South Australian Chapter

AME Lean Learning - half Day

Friday 6th March 2009

- **AME Australian Vision**

  We are recognised as the leading not for profit association for operational excellence.

- **AME Australian Mission**

  We share, energise and provide practical learning opportunities for like minded people to improve business performance. We do this through delivering conferences, regular events & networking in operational excellence.

Lean Tools and techniques for today

Presenter: Alister Lee, Lean Experience

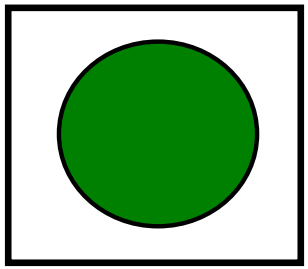
Hosted by
Paul Nolan, SA Centre for Innovation

centre for innovation

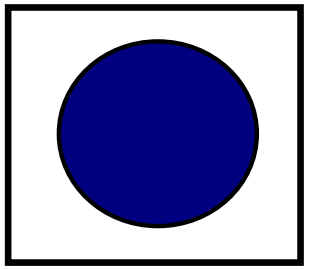
Agenda

- Introduction
- Group activity - round 1
- Brainstorm problems & solutions
- Lean principles & tools
- Group activity - round 3
- Q&A

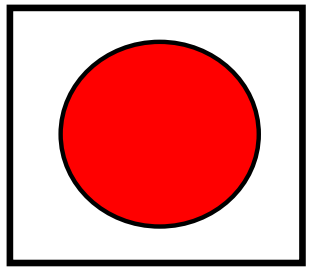
Future Solutions Enterprise produces three products



E – creates energy



CO_2 – removes carbon dioxide from the atmosphere

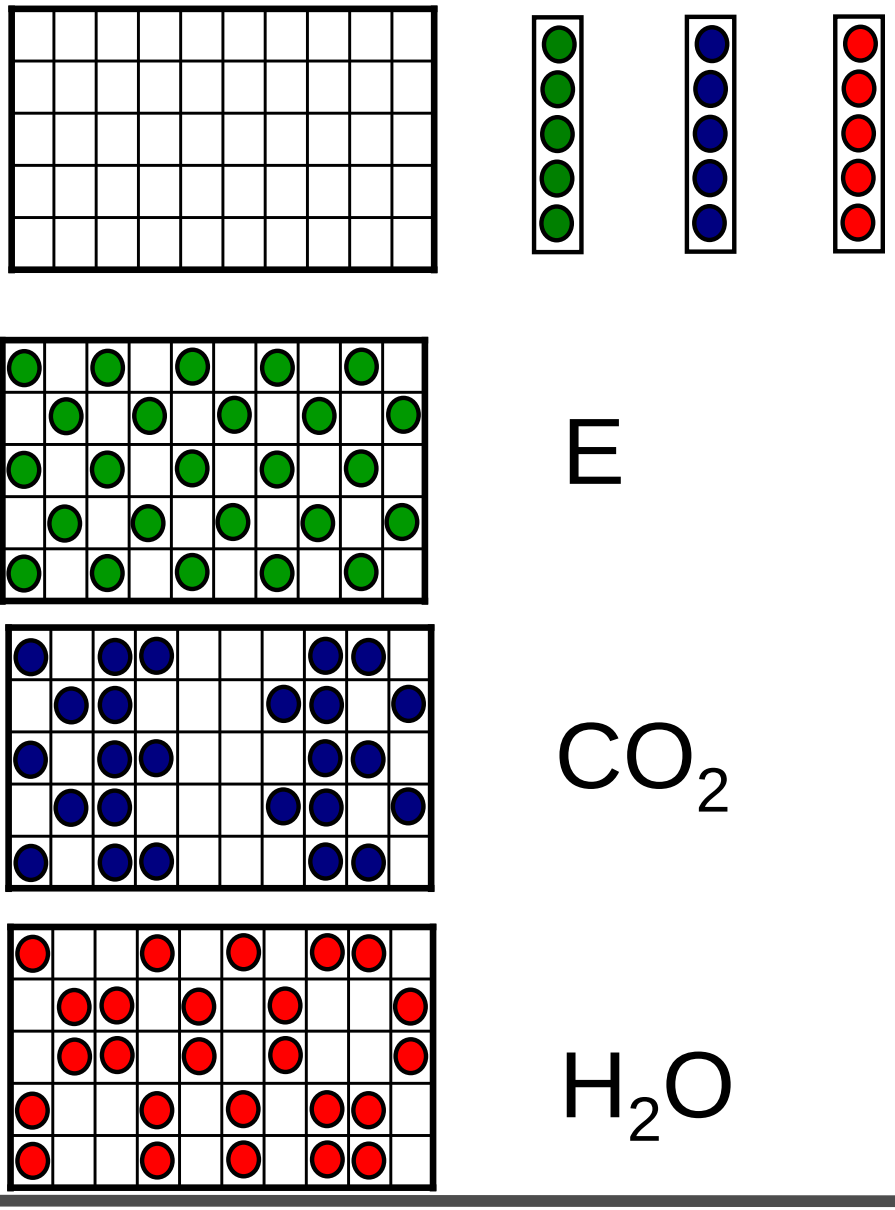


H_2O – purifies water

The production process

1. Raw materials are purchased from external suppliers

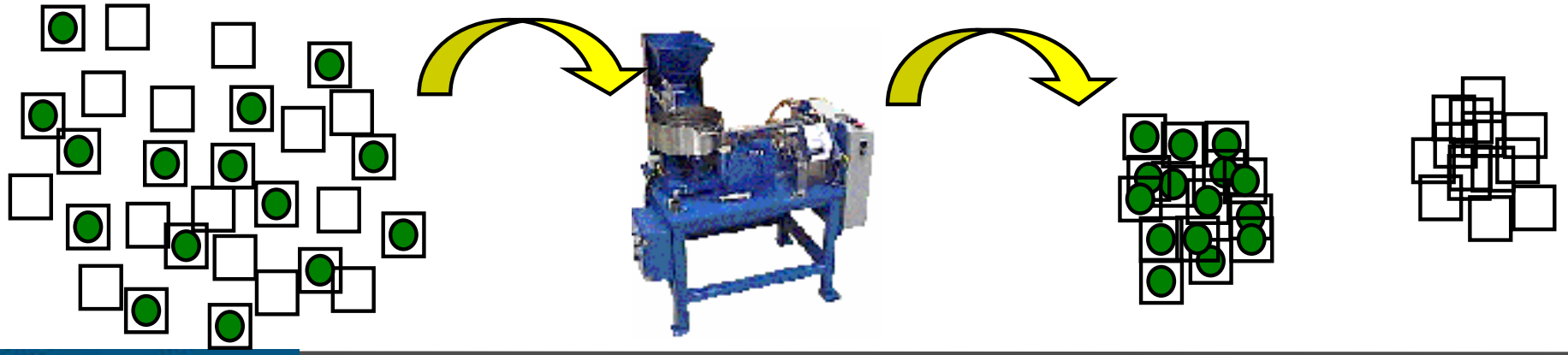
2. Fusing - nano dots are fused onto the circuit boards in a specific pattern.



The production process

3. Laser cut - the fused nano dots are laser cut into individual squares.

4. Sorting / Inspecting - the fused laser cut Nano dots are sorted from the unused squares. The sorters also check part quality.



Rules of the game

•Objective = deliver quality product to the customer.

•Customer places an order every minute for 15 minutes.

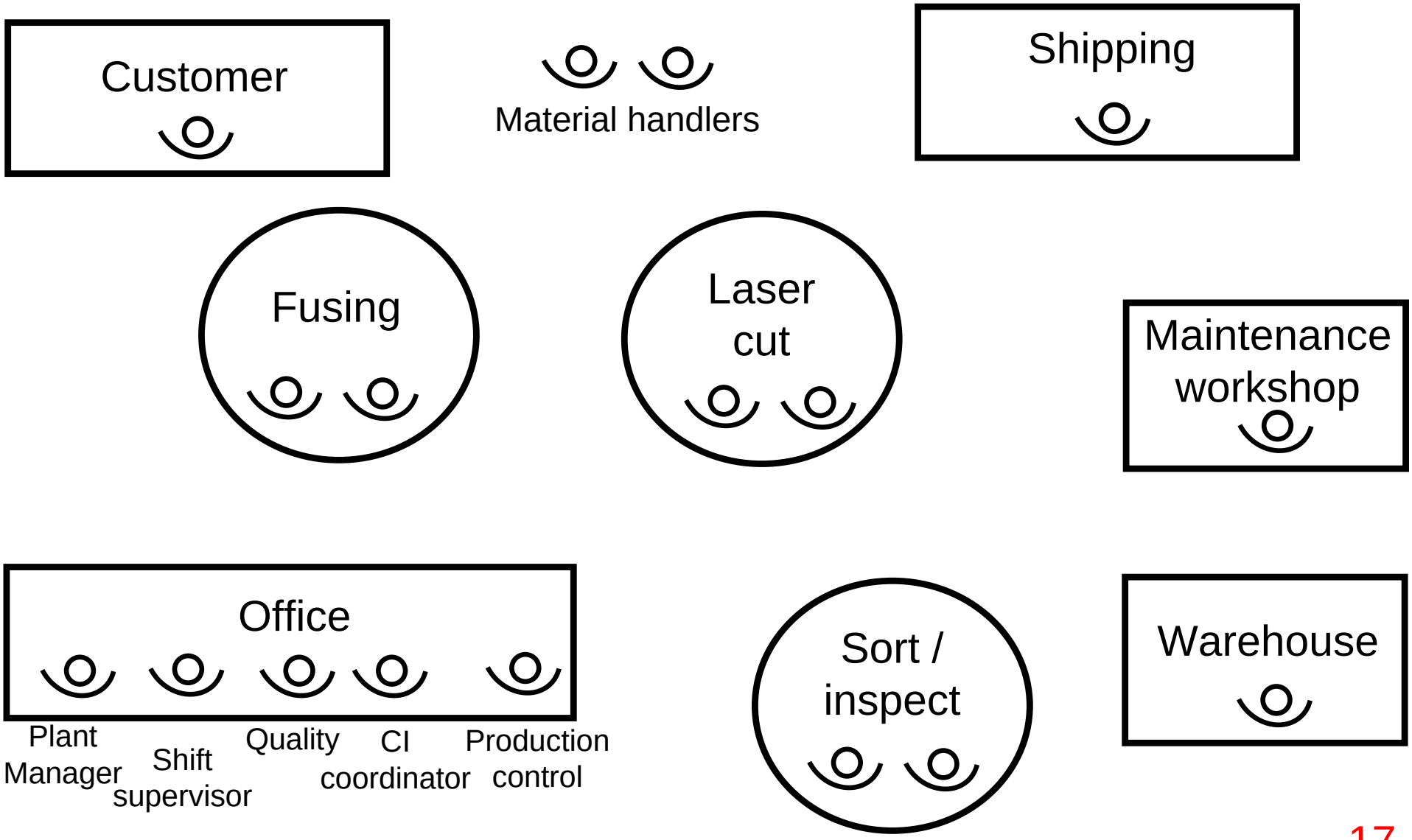
•Each person will play a role in the simulation – enjoy it.

•Think about opportunities for improvement – “creativity before capital”.

Roles for round 1

Roles	No.
Customer	1
Warehouse	1
Production controller	1
Fusers	2
Laser cutters	2
Sorters	2
Material handlers	2
Shipping	1
Maintenance	1
Quality	1
Continuous improvement	1
Shift Supervisor	1
Plant manager	1
Total	17

Layout for round 1



Debrief of round 1

- How did we do?
- What went right / wrong?
- How does this compare to your operation?
- What improvements can we make?

- How would we apply “Lean” thinking to improve this process.

- Structured approach – purpose, people & process

- Principles & tools apply to both production and office environments

What is Lean?

Lean is a set of concepts, principles and tools used to create and deliver the *most value* from the *customer's perspective* while consuming the *fewest resources.*

The term “lean” is used because a lean enterprise uses less:

- human effort
- floor space
- capital investment
- materials
- time between the customer order and delivery

Lean Principles

- Lean addresses problems at the systems level AND within individual process steps.
- The customers always define value for the process.
- Lean distinguishes steps that create value from those that do not.
- Lean reduces waste and builds in quality.

- The people who do the work are the experts.
- Learning to improve work is as important as producing the work output.

VSI 1-21

1885
Craft Production
- Machine then harden - Fit on assembly - Customization
- Highly skilled workforce - Low production rates - High Cost

1913
Mass Production
- Part inter-changeability - Moving production line - Production engineering - "Workers don't like to think"
- Unskilled labor - High production rates - Low cost - Persistent quality problems - Inflexible models

1955 -
Toyota Production System
- Worker as problem solver - Worker as process owner enabled by: -- Training -- Upstream quality -- Minimal inventory -- Just-in-time - Eliminate waste - Responsive to change
- Low cost - Improving productivity - High quality product

1993 -
Lean Enterprise
- "Lean" applied to all functions in enterprise value stream - Optimization of value delivered to all stakeholders and enterprises in value chain
- Low cost - Improving productivity - High quality product - Greater value for stakeholders

Genie Industries

HON

ALCOA

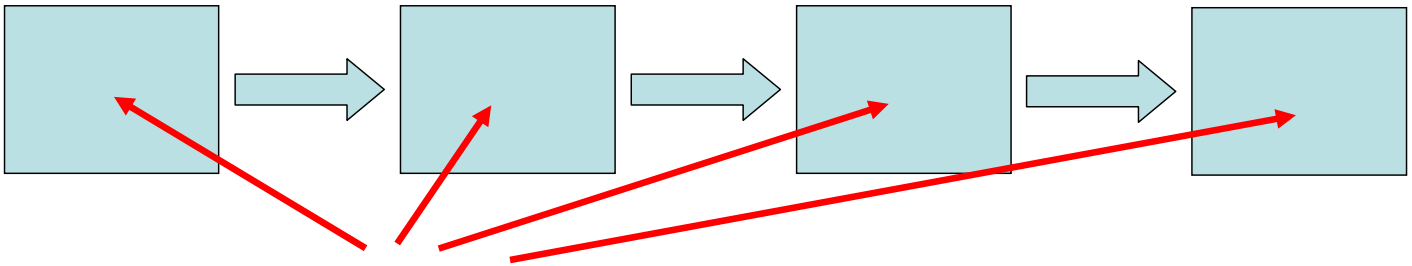
MOTOROLA

	Traditional	Lean
Production	Based on forecast	Based on orders
Layout	Based on function / department	Based on product flow
Batch size	Large	Small
Processing	Batch & queue	Continuous flow
Quality	Lot sampling	Assured during processing

Boeing video

What does a Lean process look like?

