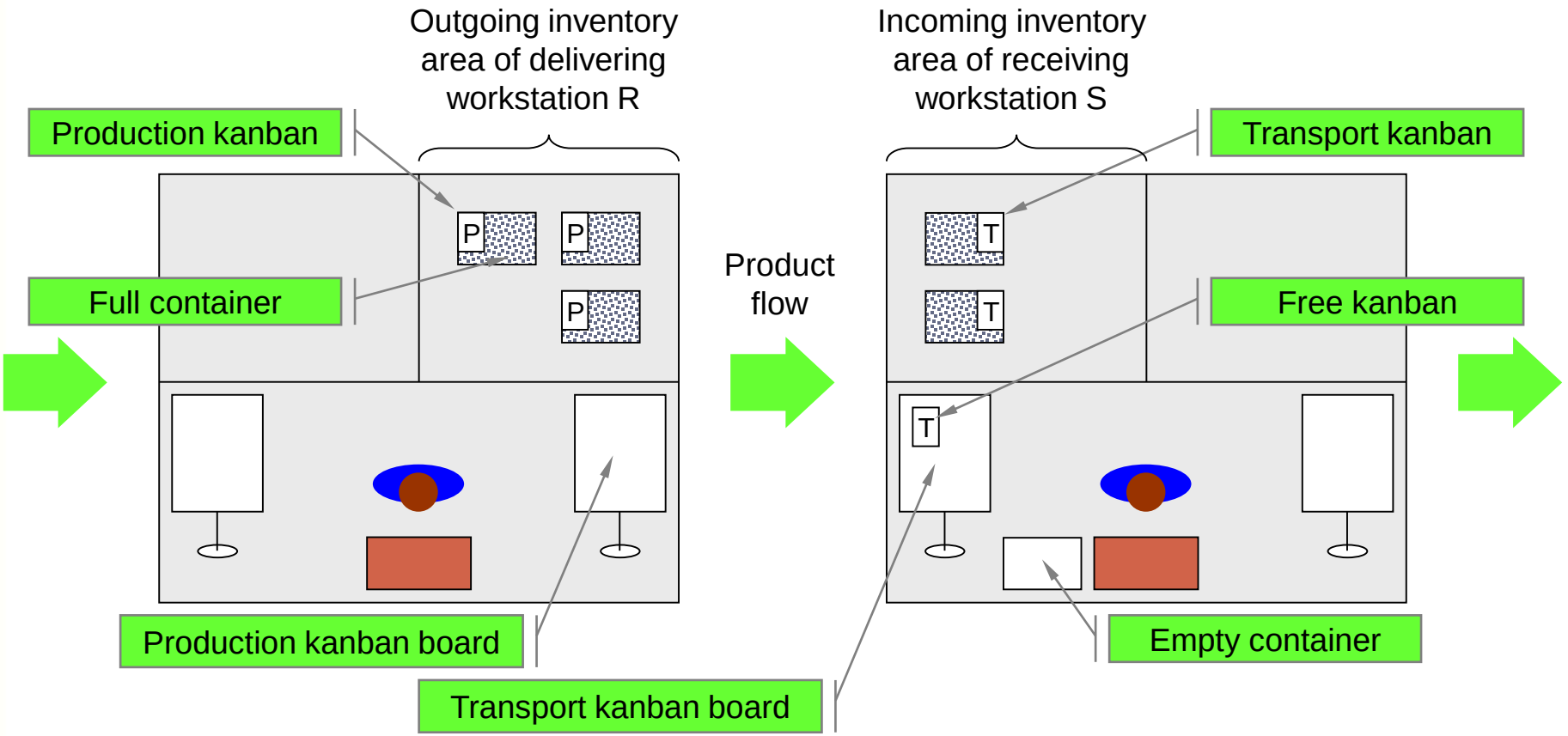
- Production kanbans
  - Circulate in the outgoing inventory area of each workstation
  - Mention: card ID, part ID, workcentre ID, # items in a full container
- Transport kanbans
  - Circulate between the outgoing inventory area of each delivering workstation and the incoming inventory area of its receiving workstation.
  - Mention: card ID, part ID, workcentre ID’s of delivering and receiving workcentres, # items in a full container

2.2. Kanban rules

- All units of a specific inventory item, must be stored in a same type of container
- # containers = #kanbans
- A full container of a specific item always contains the same number of units, mentioned on the kanban card.
- A free transport kanban on a kanban board allows an empty container to be transported upstream.
- A free production kanban on a kanban board allows workstation employees to produce parts for a next container.

