Lean Model Basics

For

IIM-Rohtake-MDP on “Lean Operations Management & Six Sigma Batch V

by

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Mentor Profile

Mani V G S

Position: Founder

Nationality: Indian

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Education

2017	SCOR – P Certification
2002	Certified Lean Manufacturing Champion – Lean Enterprise Institute
1990-1993	Masters in Industrial Design – NID, Ahmedabad, India
1983-1987	Bachelor of Mechanical Engineering – REC, Surathkal, India

Professional experience

2017-onwards	The Chainworks
2014-17	Microsoft
2008-14	Nokia Devices
1997-08	Whirlpool of India
1994-97	Voltas Limited
1987-90	TVS

Key projects

- Coaching to provide supply chain solutions through ‘D2D’ (Design to Deliver) knowledge
- Coaching pharma to deliver 50% improvement in manufacturing waste & 30% improvement in QC processes
- Coaching flexible mfg for 40%+ reduction in material wastage
- 2x improvement in production output at auto ancillary
- Lean manufacturing champion – Global trainer & coach for Whirlpool. Delivered savings in excess of 10 M$.
- Built, led & coached a team of professionals for planning, sourcing & customer delivery of business worth $4 billion pa / 6M units pm.
- Lean principles introduced & established in vendor & logistics supply chain in Whirlpool & Nokia

Languages

- Tamil (Native)
- English
- Hindi
- Kannada

Industry competence

- Consumer Electronics
- Consumer Durables
- Auto Ancillary
- Packaging
- Pharma

Methodological competence

- Lean Manufacturing
- Supply Chain & Logistics
- S&OP
- World Class Operations Management

What is Lean?

- Toyota looked at their processes to identify improvement opportunities. The concept of Toyota Production System (TPS) was born
- The main objectives of the TPS are to design out overburden (muri) and inconsistency (mura), and to eliminate waste (muda), in other words to become more lean, but still giving the customer what they want.....value
- Highest Quality, Lowest Cost and Fastest to Market through constantly shortening the Value Stream
- Three parts of a Value:
  - Concept to Launch
  - Order to Deliver (how we communicate what the customer needs and when)
  - Value-creation Process Steps

NOTE - Value Streams exist for Products and Services

Lean Orientation History

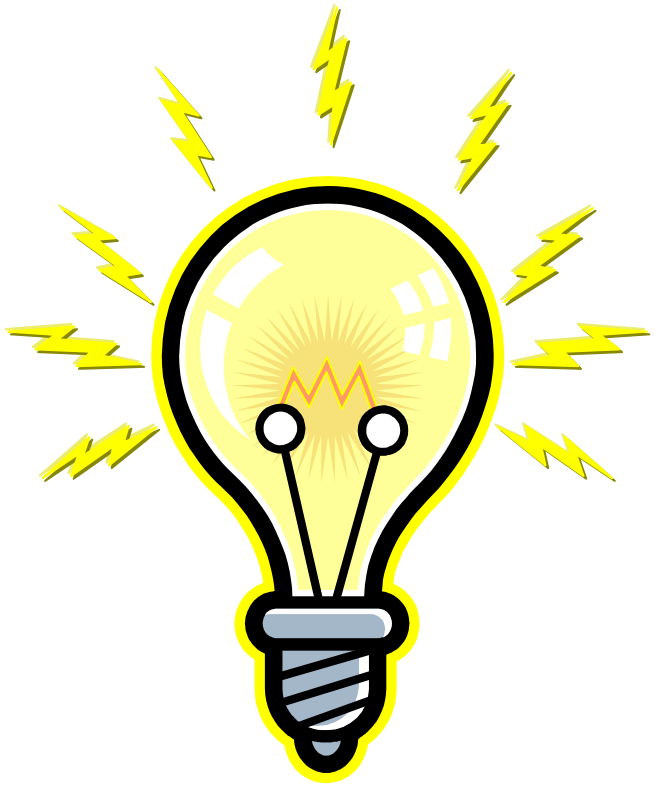
Taiichi Ohno

The Toyota Production System grew out of extreme circumstances:

- War-ravaged Japan left with little to no capital
- Japanese productivity was 1/9th of US levels
- Toyoda family company must lay-off employees for the first time in their history, strike ensues, Head of Family resigns
- Challenge from new Toyota President to ‘catch up with the US in 3 years!’
- Taichi Ohno, Production Manager and Engineer develops system upon system, focused on cutting costs
- Taichi Ohno’s responsibility continues to grow over the next few decades
- Eventually the Toyota Production System is born when Toyota adopts the business system company-wide

Ohno believed that in a stagnant or receding economy only those with the lowest costs will be successful. As economies are cyclical in nature the pursuit of perfection (no waste) is a worthwhile endeavor.