A “value stream”

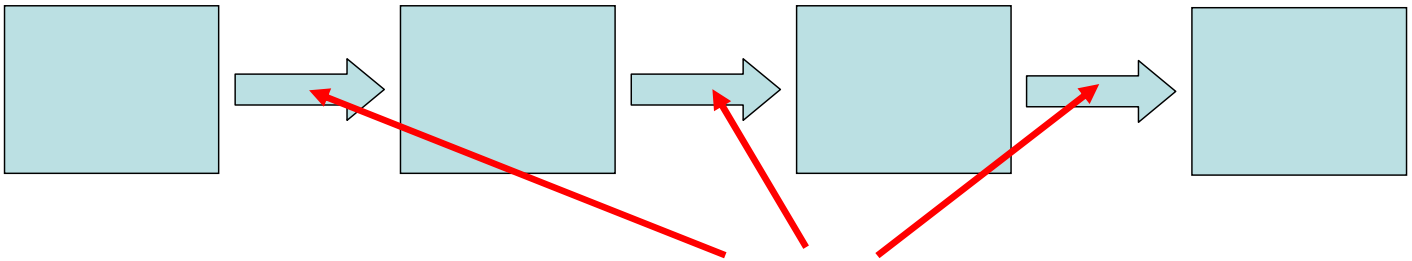


Each step in the process is:-

1. **Valuable** – as judged by customer
2. **Capable** – stable process
3. **Available** – no downtime
4. **Adequate** – just enough capacity
5. **Flexible** – to meet changing customer requirements

What does a Lean process look like?

A “value stream”



The steps are linked by:-

1. **Flow** – uninterrupted flow wherever possible
2. **Pull** – at the pull of the customer
3. **Levelling** – of demand & output

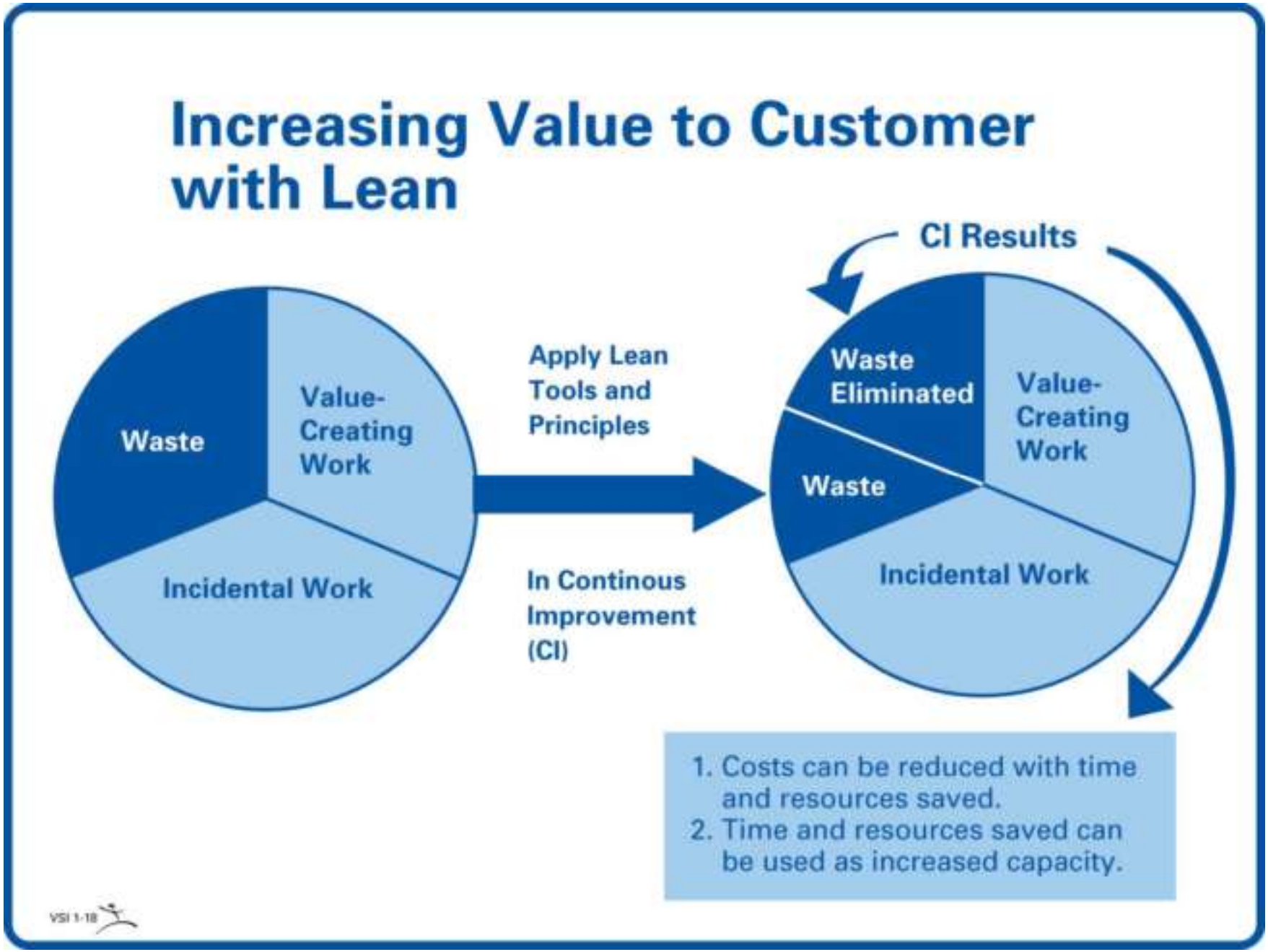
Value added
Action that transforms the product or service in a way that is valuable to the end customer.

Incidental work
Action that enables or supports the value adding work.

Categories of Work Motion

Waste
Anything other than the minimum amount of time, material, people, space, energy, etc needed to add value to the product or service.

Focus on Waste Identification and Reduction

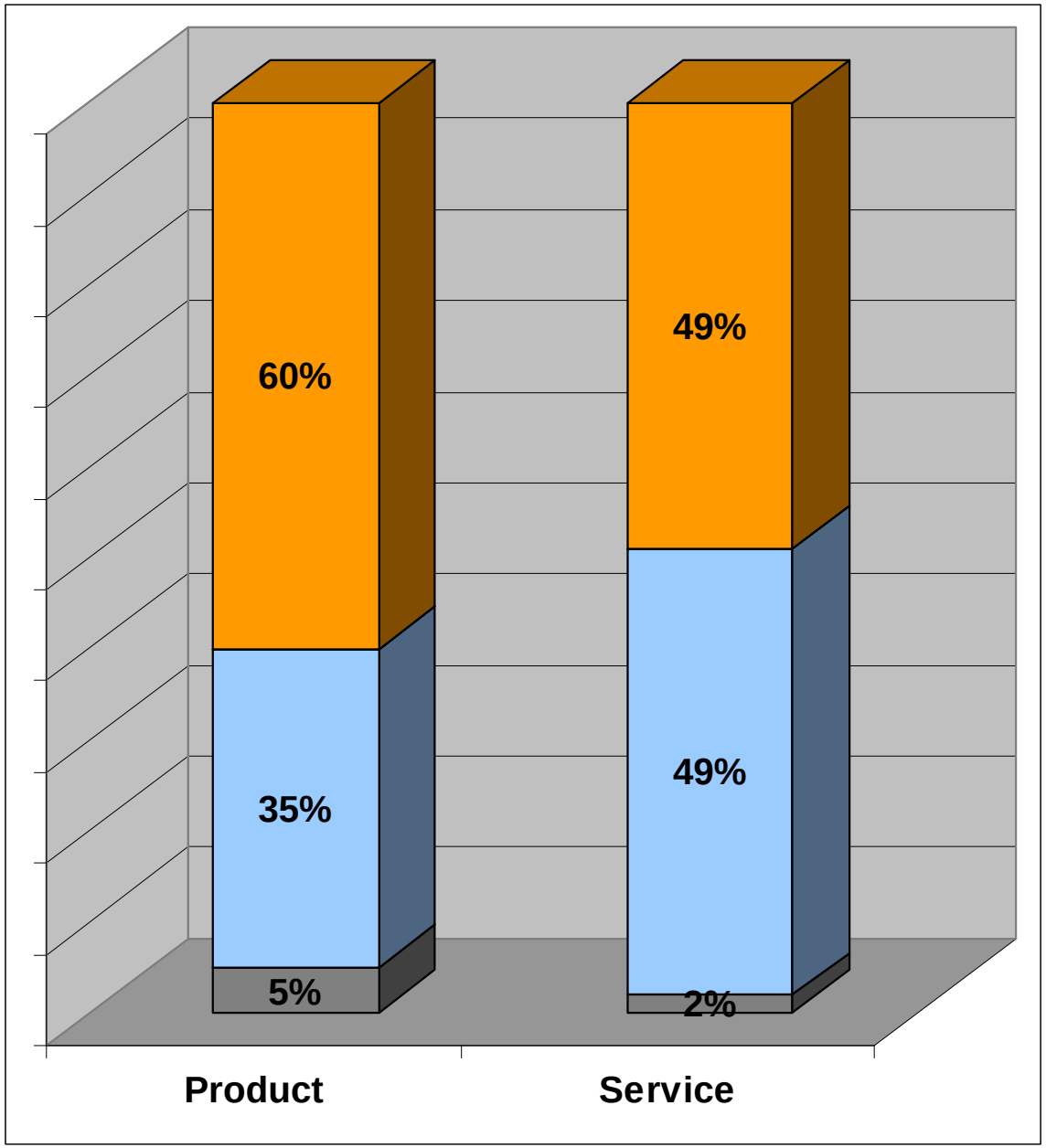

Increasing Value to Customer with Lean
CI Results
Waste
Value-Creating Work
Incidental Work
Apply Lean Tools and Principles
In Continous Improvement (CI)
Waste Eliminated
Waste
Value-Creating Work
Incidental Work
1. Costs can be reduced with time and resources saved.
2. Time and resources saved can be used as increased capacity.
VSI 1-18

Typical ratios prior to applying Lean

Waste

Incidental/ Support

Value added



Opportunities!

Short term

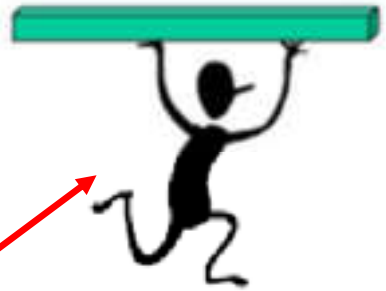
Longer term

Source: LERC research

Unnecessary Motion

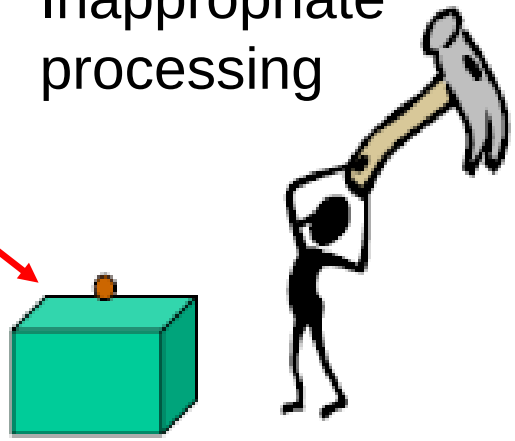
Defects, inspection, rework

Unnecessary Transportation

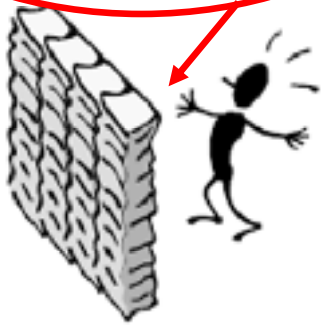


Overproduction

Inappropriate processing



Delays & waiting



Excess work in progress

Which is the worst waste?

Symptom or cause?

Type	Definition	Production example	Office example
Overproduction	Producing more, sooner and faster than required by the next process	Unbalanced production rates	Build up of work in progress
Unnecessary motion	Any human or equipment motion that does not add value.	Excess travel in a die	Walking to find information
Unnecessary transportation	Any movement of materials or information more than the minimum required.	Moving product in/out of storage	Getting reports from the copier
Over processing	Doing more work than necessary	Over engineered design	Mass emails
Excess work in progress	Excess inventory or work in progress	Slow moving inventory	High work in progress
Delays & waiting	Operator or machine idle time	Machine downtime	Waiting for information
Defects	Correction to work not done right the first time	Scrap or rework	Correcting information

Can you think of other types of waste?

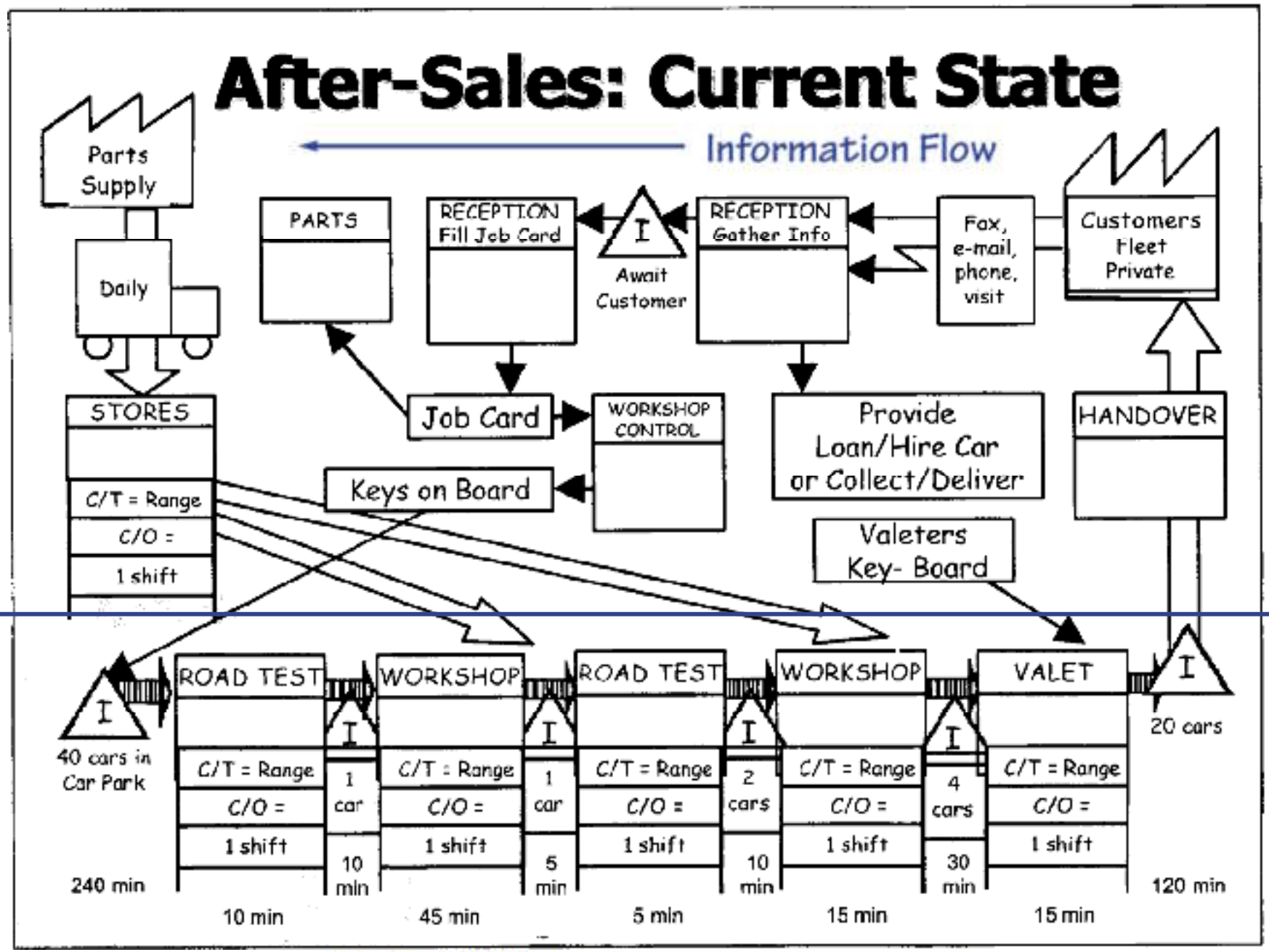
- Making the wrong product / service efficiently
- Untapped human potential
- Inappropriate systems
- Wasted materials
- Wasted energy and water
- Pollution