3. How JIT/kanban works

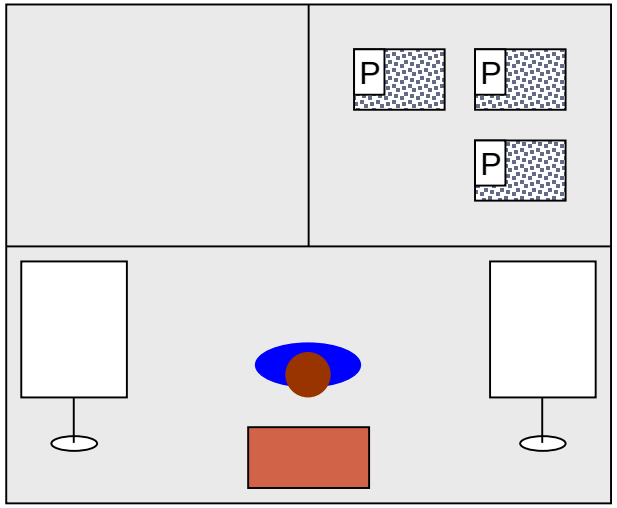
3.1. One next downstream workstation



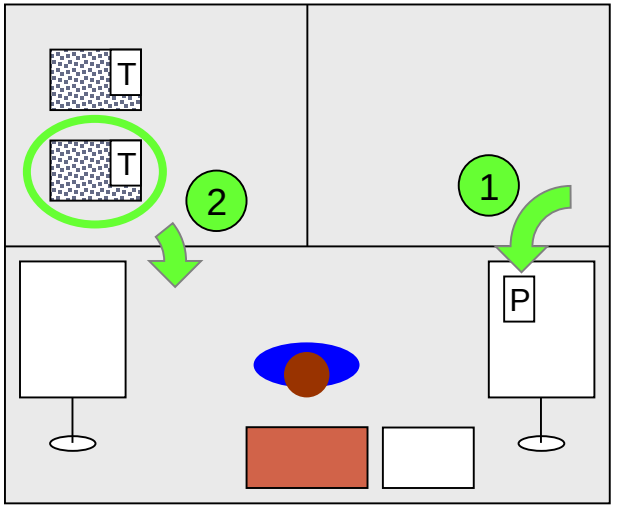
3. How JIT/kanban works

3.1. One next downstream workstation

Workstation R



Workstation S



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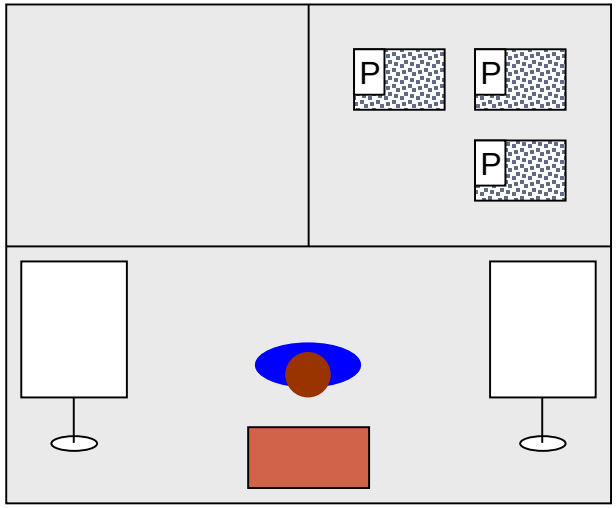
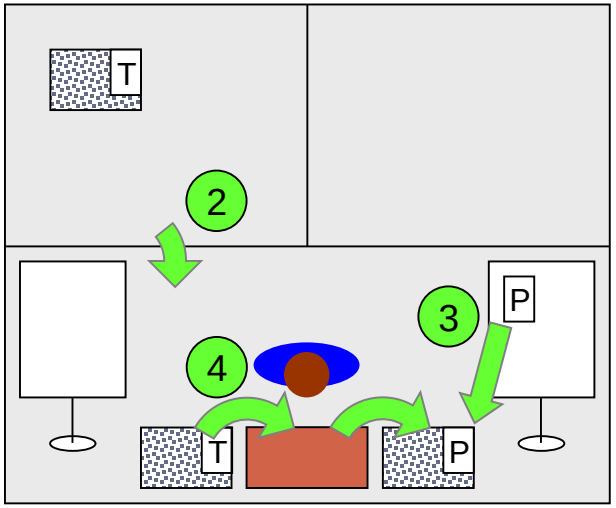


Workstation S



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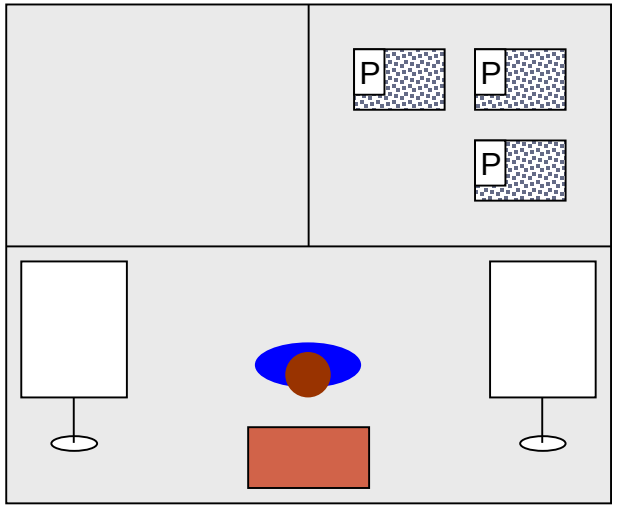
Workstation R



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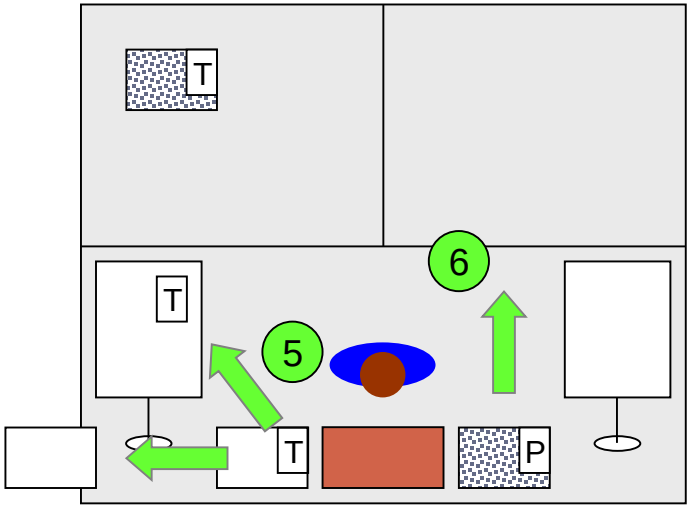

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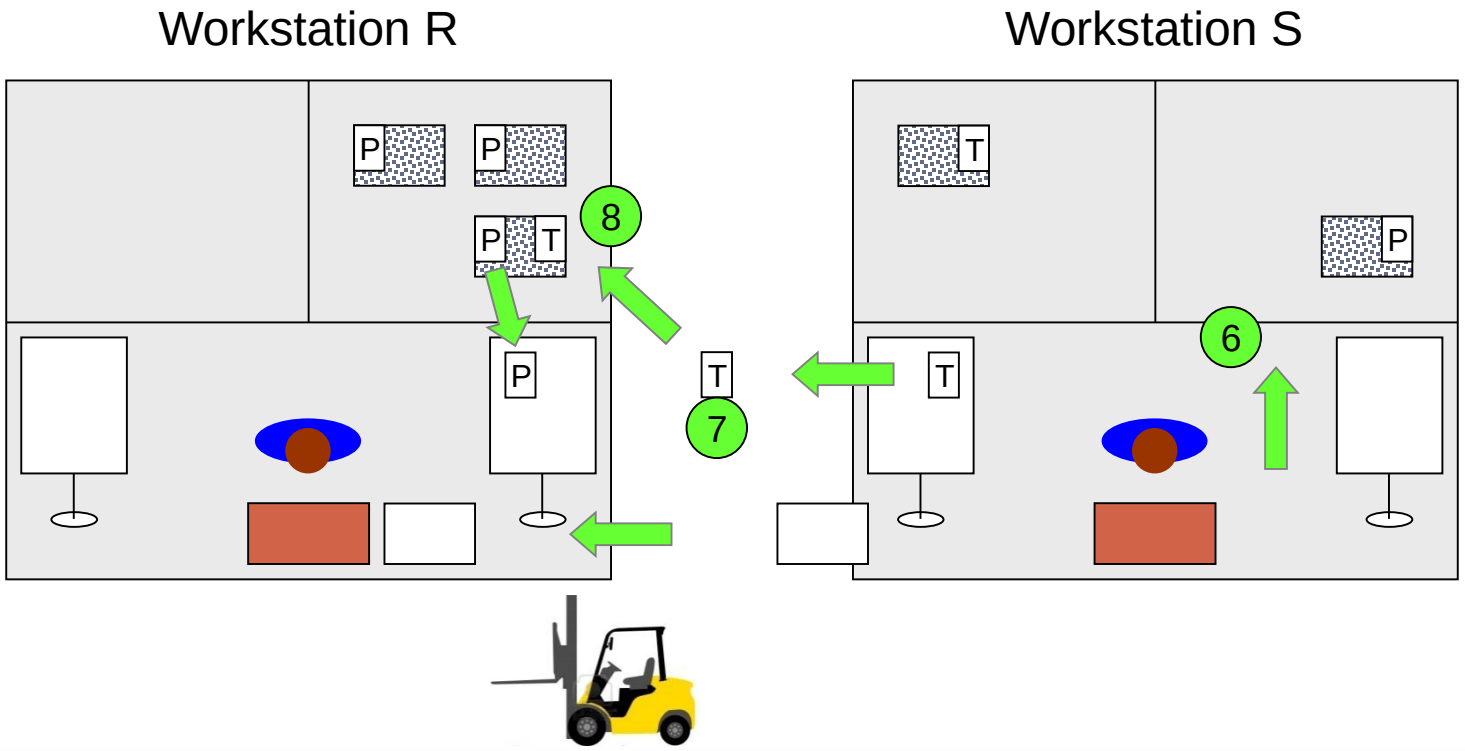