Lean Thinking



Lean Thinking helps to precisely define the value as perceived by the customer, to identify the activities that generate value and to make those activity to flow smoothly without interruptions pulled by the customer requests.

Lean Thinking is counterintuitive, so it's difficult to grasp at first instance, but dramatically obvious once the "light is on".

Lean is Based on two philosophies:

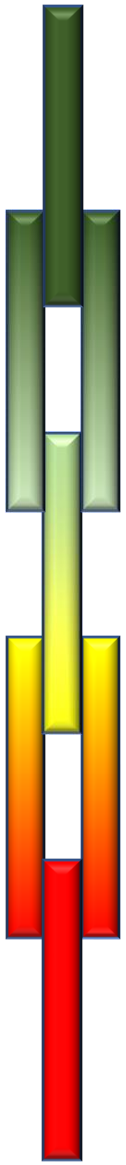
- Elimination of waste
- Respect for people

And … What is Value?

- Value is what consumers and customers are willing to pay for
- We create value when we deliver products and services that meet or even exceed the expectations of our consumers, customers and stakeholders

Everything that does not add value to the consumer / customer is waste!

The five principles of Lean Thinking



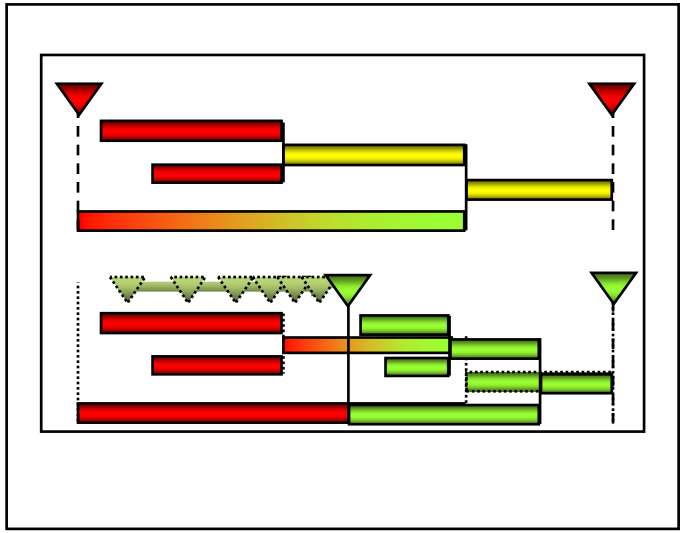
1st principle Value	Identify Value through the Customers' Eyes
2nd principle Mapping	Define the Value (creation) Stream and identify what is not adding value
3rd principle Flow	Let the Value Flow: align in the best sequence the activities that create value and perform them without interruption
4th principle Pull	Let the Customer Pull Value
5th principle Perfection	Pursuit of Perfection

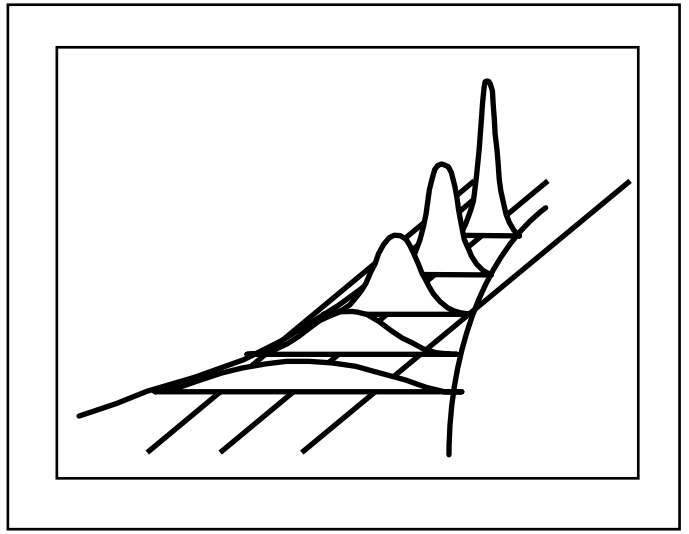
SOURCE: Lean Thinking, Womack & Jones, 1995

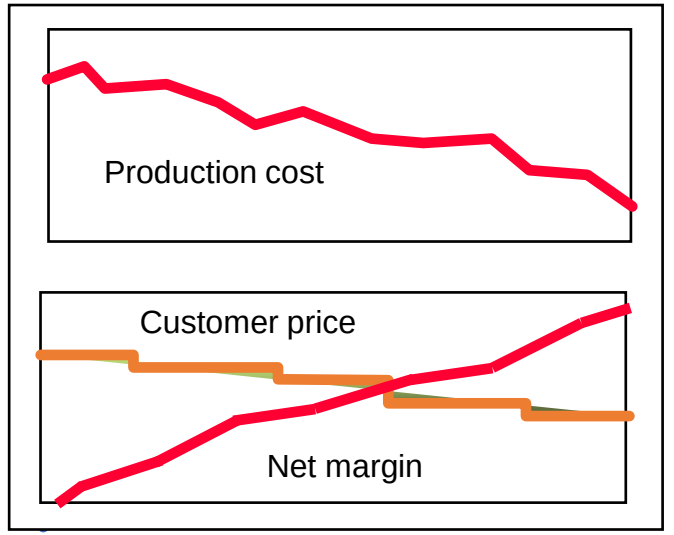
The Lean Challenge

We need to be able to do <u>three</u> things well, all <u>at the same time</u>!