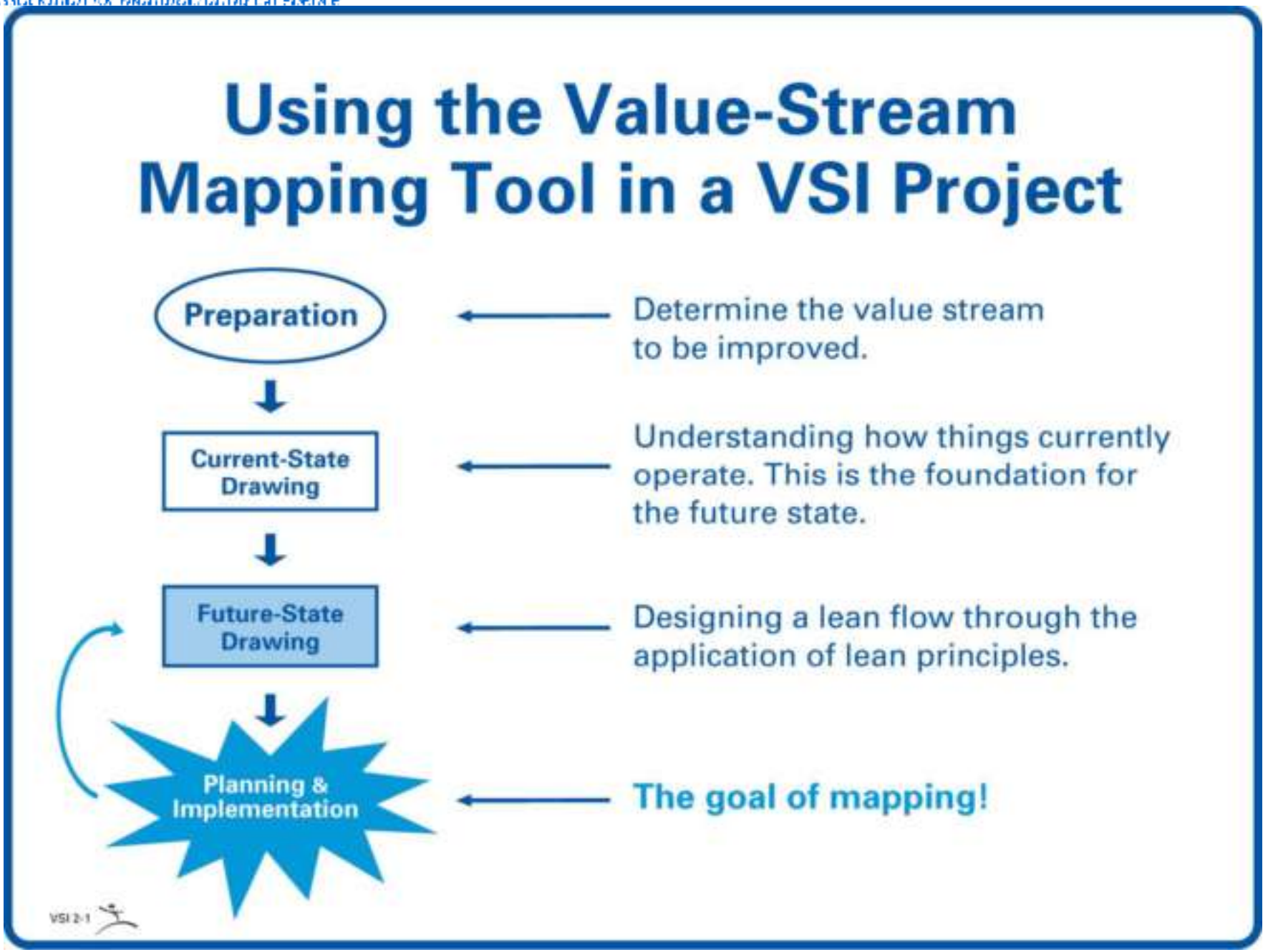
Service wastes

- Duplication
- Unclear communication
- Changing priorities
- Lost opportunities

Steps to create a lean value stream

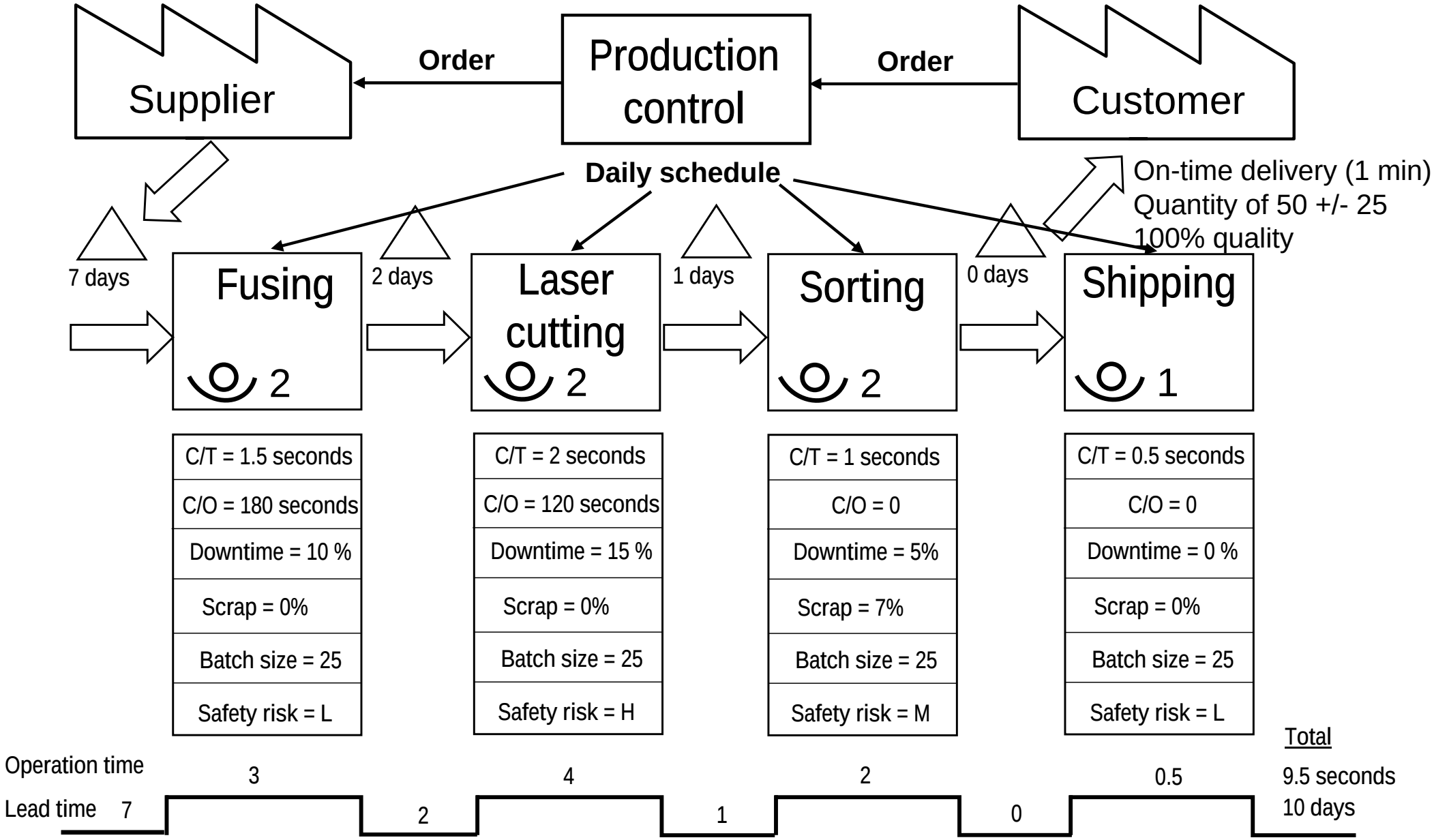
1. Define customer requirements
2. Make the work flow
3. Improve work quality and reliability
4. Manage to learn and improve


After-Sales: Current State
Information Flow
Parts Supply
Daily
PARTS
RECEPTION Fill Job Card
I
Await Customer
RECEPTION Gather Info
Fax, e-mail, phone, visit
Customers Fleet Private
STORES
C/T = Range
C/O =
1 shift
Job Card
WORKSHOP CONTROL
Keys on Board
Provide Loan/Hire Car or Collect/Deliver
HANDOVER
Valeters Key- Board
I
40 cars in Car Park
240 min
ROAD TEST
C/T = Range
C/O =
1 shift
10 min
I
1 car
10 min
WORKSHOP
C/T = Range
C/O =
1 shift
45 min
I
1 car
5 min
ROAD TEST
C/T = Range
C/O =
1 shift
5 min
I
2 cars
10 min
WORKSHOP
C/T = Range
C/O =
1 shift
15 min
I
4 cars
30 min
VALET
C/T = Range
C/O =
1 shift
15 min
I
20 cars
120 min
Material Flow

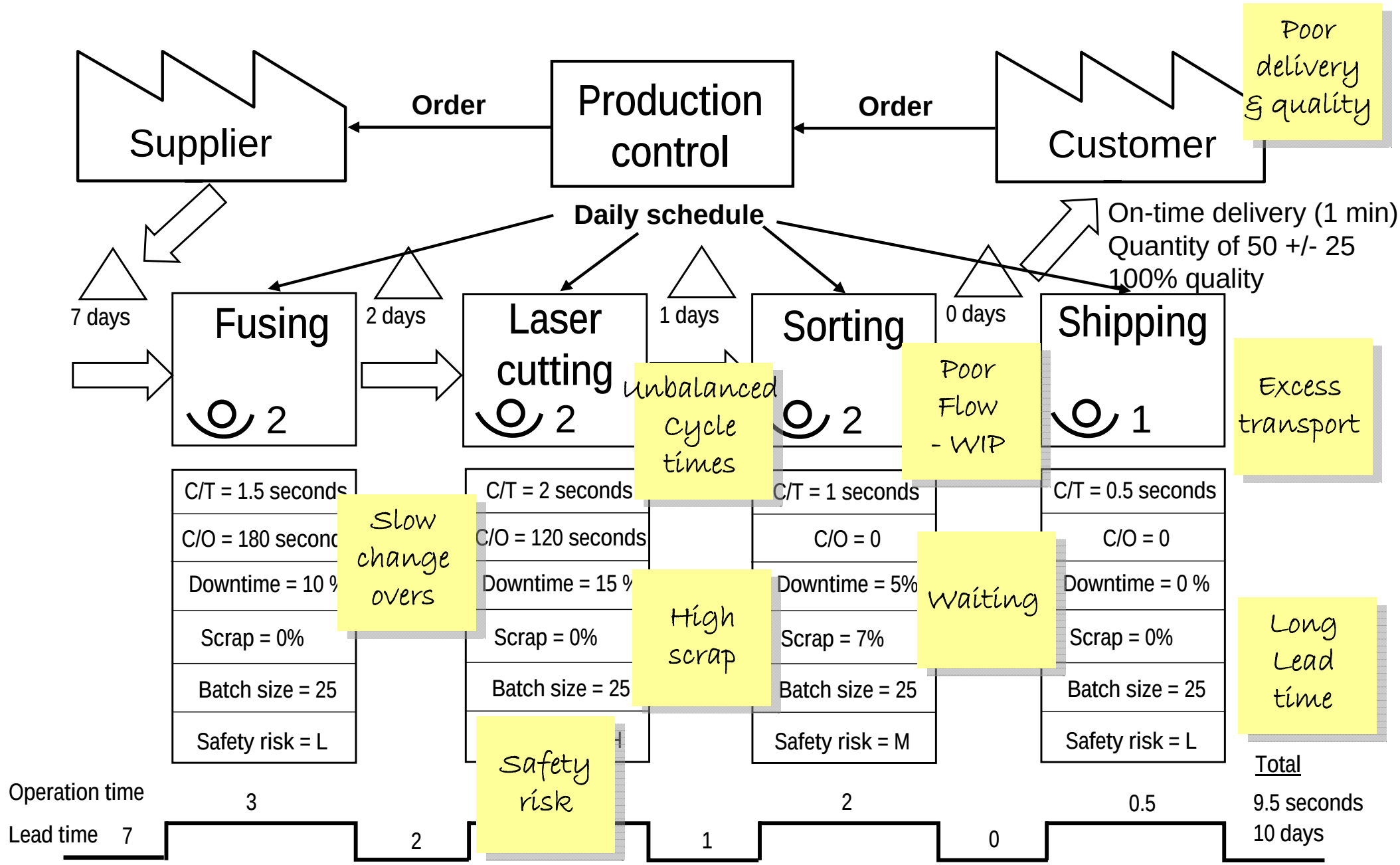


Source: Mapping to See, LEI

Current state map – round 1



Current state map – round 1



Step 1

Define customer requirements

Critical questions

1. Who are my customers (end-use & internal)?
2. What do my customers *really* require – how many, how often, what quality – and why?

Key Lean concepts/tools

Problems	**Lean solutions**
Customer requirements unclear	Ask customers

What are the customer requirements for Future Solutions Enterprise?

- Delivery – correct quantity as per order, in correct sequence, delivered within one minute from time of order.
- Quality – full nano dot with no visible damage. Reject for damage or missing nano dots (blank squares).

Any other customer requirements?

- Functionality
- Price
- Service

TAKT Time

Synchronizes pace of assembly to match pace of sales.