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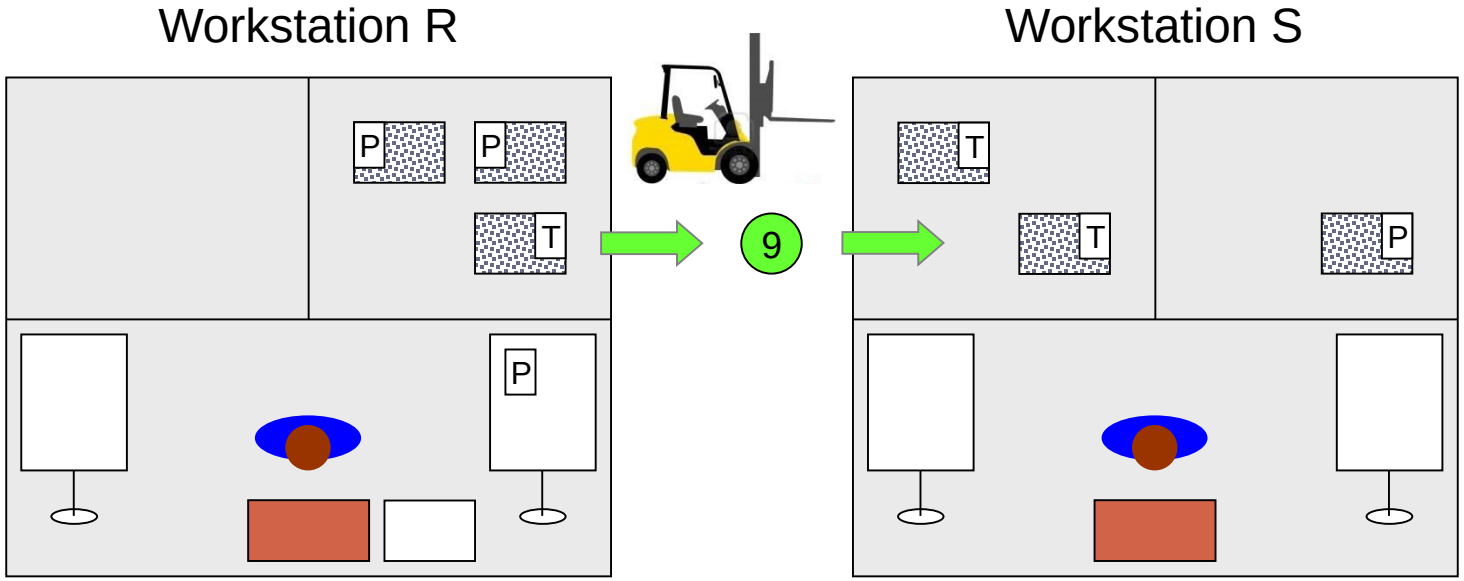

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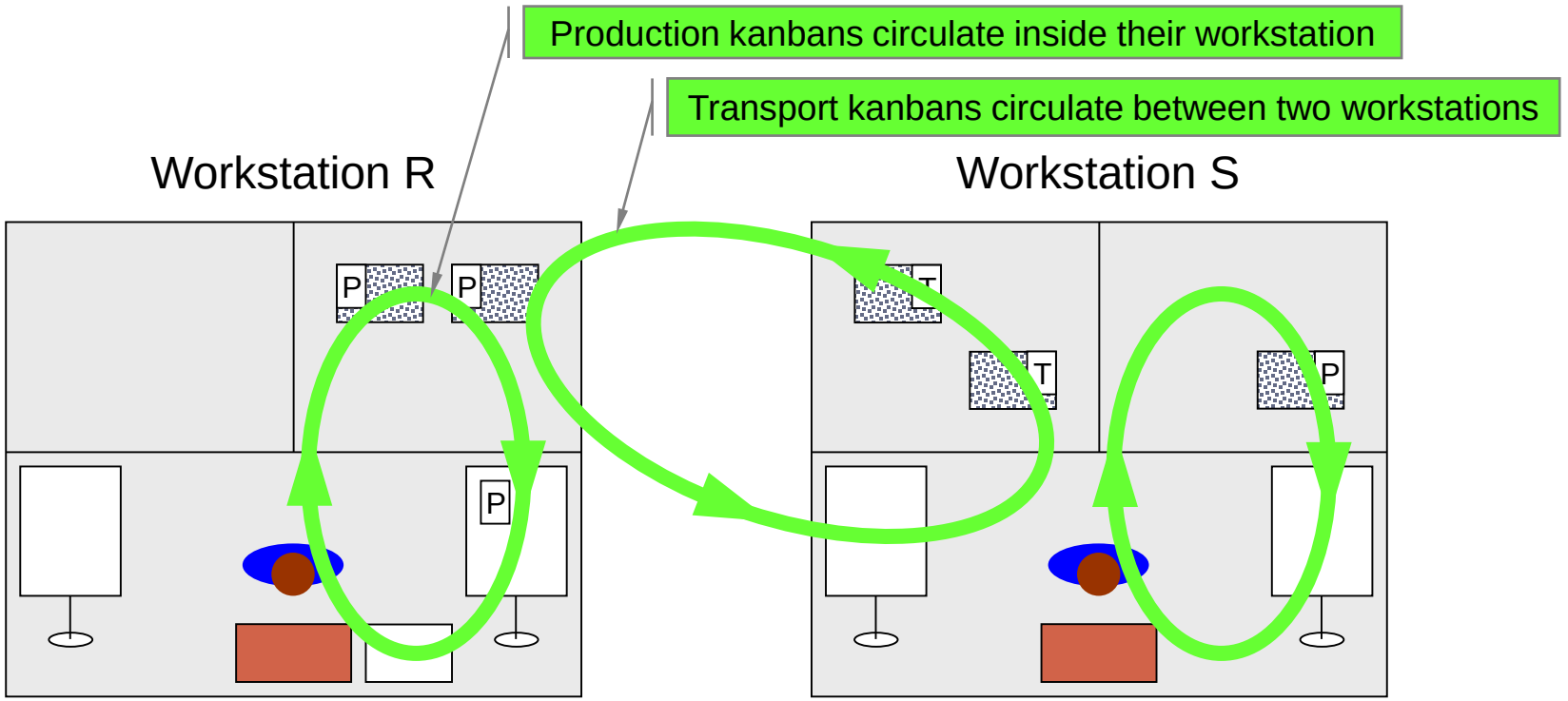