Reduce Lead Time **AND** Improve Quality **AND** Reduce Cost





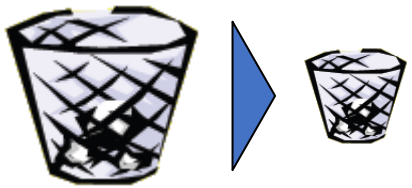


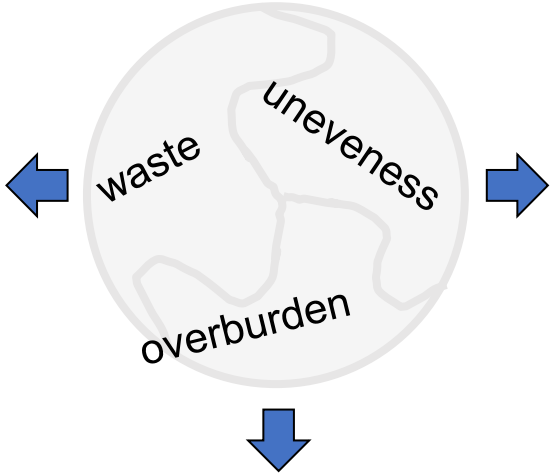
"Faster" "Better" "Cheaper"

And… improve safety, housekeeping and ergonomics

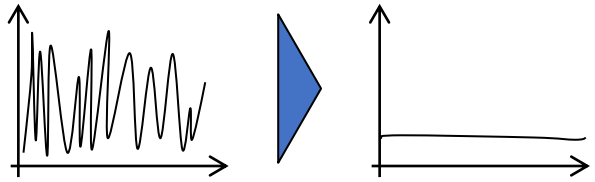
The "3 enemies" of operations:

Reducing waste "Muda"
(*Muda* = Absence of value) means improving quality, lowering costs and achieving consistent service levels.

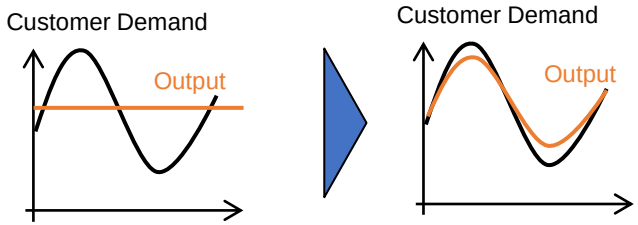




Reducing unevenness "Mura"
(*Mura* = Absence of stability) means improving process capability i.e. improving quality and lowering costs.



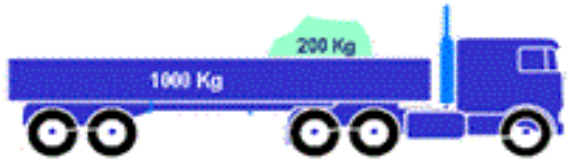
Reducing overburden "Muri"
(*Muri* = Absence of standard) means becoming able to meet customer demands at the right time in the right quantities and at the right quality.



"*mu*" is a Japanese term for "*absence*

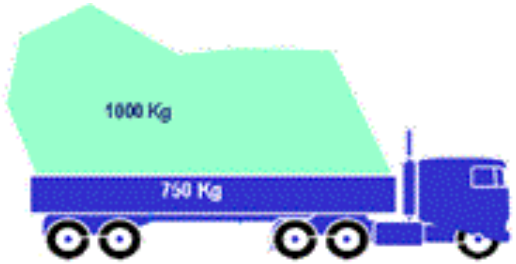
A simple way to visualise the "3 enemies"