Rate for assembling a product based on sales rate.

$$\text{Takt Time} = \frac{\text{Effective Working Time per Shift}}{\text{Customer Requirement per Shift}}$$

$$\frac{27{,}000 \text{ sec}}{460 \text{ pieces}} = 59 \text{ sec}$$

Source: Training to See, LEI

Step 2

Make work flow – no waiting or rework

Critical questions

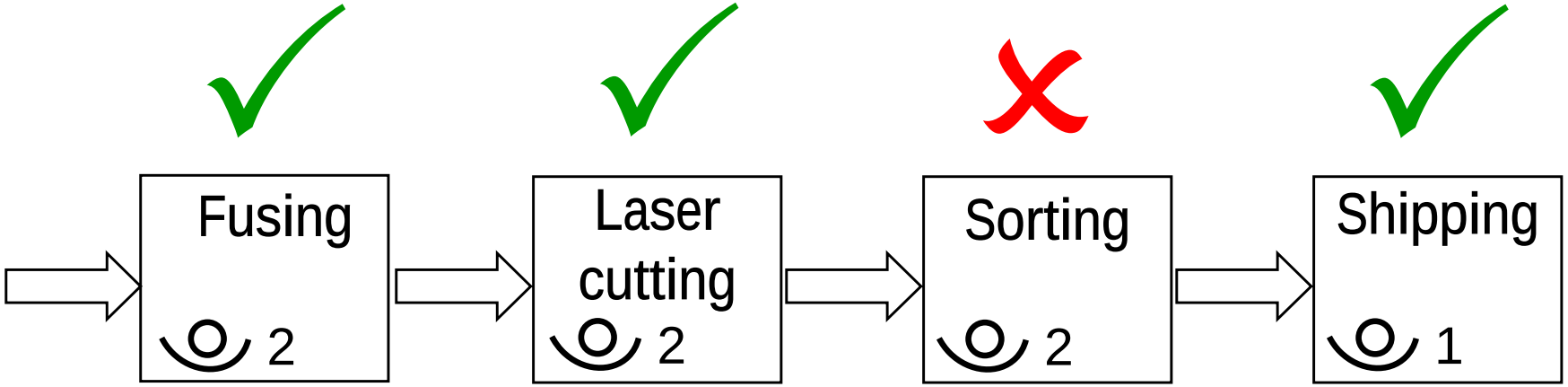
1. Do we really need all these steps?
2. How can we avoid/eliminate all delays and interruptions to make the work flow?

Key Lean concepts/tools

Problems	**Lean solutions**
Non-value added steps	Eliminate / Combine / Reduce / Simplify
Poor flow	Continuous flow vs batch Pull systems
Unbalanced workload	Work balancing

Flow where you can, pull where you can't

What steps in our process add value?

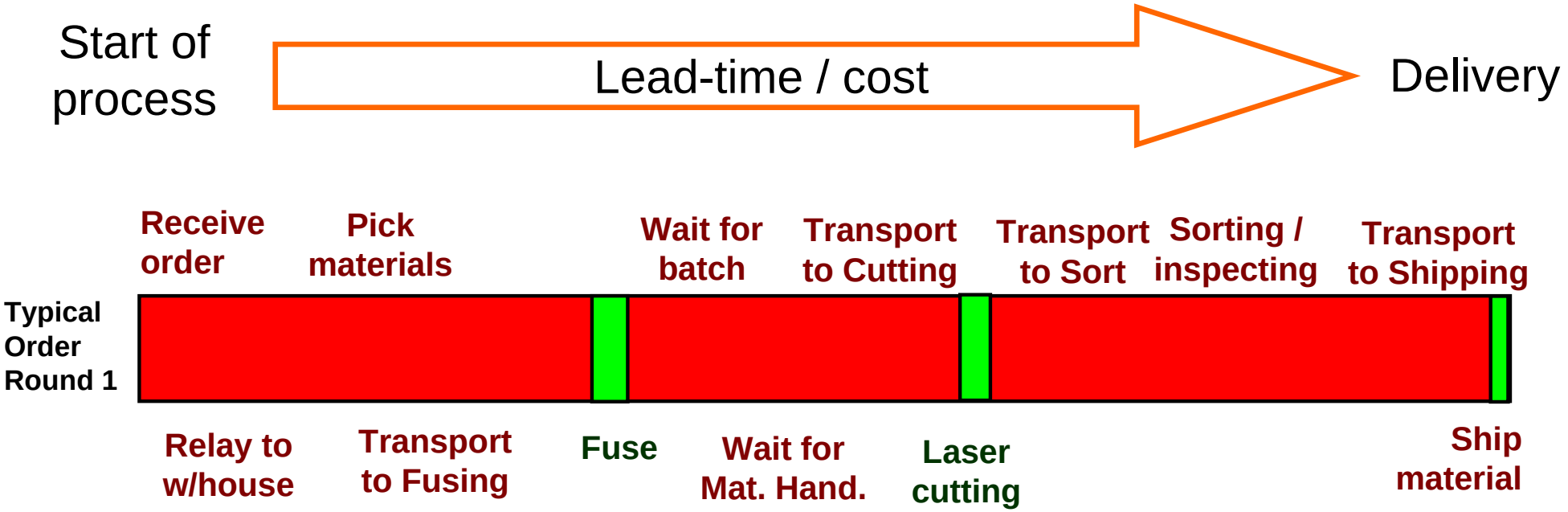


But dig deeper:

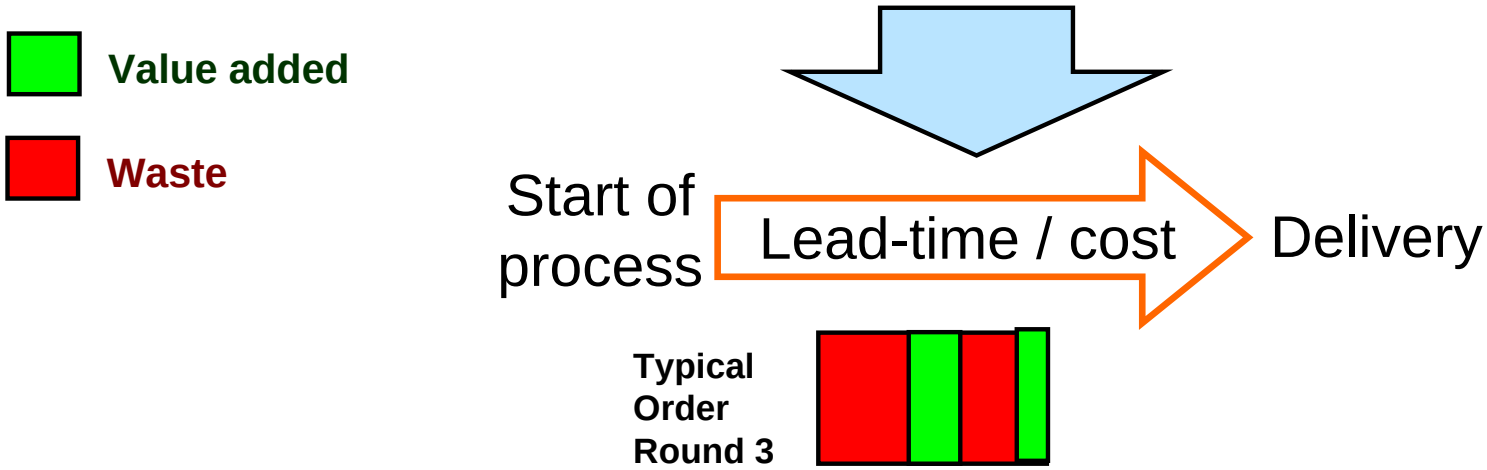
- Taking the grid sheet ✗
- Taking the nano dots ✗
- Pealing the nano dots ✗
- Moving dot to grid sheet ✗
- Placing nano dot ✓
- Moving completed sheet ✗

- Taking the grid sheet ✗
- Moving scissors to grid sheet ✗
- Cutting ✓
- Moving cut nano dots ✗

- Handling the nano dots ✗
- Storing the nano dots ✗
- Transporting to customer ✓

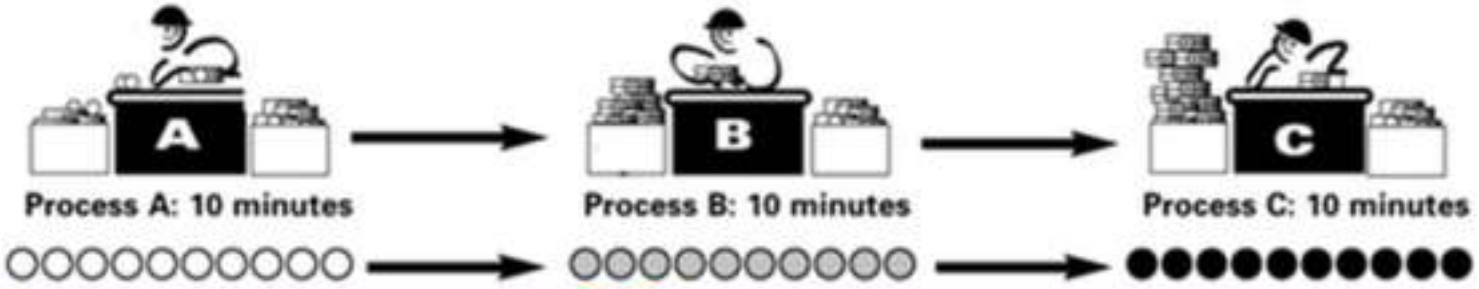


Lean focuses on eliminating waste and improving flow to reduce lead-time



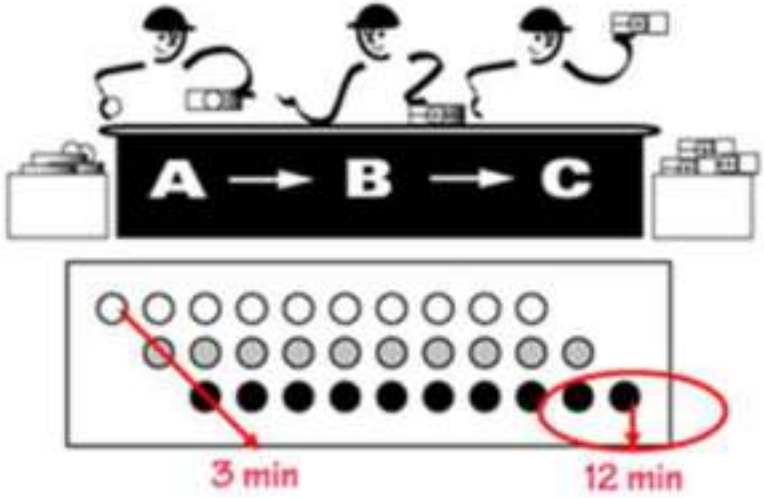
Continuous Flow Processing

Batch & Push Processing



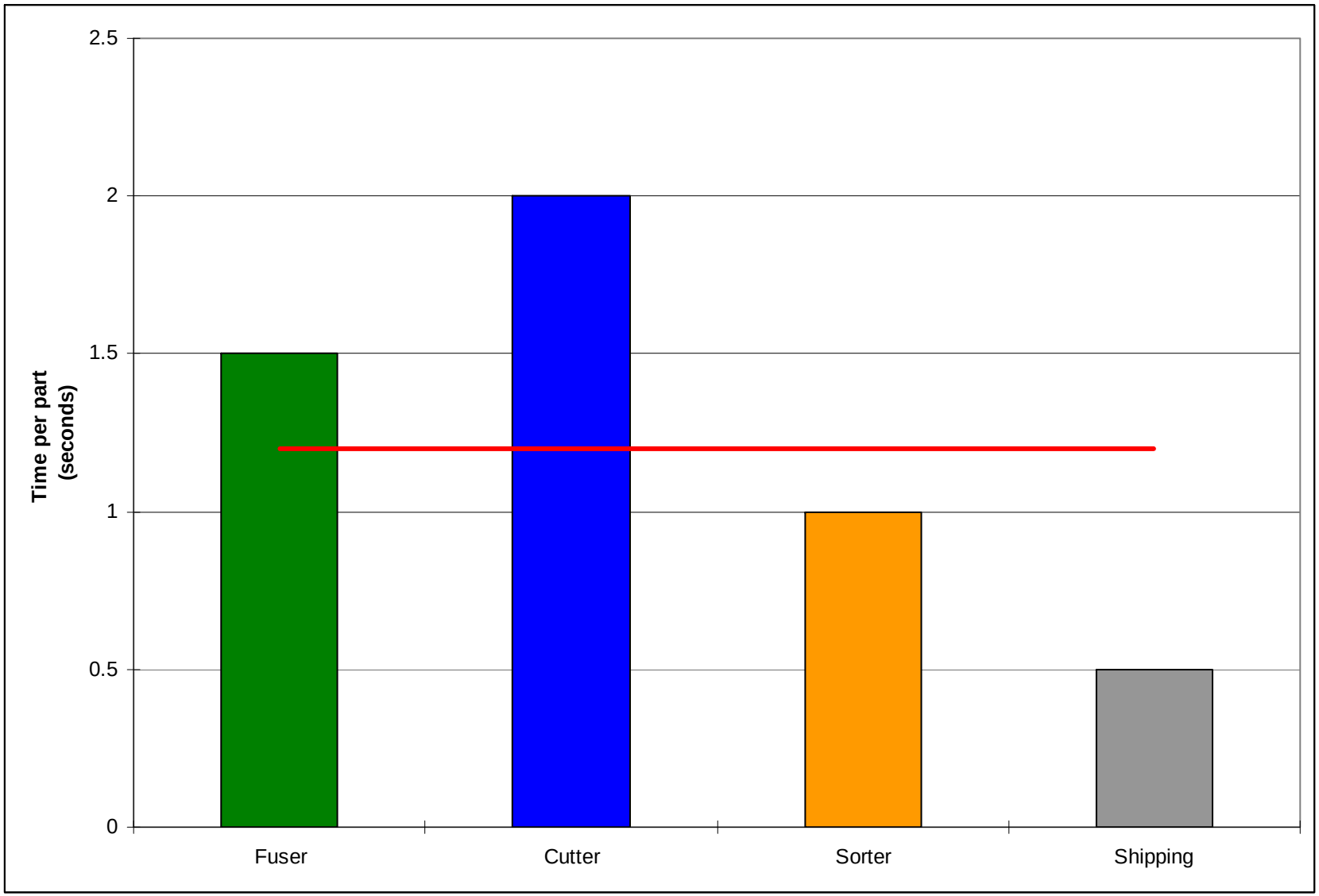
Lead Time: 30++ minutes for total order

Continuous Flow "make one, move one"



Source: Training to See, LEI

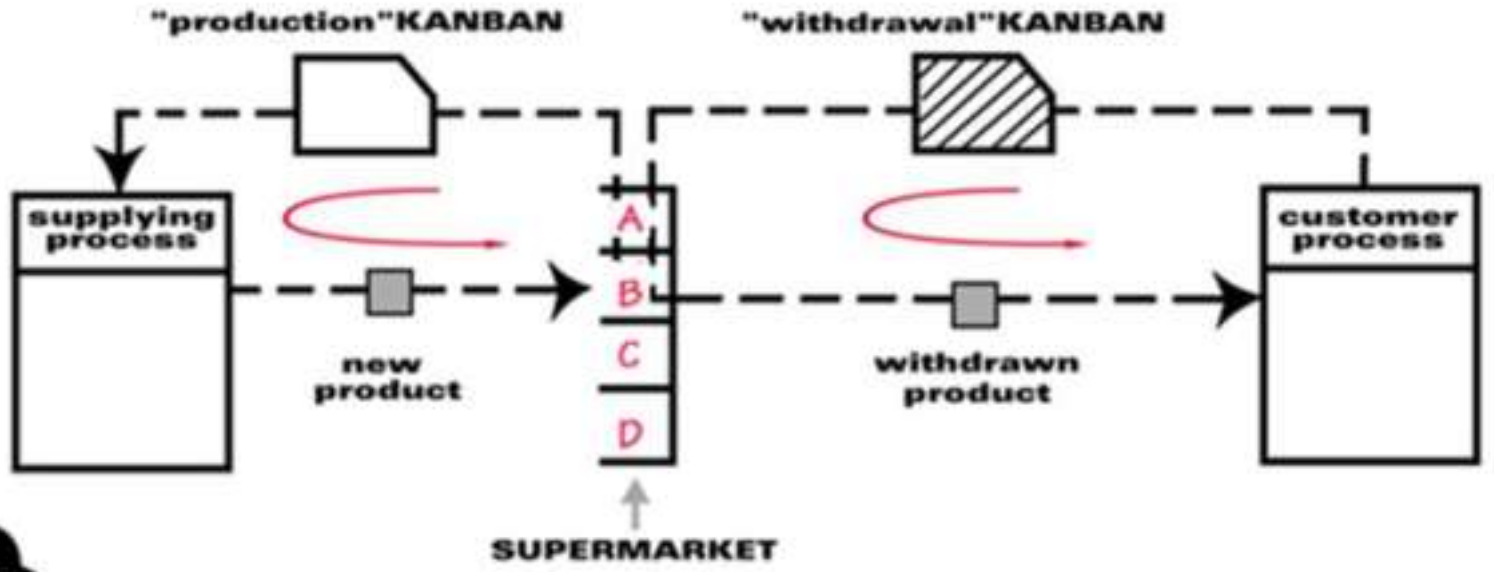
Operation balance chart



Supermarket Pull System

1) Customer process goes to supermarket and withdraws what it needs when it needs it.