3. How JIT/kanban works

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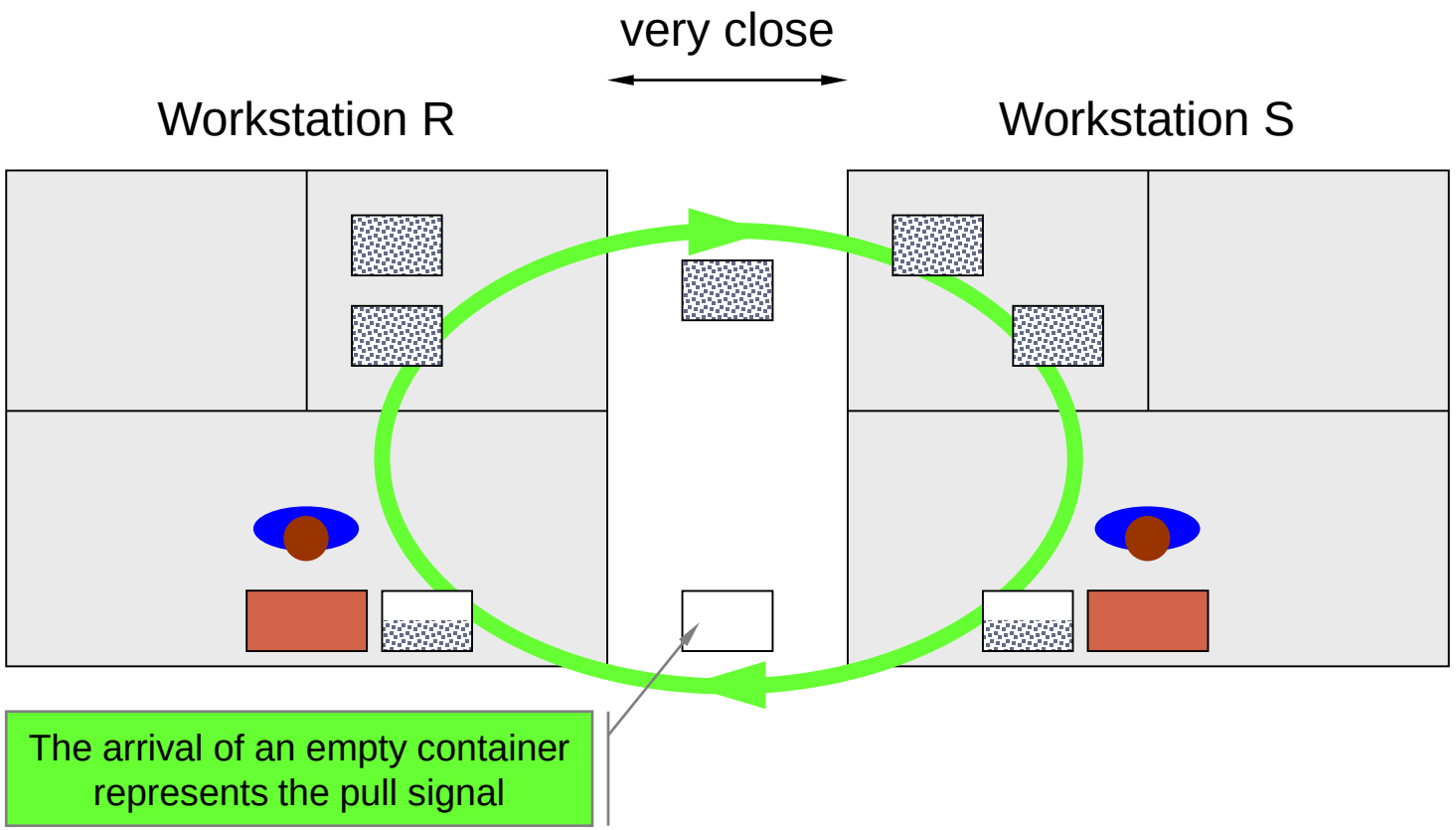
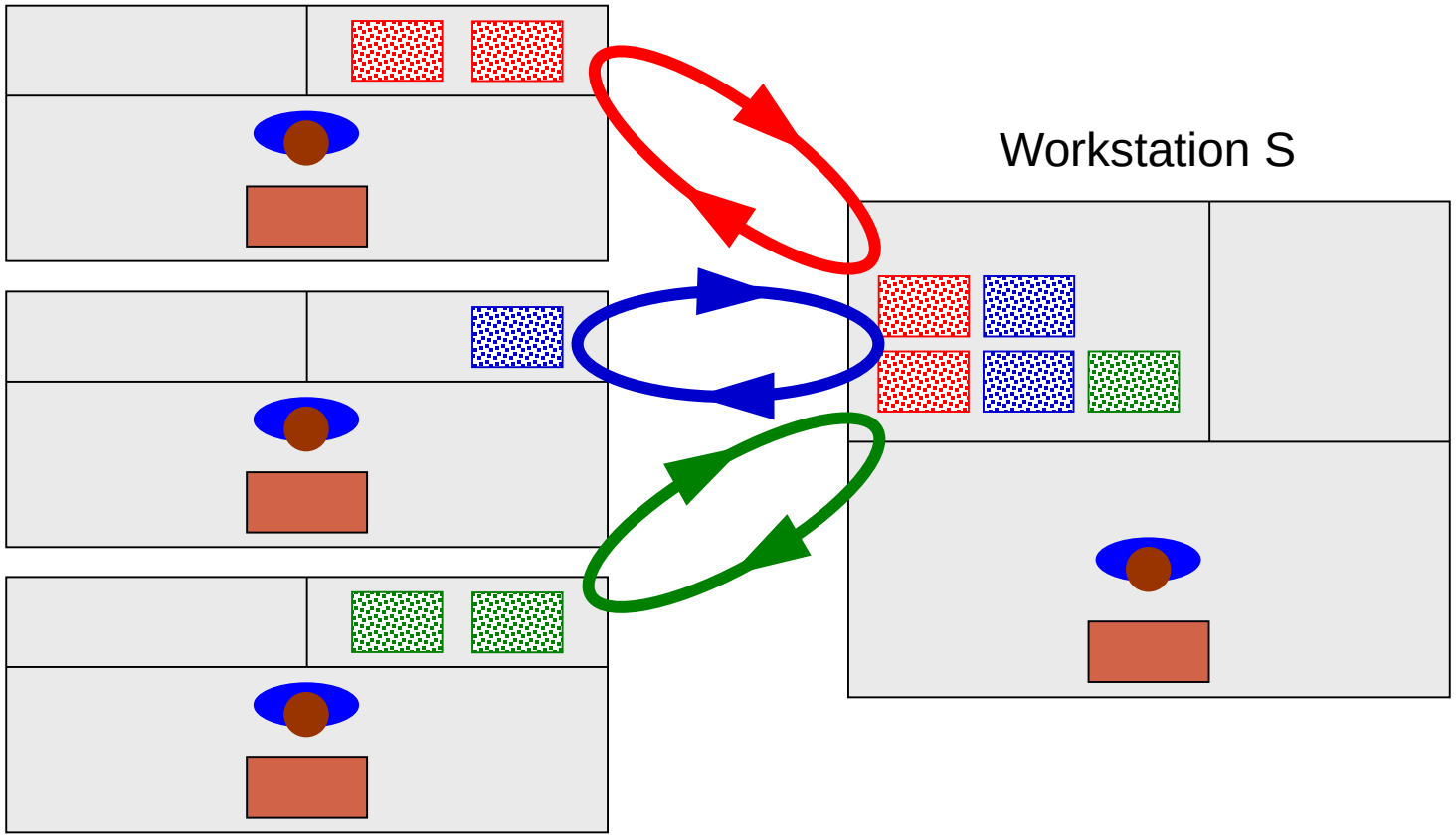