2) Supplying process produces to replenish what was withdrawn.

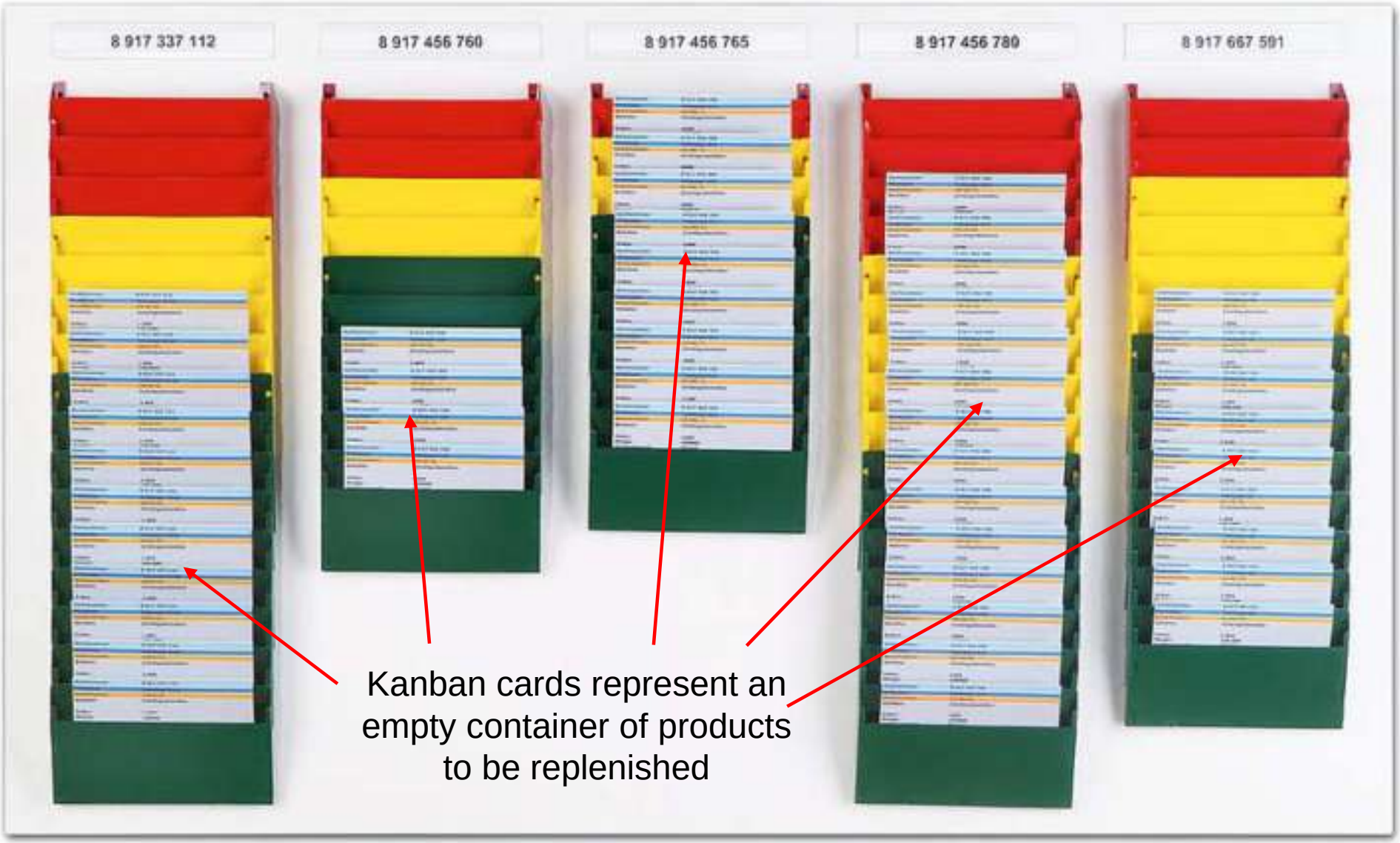


Purpose: A way to control production between flows

Controls production at supplying process without trying to schedule

5 different products to produce

Kanban board



What product do I produce next?

Step 3

Improve work quality and reliability

Critical questions

1. How do we build in quality at each step of the process?
2. How can we reduce variability at each step of the process?

Key Lean concepts/tools

Problems	**Lean solutions**
Poor quality	Quality at source Error proofing Implement standard work & visual standards
Poor reliability (downtime & variation)	5S & visual workplace Implement standard work Total productive maintenance Quick changeover

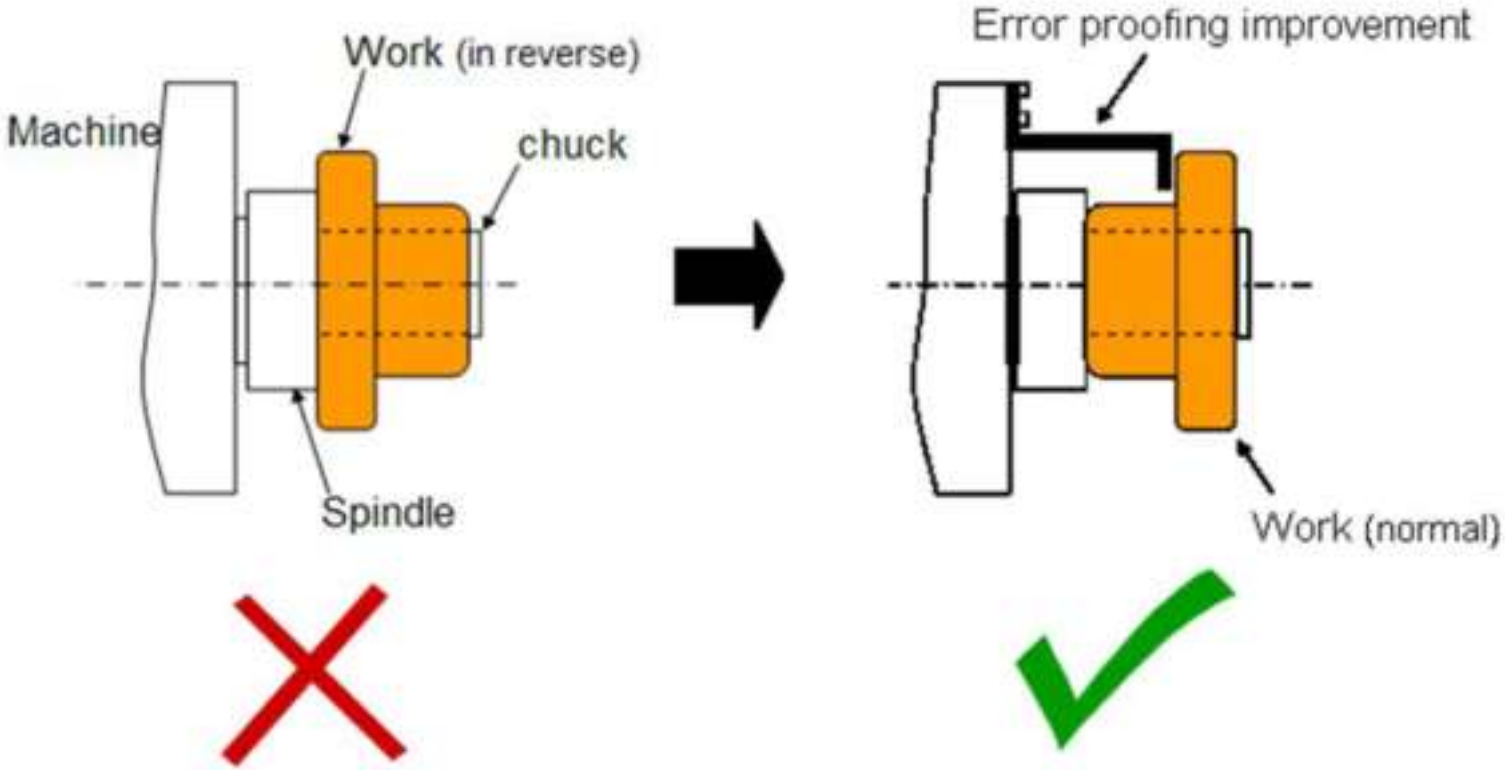
Remember 3 rules….

An error proofing system should take into consideration these 3 simple rules :

Ideally, design the product so that it can't be assembled incorrectly!!!

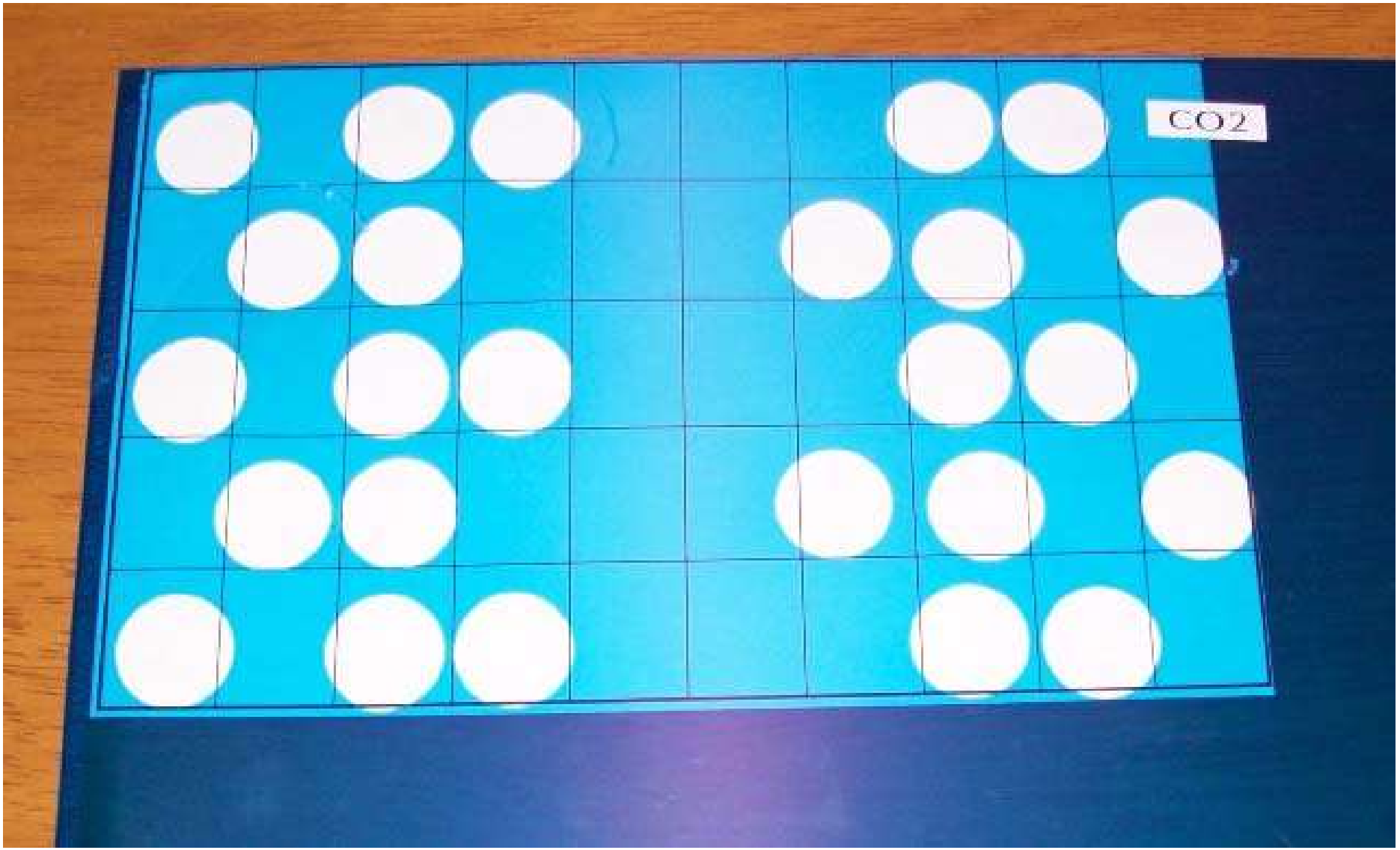
Introduction -What is Error Proofing?

- **Error Proofing is a process improvement that is designed to prevent a specific defect from occurring**



4 of 29

Fusing template

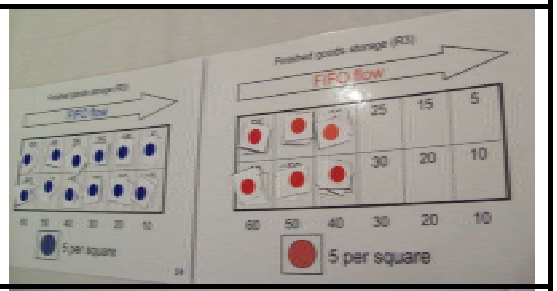
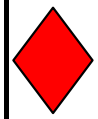
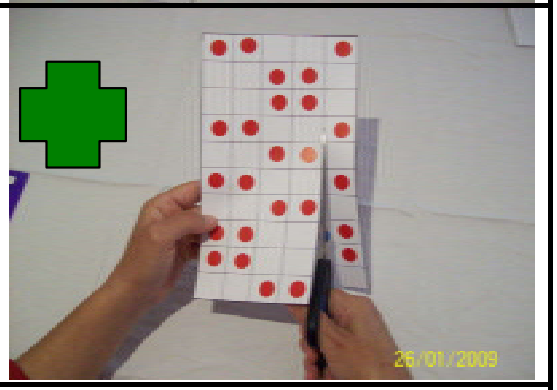


Standard Work

- Standard work is the documentation and application of the best practices of a manufacturing process.
- It may include photographs and/or drawings.
- It ensures that production operations are performed the same way each time.
- It is developed with the operators.
- It is posted at the workstation.
- Forms the baseline from which improvements are made.