2. JIT/kanban: definition

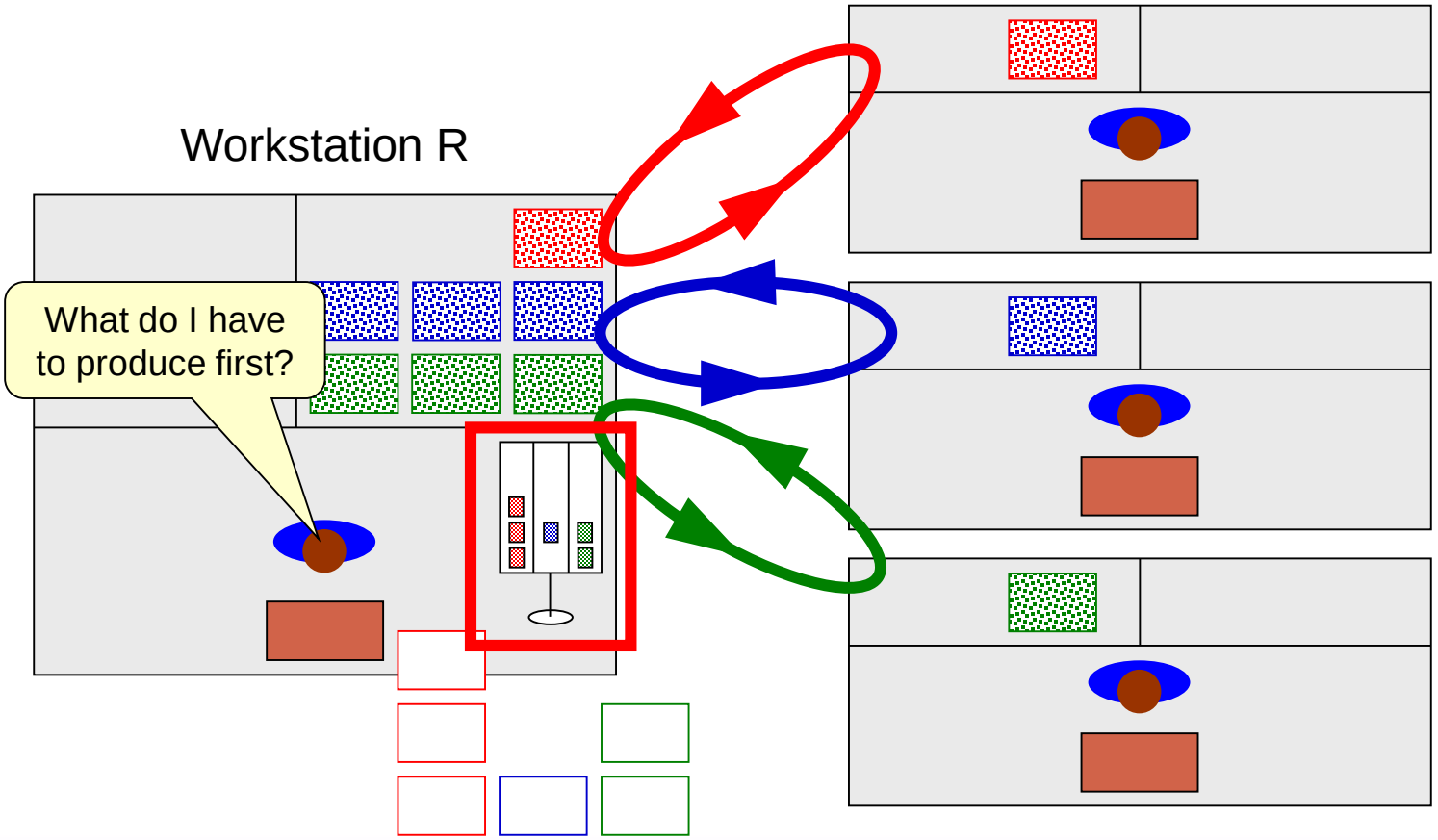
3.1. One next downstream workstation

Part Description				Part Number	
Smoke-shifter, left handed.				14613	
Qty	20	**Lead Time**	1 week	**Order Date**	9/3
Supplier	Acme Smoke-Shifter, LLC			**Due Date**	9/10
Planner	John R.	Card **1** of **2**			
		Location	Rack 1B3		

3.2. Multiple previous upstream workstations



3.3. Multiple next downstream workstations



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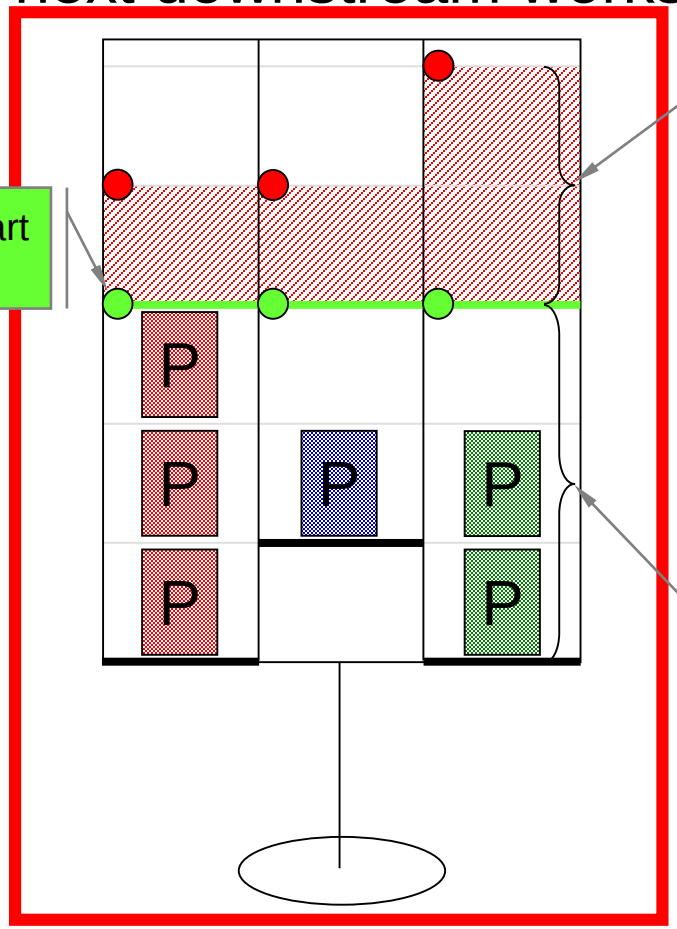


Green parts safety stock

The worker has to start producing red parts

2 levels:

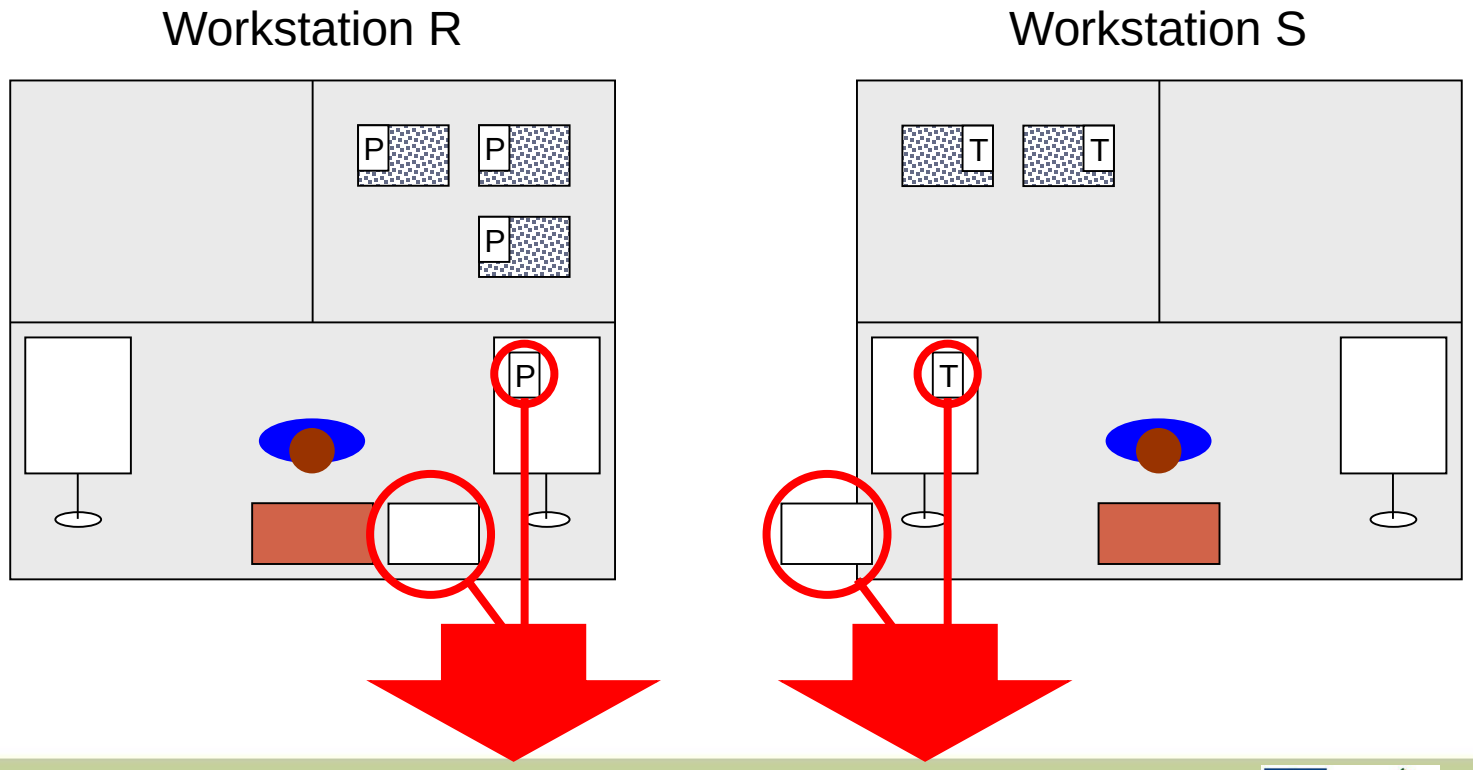
● = total # production kanbans

● = run line

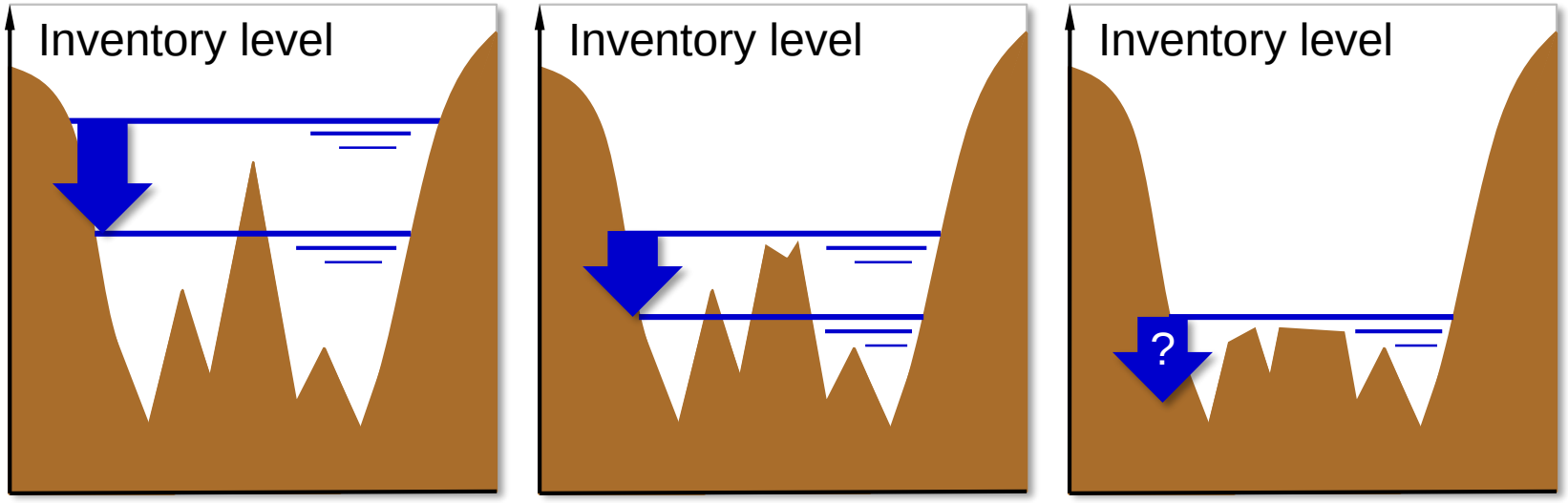
Green parts target batch size

4.1. How can inventory be reduced?

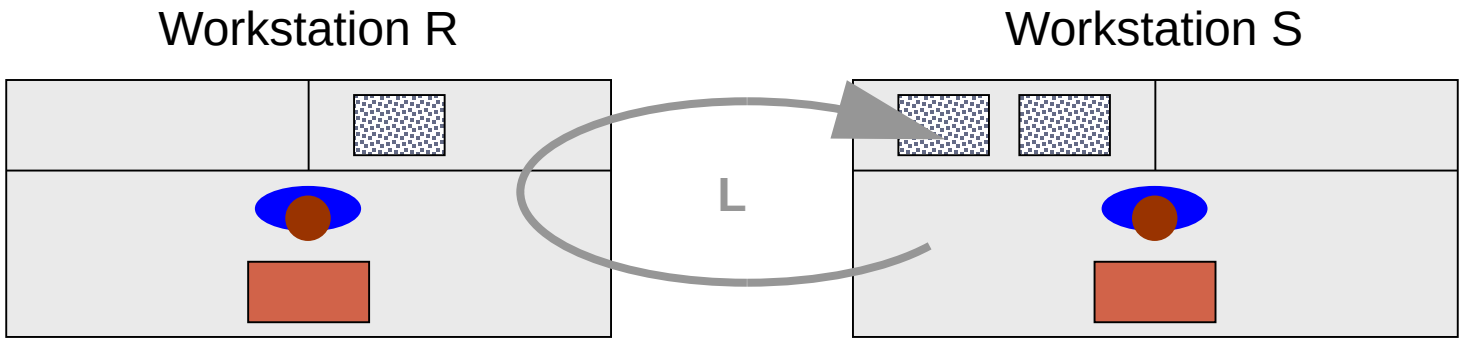
Gradually take kanbans and containers away!



4.2. Analogy model



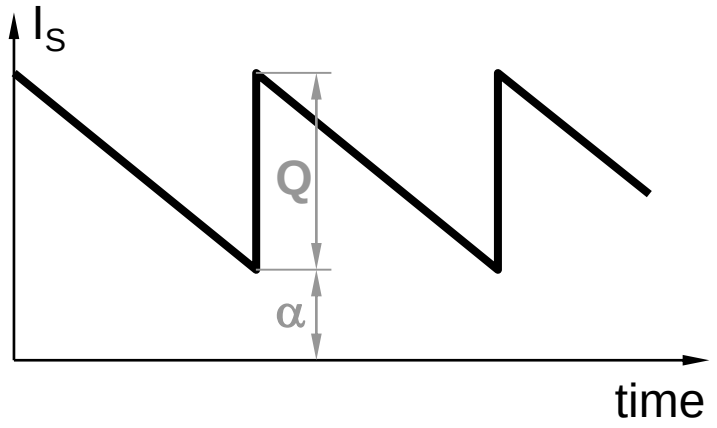
4.3. Minimum number of kanbans



$$I_{s_{max}} = Q + \alpha \leq N * n$$

$$Q \geq D * L$$

$$N \geq \frac{D * L + \alpha}{n}$$



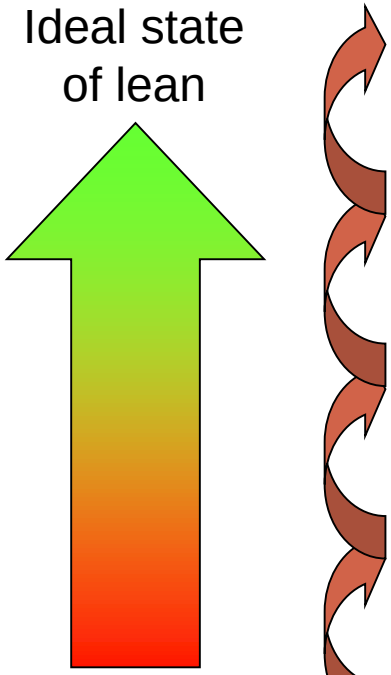
5. One piece flow

5.1. What is flow production?

- Specify value from the point of view from the customer
- Identify the value stream
- Make value flow
- Introduce pull
- Go for perfection

Stalk and Hout: “Never delay a value adding step by a non value adding step (although temporarily necessary). Try to do such steps in parallel.”