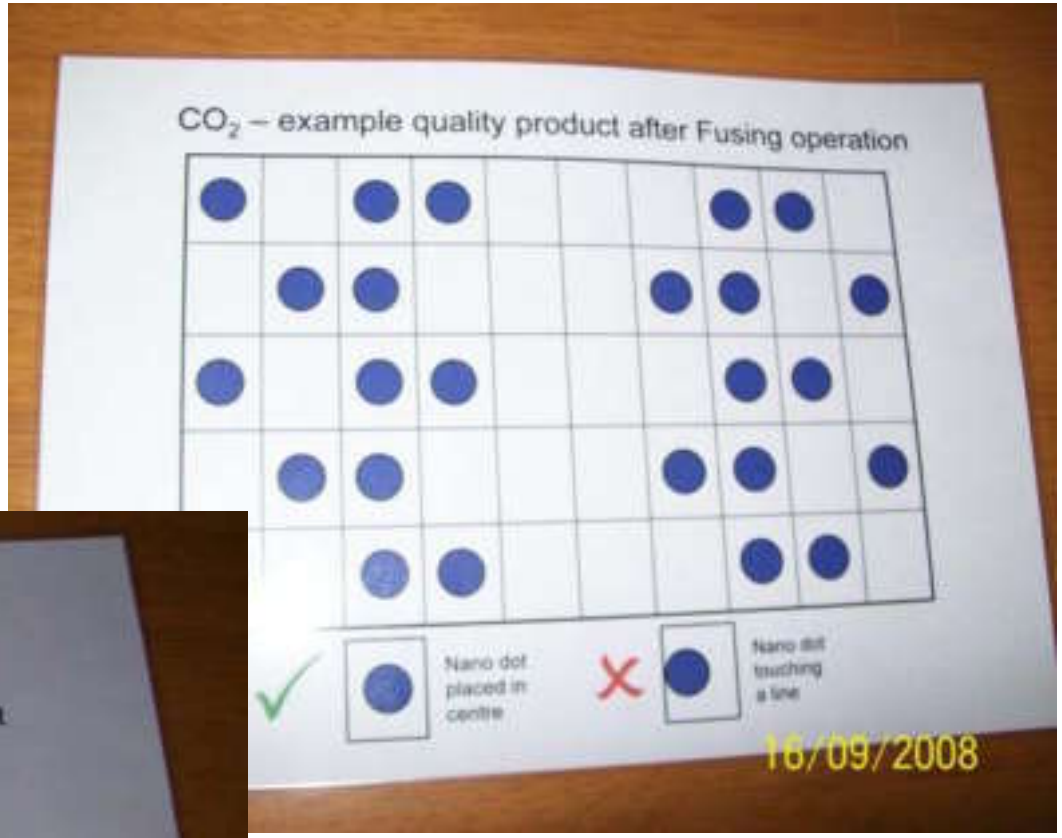
T shirt folding activity

AREA	Laser Cutting	STANDARD WORK GUIDE		
STD #	2035 Page 1 of 2			
Job Title		**Approved by**	**Revision**	**Date**
Laser Cutter		J Lee	Round 3	14/9/08

#		Time		Process description	Key points	Visual aides
		Work	**Walk**			
1				Determine next product to build based on replenishment of product taken from FG storage.	Coordinate production with the other Laser Cutter so as not overproduce – maximum of 60 per prod.	
2				Pick up the circuit board from the WIP storage location and cut the board into strips along the longest side.	Cut the strips into 2 piles with same pattern of the nano dots. Be careful – Lasers sharp.	

1. Critical	2. Safety	2. Look	
			

Visual quality standard



Remove non-essential items from the workplace.

1. Sort

Arrange essential items for easy access and visibility

2. Set in Order

3. Shine

Keep work areas and equipment clean

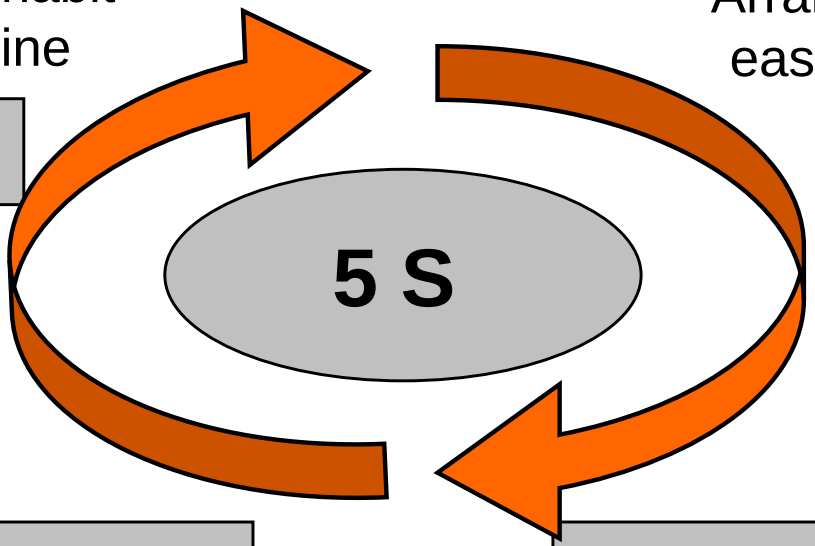
4. Standardise

Make cleaning and checking a routine practice

5. Sustain

Make 5S a strong habit - requires discipline

Make problems visible and solve them.



A place for everything and everything in it's place.

Caution

- The main purpose of 5S is workplace organisation. It reduces the following wastes:
  - motion
  - variation in how the work is performed (standard work)
  - looking for materials or information
  - interrupting work due to missing items

- If people see 5S as simply housekeeping, they will miss the full benefit.

- Implementing 5S is an opportunity to empower the people that work in an area to take ownership of the area and organise it in a manner that reduces wasted effort.


08/08/2008


ASSEMBLY: LINE 2

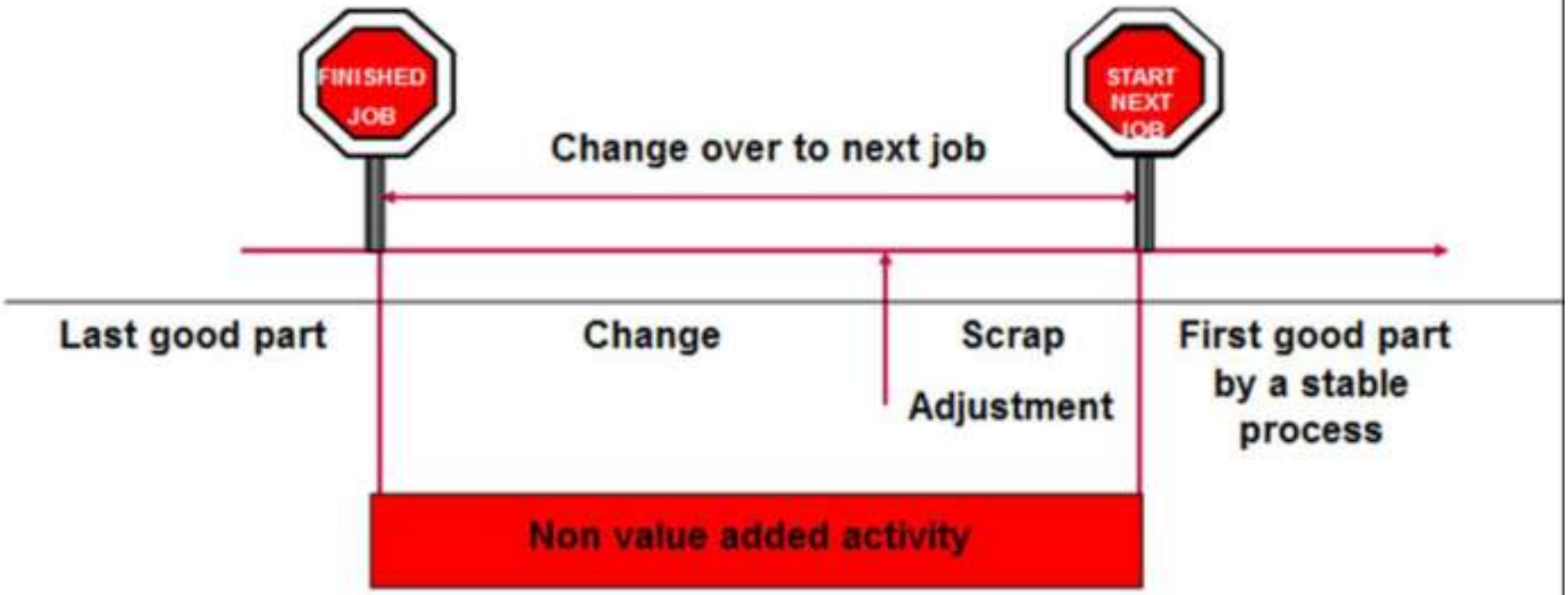
Before

After

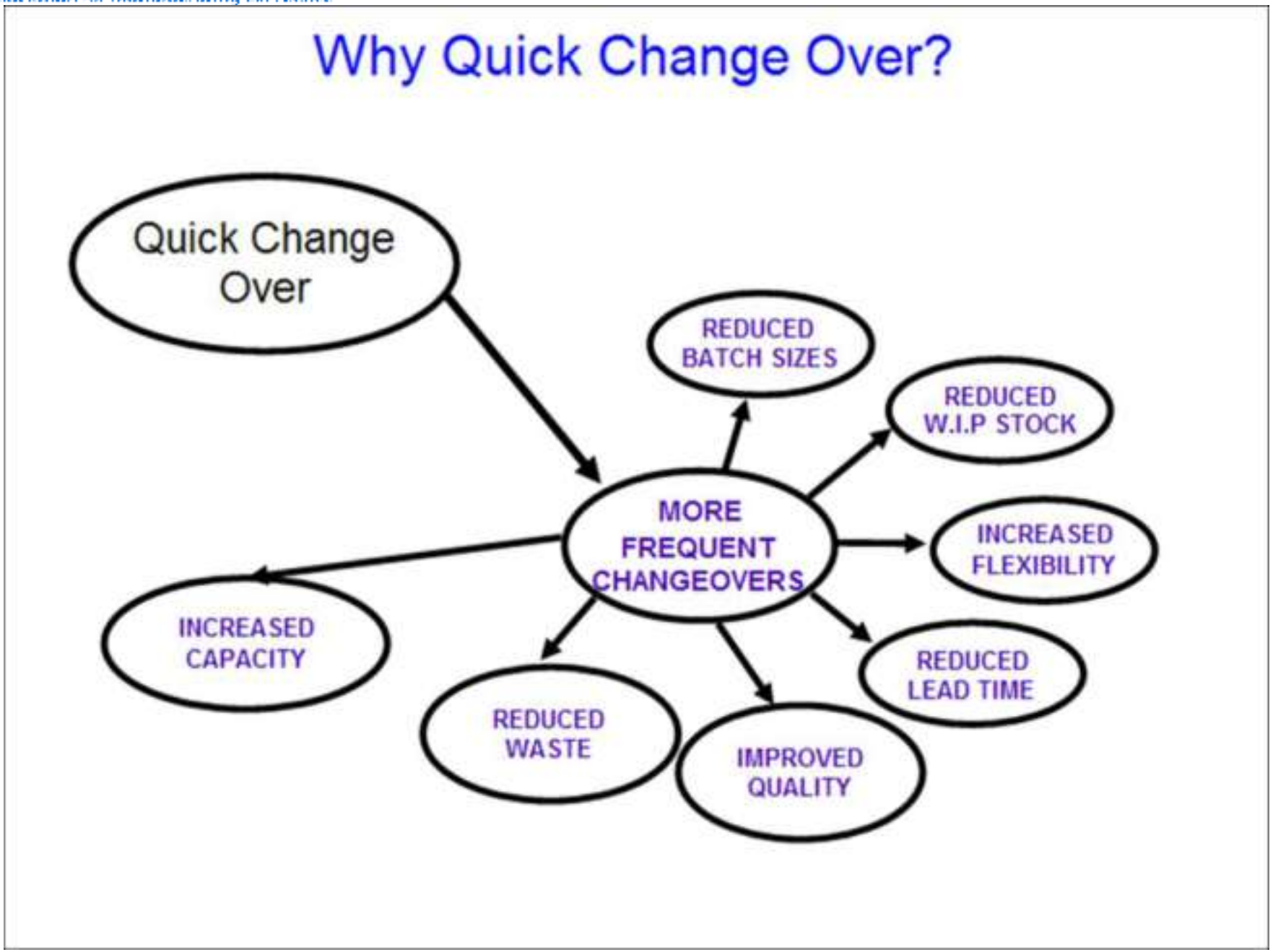
- Reduce equipment bottlenecks (Theory of Constraints)
- Reduce the six major equipment losses (OEE measure)
- Improve existing planned maintenance systems
- The operator is the best condition monitor
- Provide training to upgrade operations and maintenance skills
- Involve everyone and utilize cross-functional teamwork

- A company-wide team-based effort to build quality into equipment and to improve overall equipment effectiveness
- Total
  - all employees are involved
  - it aims to eliminate all accidents, defects and breakdowns
- Productive
  - actions are performed while production goes on
  - troubles for production are minimized
- Maintenance
  - keep in good condition
  - repair, clean, lubricate

What is a Change Over ?