5.2. What is one piece flow?



One piece flow:

parts pulled in sequence with one piece buffer size

Reduce FIFO buffer size to only one piece

FIFO sequenced flow:

parts pulled in sequence through limited FIFO buffer

Produce and pull parts in sequence

Sequenced pull:

parts pulled in sequence

Pull parts in sequence

Supermarket pull:

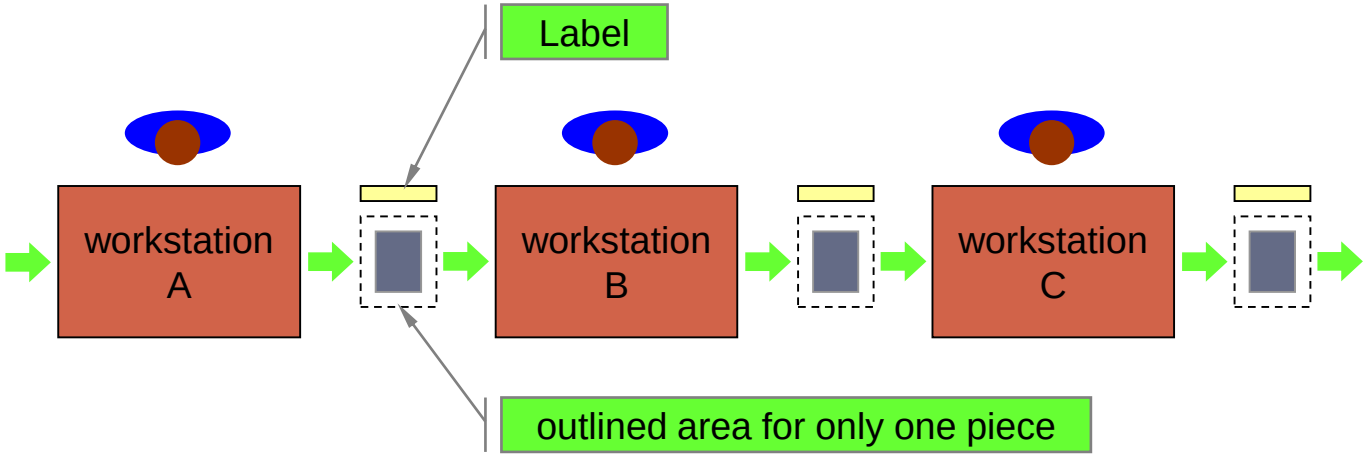
parts pulled but not in sequence

Link processes and introduce pull

Push or scheduled production:

parts pushed

5.2. What is one piece flow?



5.3. Rules for one piece flow

- Rule 1: Base takt time on market requirements
- Rule 2: Base equipment capacity utilisation on takt time
- Rule 3: Centre production on assembly processes
- Rule 4: Factory layout must be conducive to one piece production
- Rule 5: Goods must be conducive to one piece production

5.4. How to achieve one piece flow?

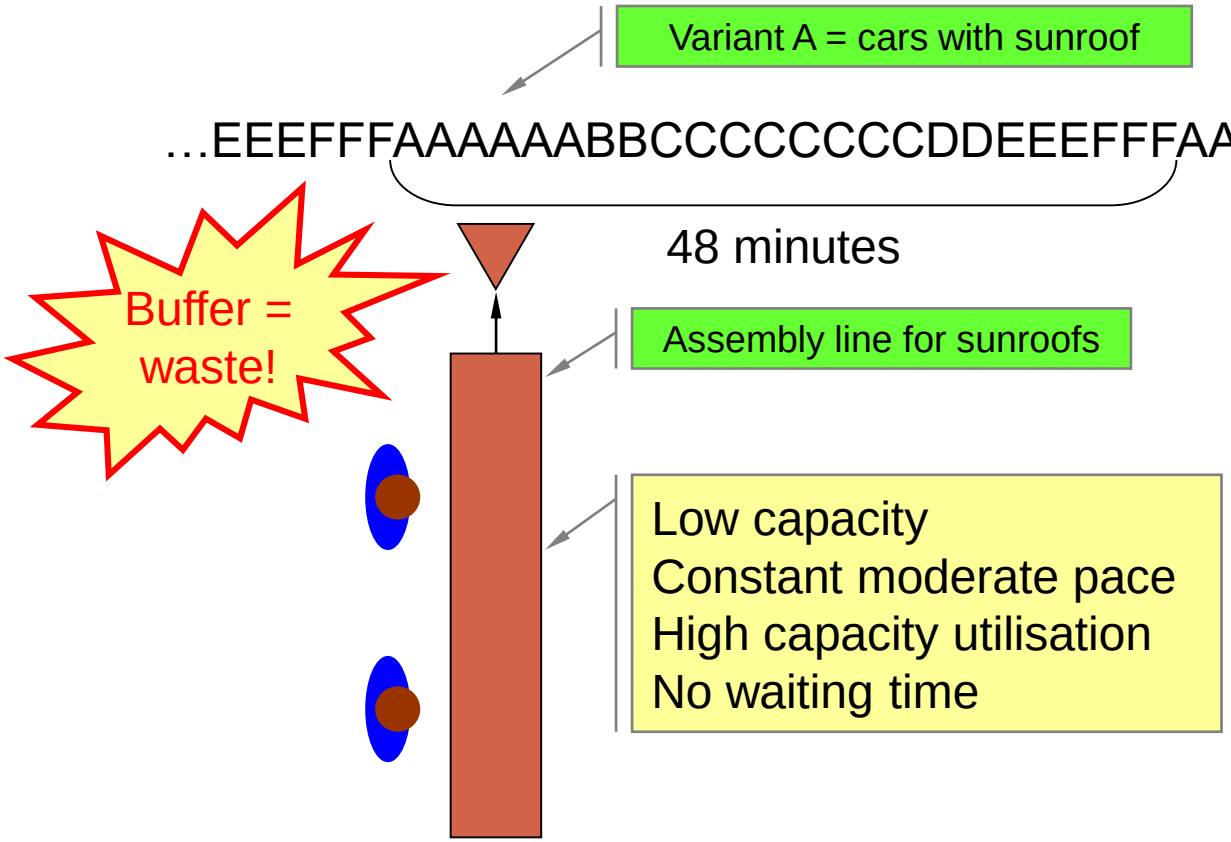
- Abolish planning-centred production
- Abandon the idea that batch production is the most efficiënt production method
- Should we stop using the word ‘system’?
- We must also abandon the idea of automated warehouses
- Abandon the idea of horizonal layout
- We need to develop new methods for quality control

6.1. Production leveling

Product variant	Monthly demand	Daily demand	Variant takt time (min.)	# variants in pitch time
A	1200	60	8	6
B	400	20	24	2
C	1600	80	6	8
D	400	20	24	2
E	600	30	16	3
F	600	30	16	3

Lowest common multiple = 48 = pitch time

6.2. Final assembly schedule: multi model production

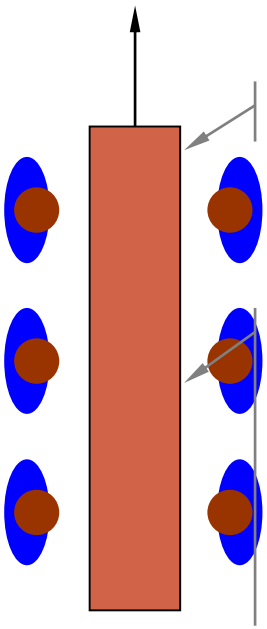


6.2. Final assembly schedule: multi model production

Variant A = cars with sunroof

…EEEFFFAAAAAABBCCCCCCCCDDEEEFFFAAAAAABB…

48 minutes



Assembly line for sunroofs

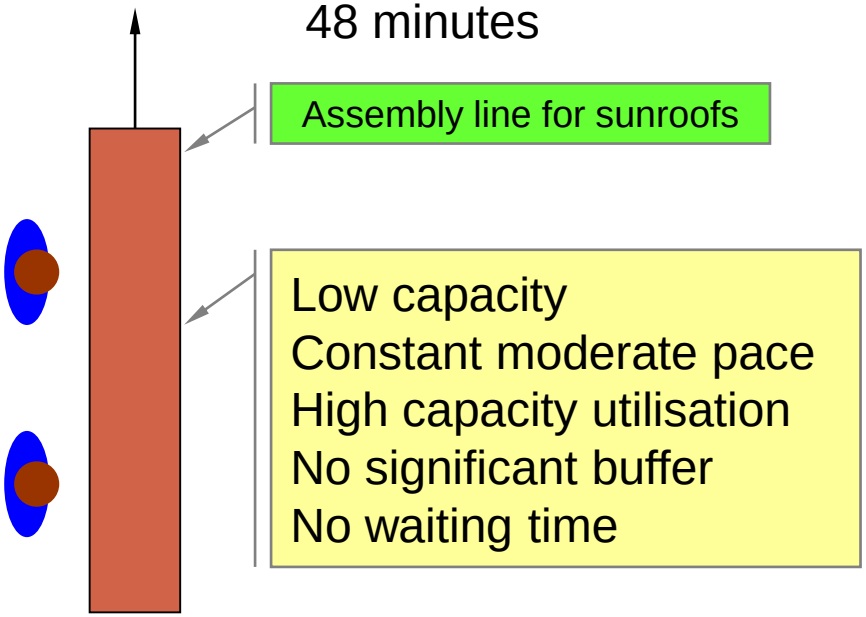
Waiting time = waste!

High capacity
High pace during 12 minutes, idle during the remaining 36 minutes
Low average capacity utilisation
No significant buffer

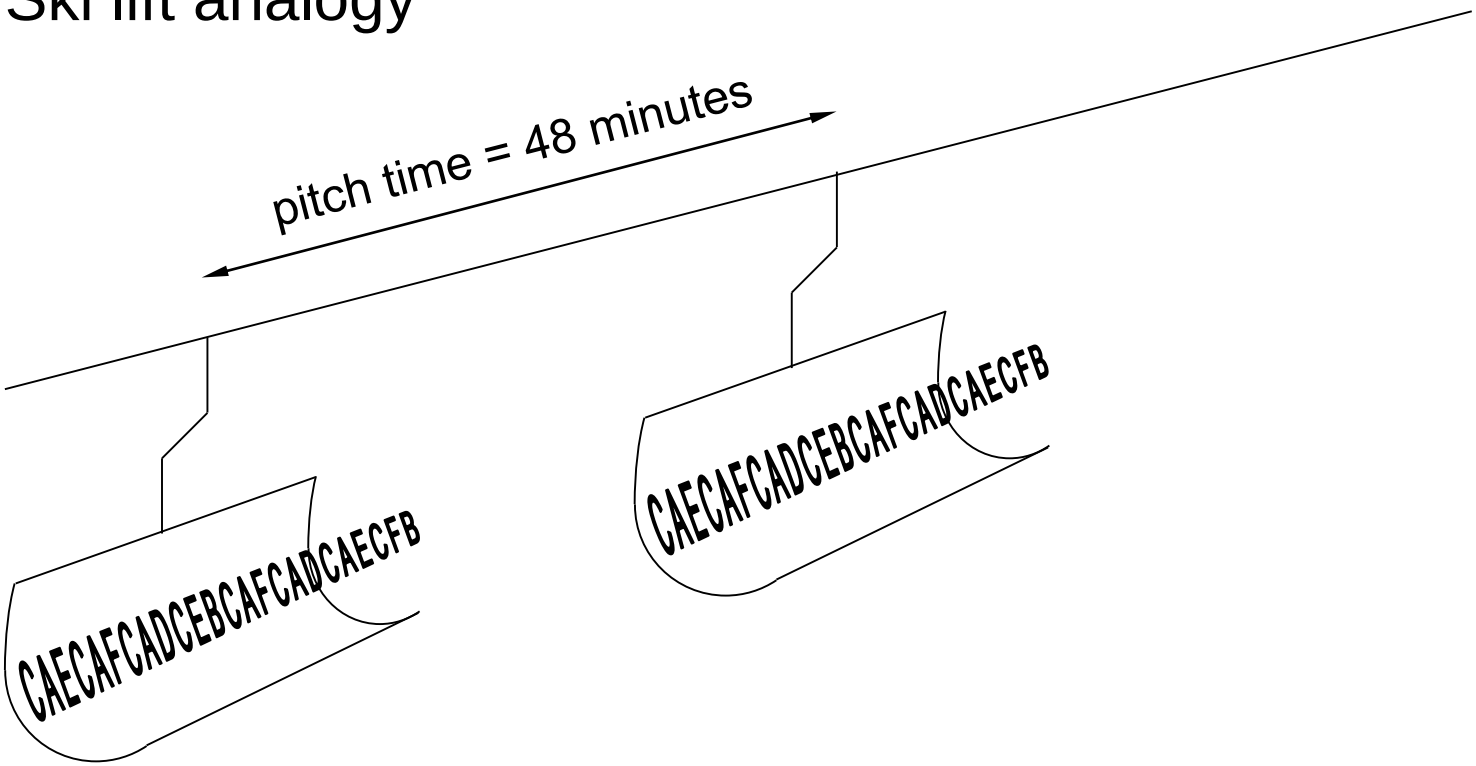
6.3. Final assembly schedule: mixed model production

…CAECFBCAECAFCADCEBCAFCADCAECFBCAECAFCA…

48 minutes



6.4. Ski lift analogy



6.5. Heijunka box

	48 min	48 min	48 min	…..
Variant A	A A A A A A	A A A A A A	A A A A A A	
Variant B	B B	B B	B B	
Variant C	C C C C C C C C	C C C C C C C C	C C C C C C C C	
Variant D	D D	D D	D D	
Variant E	E E E	E E E	E E E	
Variant F	F F F	F F F	F F F	

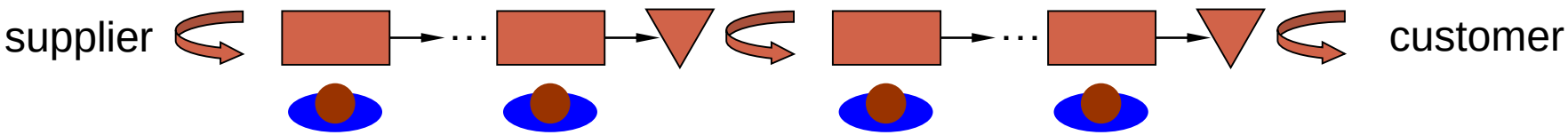
Variant C kanban

6.5. Heijunka box

Heijunka box = leveled schedule

	48 min	48 min	48 min	.....
Variant A	A A A A A A	A A A A A A	A A A A A A	
Variant B	B B	B B	B B	
Variant C	C C C C C C C C	C C C C C C C C	C C C C C C C C	
Variant D	D D	D D	D D	
Variant E	E E E	E E E	E E E	
Variant F	F F F	F F F	F F F	

CAECAFCADCEBCAFCADCAECFB



Flow loop with pull production Flow loop with pull production

7.1. Books

- Bicheno J., 'The New Lean Toolbox, towards fast, flexible flow', University of Buckingham, England 2004.
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- Liker J.K. and Meier D., 'The Toyota Way Fieldbook', McGraw Hill, 2006.
- Sekine K., 'One Piece Flow', Productivity Press, Portland 1992.