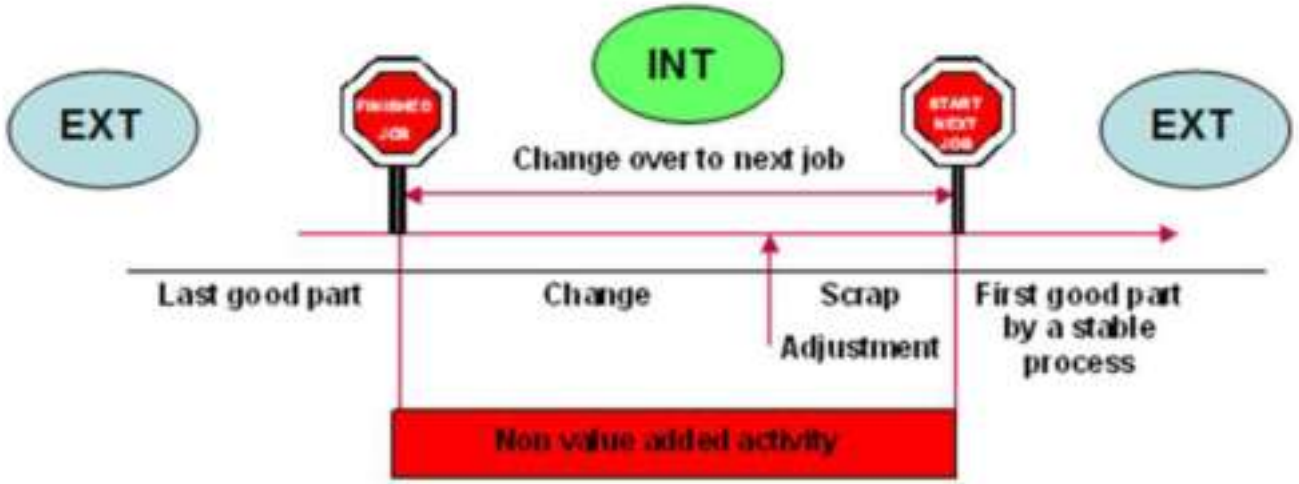
"Quick Change Over" is a method of analysing and reducing the time needed to change a process from producing one good part to producing the next good part by using a team approach


Why Quick Change Over?
Quick Change Over
REDUCED BATCH SIZES
REDUCED W.I.P STOCK
MORE FREQUENT CHANGEOVERS
INCREASED FLEXIBILITY
INCREASED CAPACITY
REDUCED LEAD TIME
REDUCED WASTE
IMPROVED QUALITY

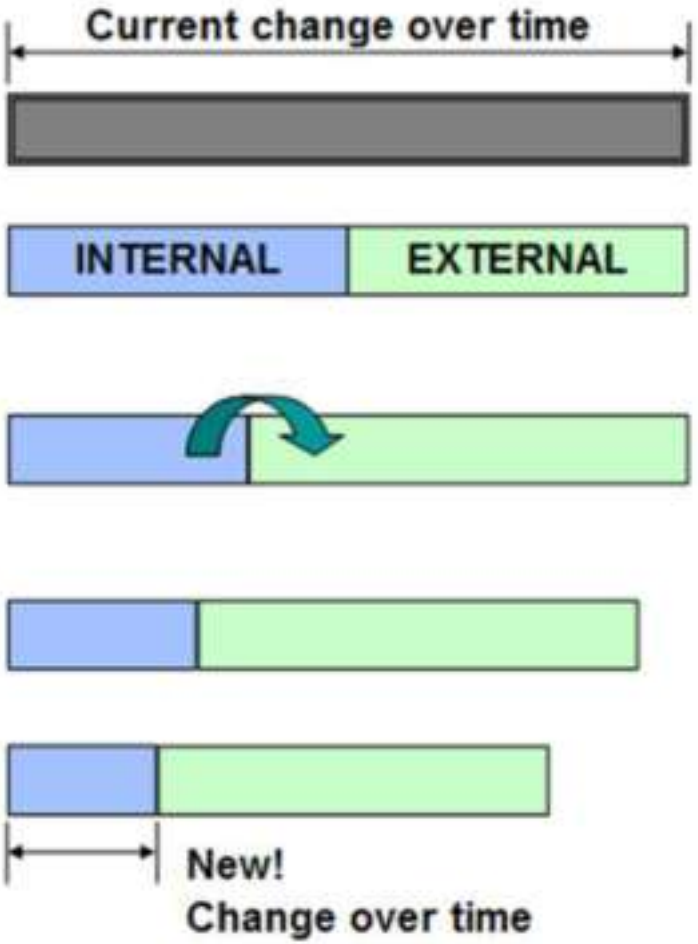
2 Key Elements in Any Change Over

- Internal Activities
  - must be performed while the machine / process is stopped i.e. not making parts

- External Activities
  - can be performed whilst the machine / process is running . i.e. making parts

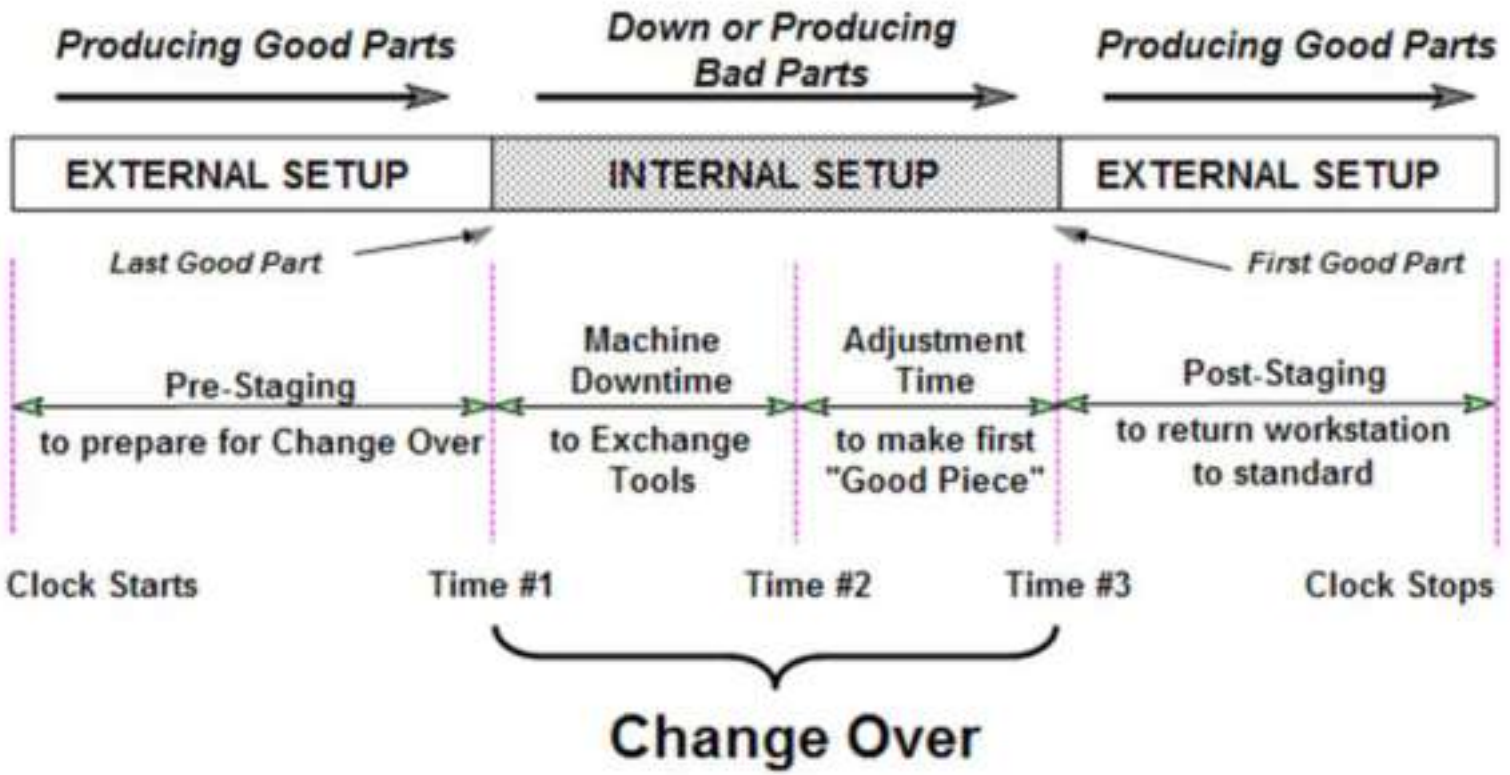


6 Steps in a Change Over Improvement



- 1. Select appropriate set up to reduce
- 2. Observe / measure the current process
- 3. Separate / internal and external activities
- 4. Convert internal activities into external activities
- 5. Reduce internal activities
- 6. Reduce external activities

Change Over Activity " Detail"



Step 4

Manage to learn and improve

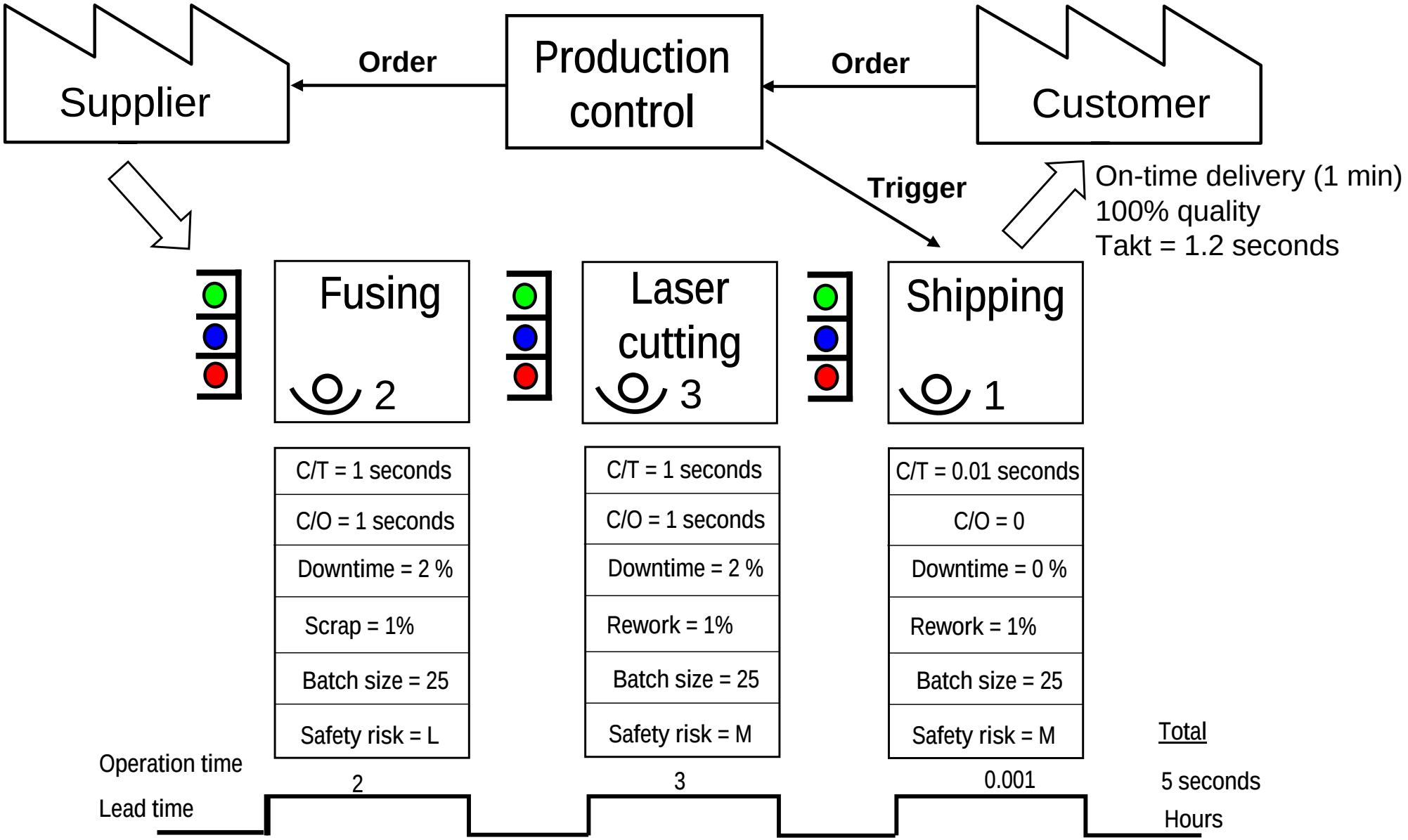
Critical questions

1. How do we highlight problems and resolve them?
2. How can we continually improve our processes?

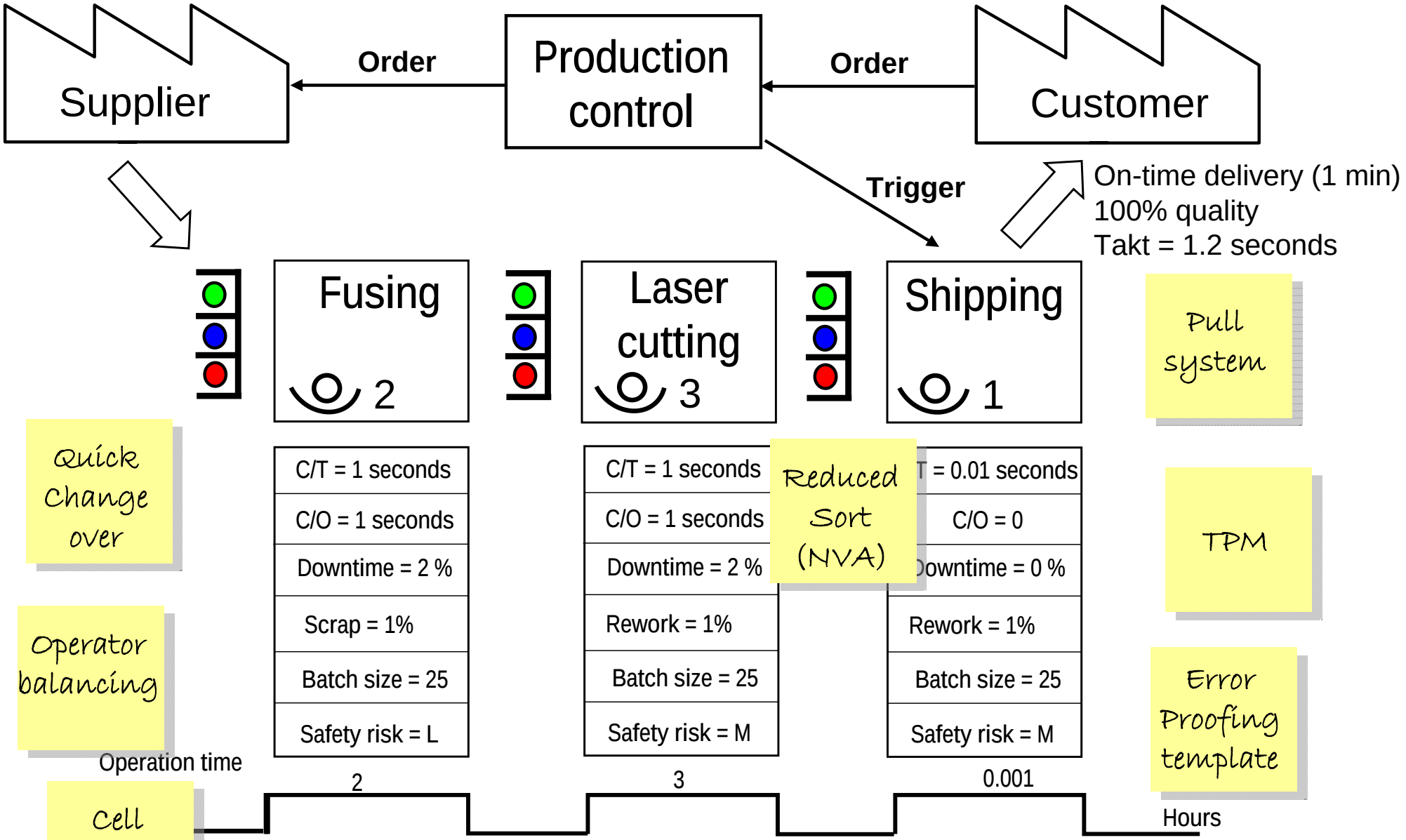
Key Lean concepts/tools

Problems	**Lean solutions**
Highlight & resolve problems	Visual management & 5S Lean metrics Problem solving
Continuous improvement	Team involvement Kaizen Value stream mapping

Future state map – round 3



Future state map – round 3



Changes for round 3

•Quality & CI team worked with operations to develop standard work to standardise the current best and safest method to do the work

•Team “rapid improvement workshop” in the Laser cutting changed the work sequence to reduce non-value added sorting / inspecting

•Production team changed layout to reduce waste and assist flow

•Production control implemented a pull system to link production to actual customer orders

•Quality implemented visual quality standards based on discussions with customer to highlight requirements

Changes for round 3

•Quality added error proofing template to fuser operation to reduce risk of quality problems and reduce cycle time

•Maintenance applied 5S to the toolbox to reduce time wasted in searching for parts and TPM to reduce the frequency of breakdowns

•Quick changeover teams reduced changeover times on fusing & laser cutting

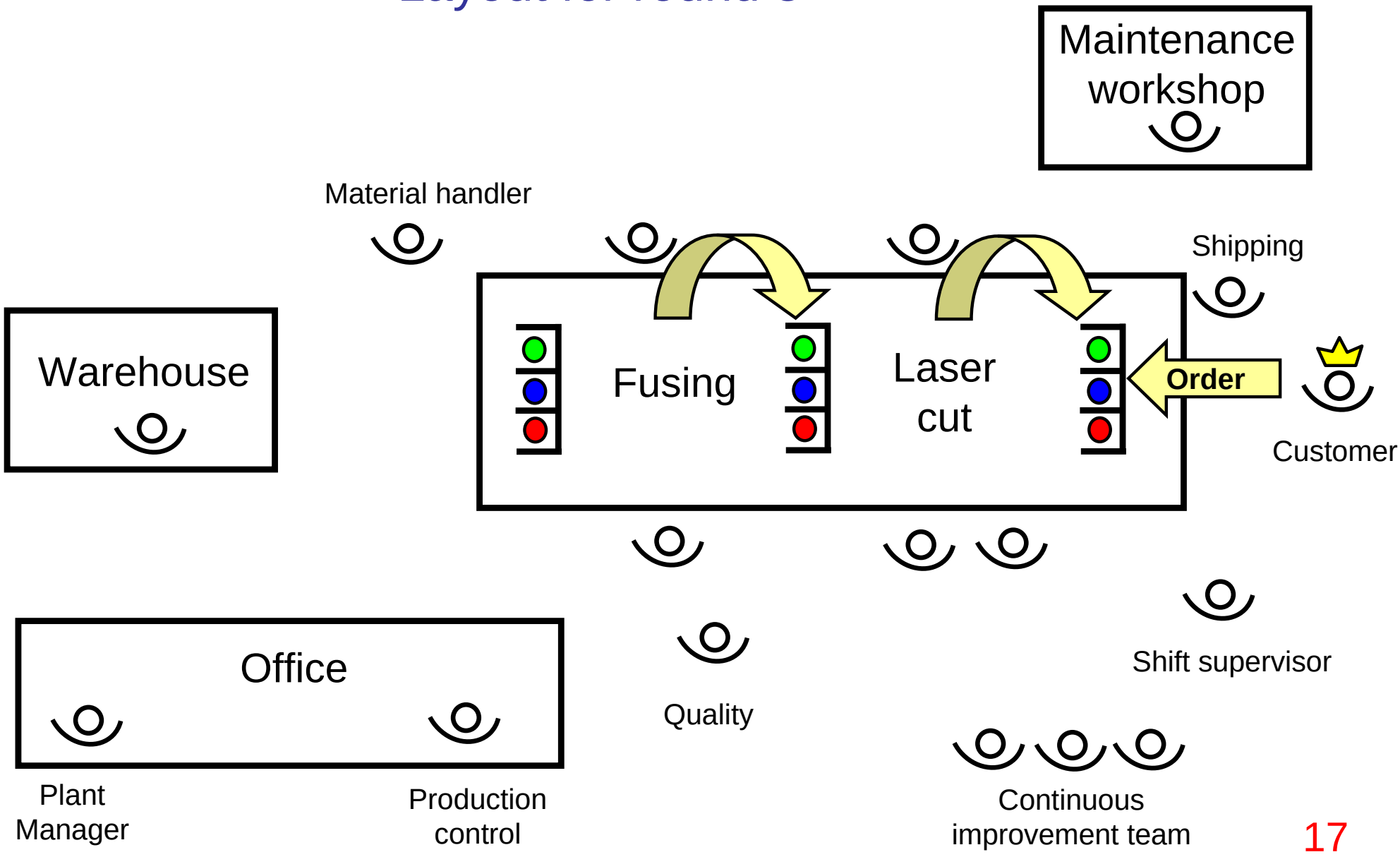
•Supplier eliminated waste around edges of circuit board

•Warehouse & material handlers implemented point of use storage at the fusing operation

Roles for round 3

Roles	Round 1	Changes	Round 3
Customer	1		1
Warehouse	1		1
Production controller	1		1
Fusers	2		2
Laser cutters	2		2
Sorters	2	-1 CI team	1
Material handlers	2	-1 CI team	1
Shipping	1		1
Maintenance	1		1
Quality	1		1
Continuous improvement	1	+2 sorter, mat hand.	3
Plant manager	1		1
Shift Supervisor	1		1
Total	17		17

Layout for round 3



Debrief of round 3

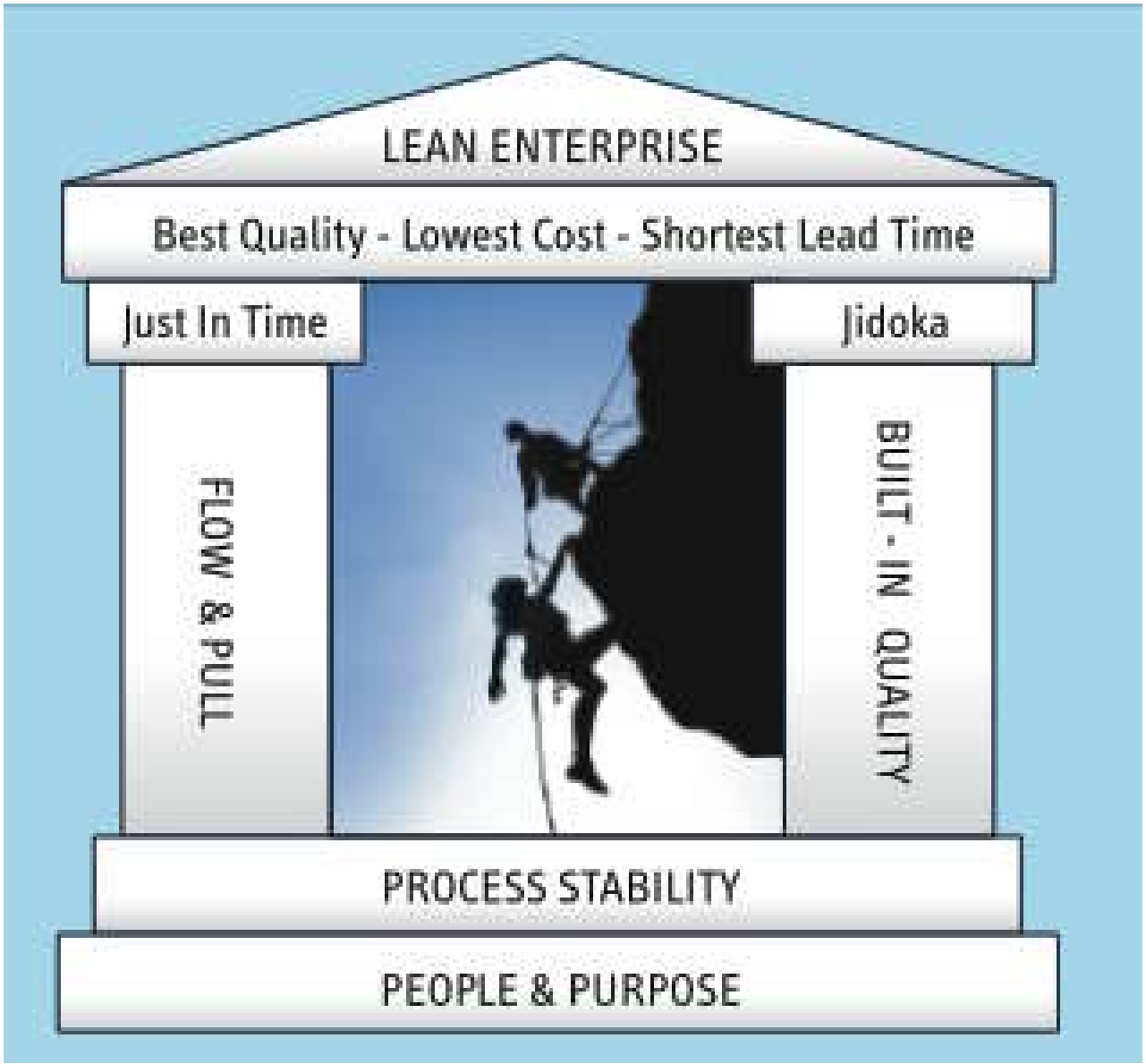
- How did we do?
- Did the improvements work?
- What further improvements can be made?
- How does this compare to your operation?

Lean Enterprise Transformation

Where Do You Start - From Top or Bottom?

john shook

Source: John Shook, LEI



Roof

Shorten production flow by eliminating waste and variation.

Pillars

Just in Time - Flow, pull and levelling.

Built in Quality (Jidoka) - TPM, error proofing and visual control.

Climbers

People development and teamwork is central.

Foundation

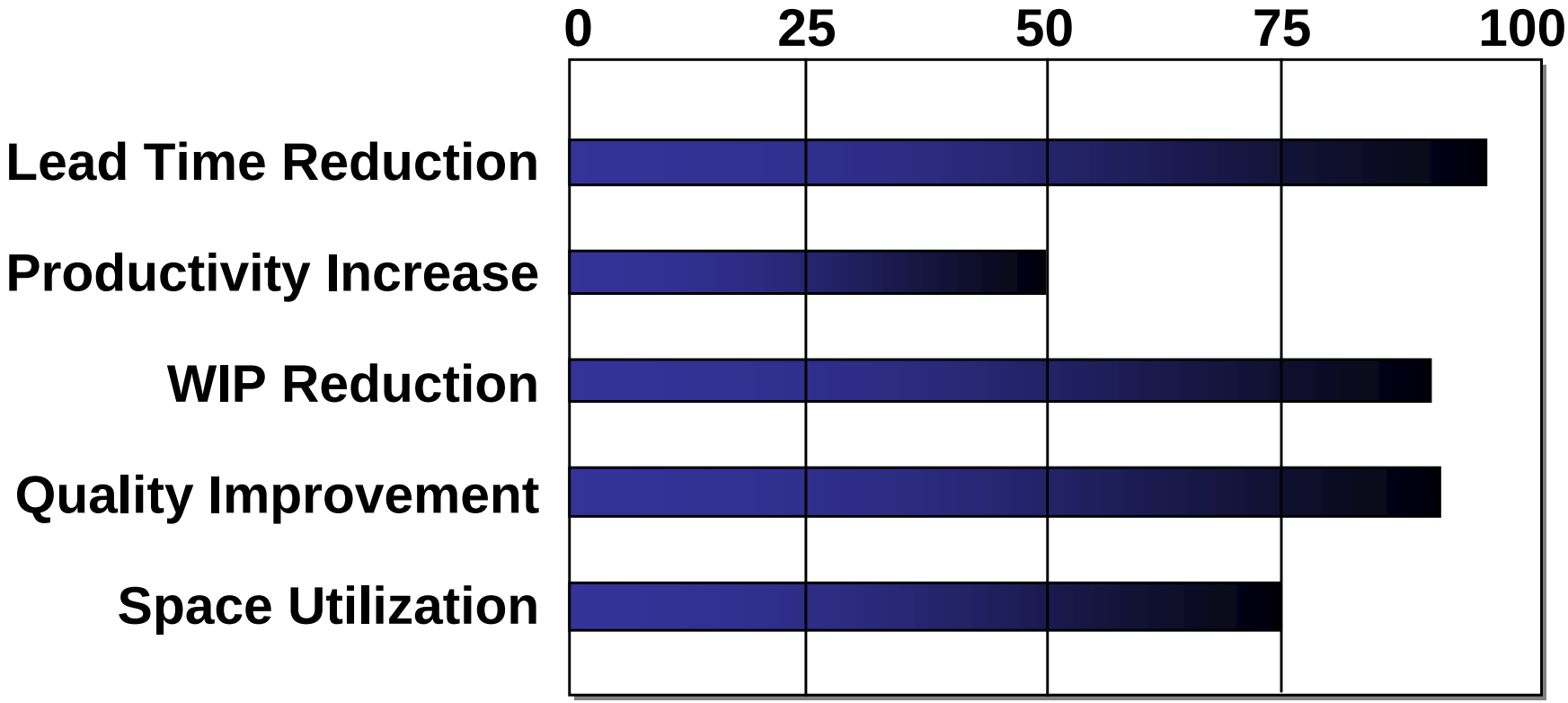
Process Stability - standardised work, 5S, visual workplace, problem solving and continuous improvement.

People & Purpose - strong leadership, clear purpose, employee engagement, development and mutual trust.

Lean tools	Purpose	Example in simulation
Value stream mapping	Visual, team-based & structured approach	Used to plan improvements
5S	Workplace organisation reduces waste & highlight problems	Maintenance toolbox
Visual management	Provides information & highlights problems	Standard work Quality standard
Error proofing	Quality at source	Fusing template
Standard work	The current safest & most efficient method is used by all operators	Operations
Total productive maintenance (TPM)	Reduces equipment related downtime	Discussion
Quick changeover	Reduces downtime due to changing products	Discussion

Lean tools	Purpose	Example in simulation
Point of use storage	Reduces wasted motion & transportation	Dot dispensing
Work balancing	Balances work to takt time	Balancing line
Continuous flow	Reduces product delays between sequential steps	Reduced batch sizes to one piece flow -round 4
Pull systems	Links production through replenishment	Kanban system
Production levelling	Reduces variation in demand and work rates	Discussion
Rapid improvement event (Kaizen)	Intensive team based workshop	Laser cutting improvement

Percentage of Benefits Achieved



Flexibility Skill Enhancement Visual Management

"In times of profound change, the learners inherit the earth, while the learned find themselves beautifully equipped to deal with a world that no longer exists."

Al Rogers