MUDA:
waste of resources

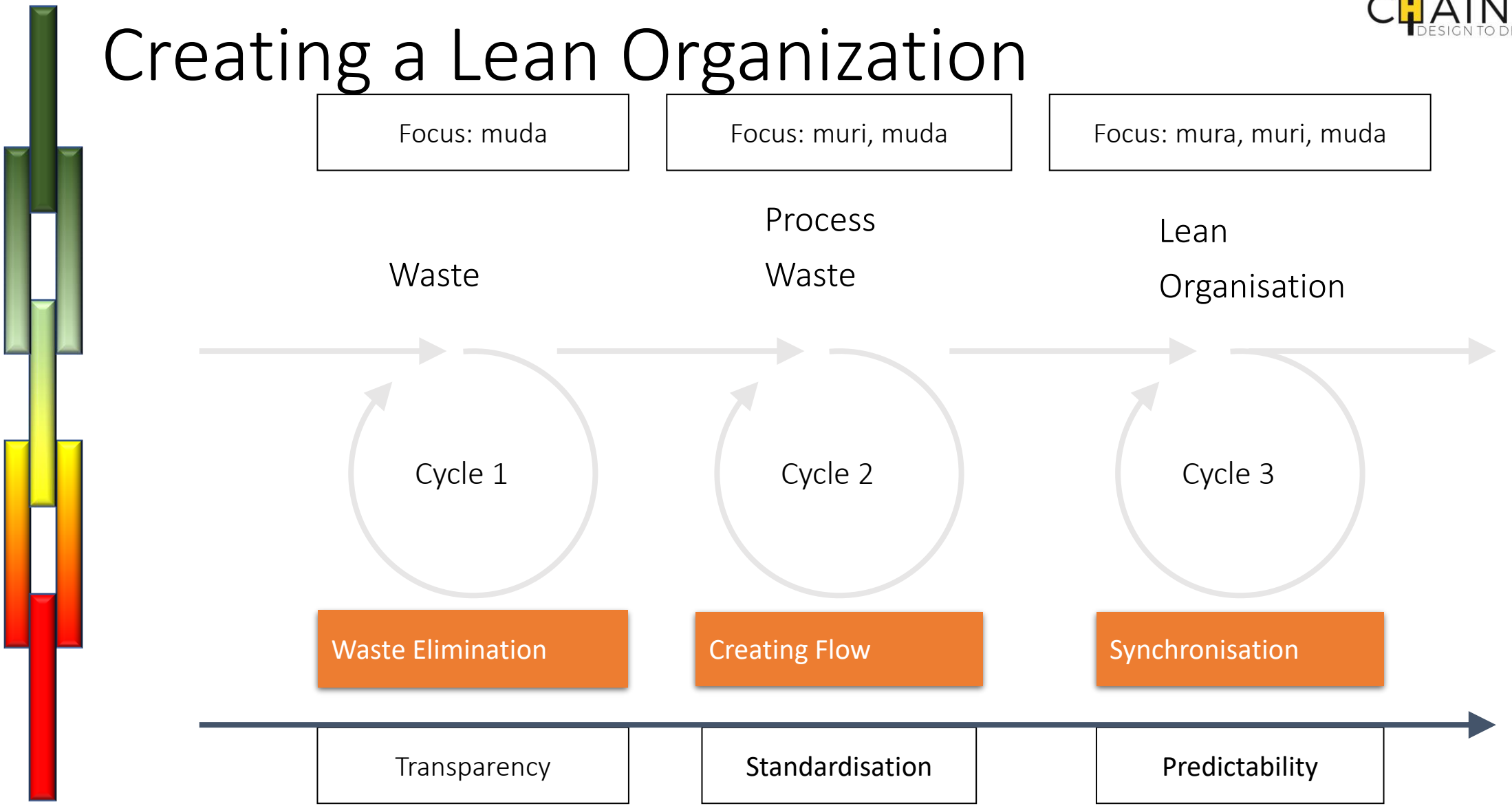


MURA:
fluctuations, variability,
irregular resources workload

MURI :
overload of people / resources



Creating a Lean Organization



Being able to recognise **the Waste** in the Value Stream is the first step for improving towards a Lean Flow

- “Waste” is any activity that consumes resources but creates no value for the customer
- The waste in the Value Stream is classified into seven main categories, the “Seven Wastes” (or “Seven Muda”)
- Understanding the nature of waste is the first step in being able to recognise it, and thereby work to eliminate it
- After the waste is recognised a deployment will identify the losses in the Value Stream
- The actions required to remove the losses will then allow the elimination of the waste

MUDA: the 7 losses

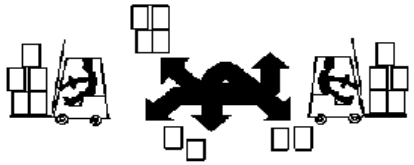
INVENTORY

OVERPRODUCTION

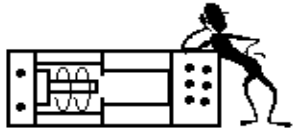
DEFECTS

LOSSES

TRANSPORTATION

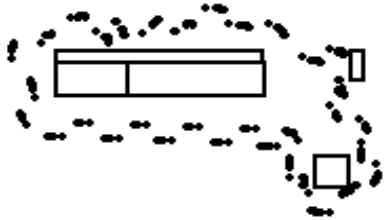


WAITING



OVER-PROCESSING

MOTION



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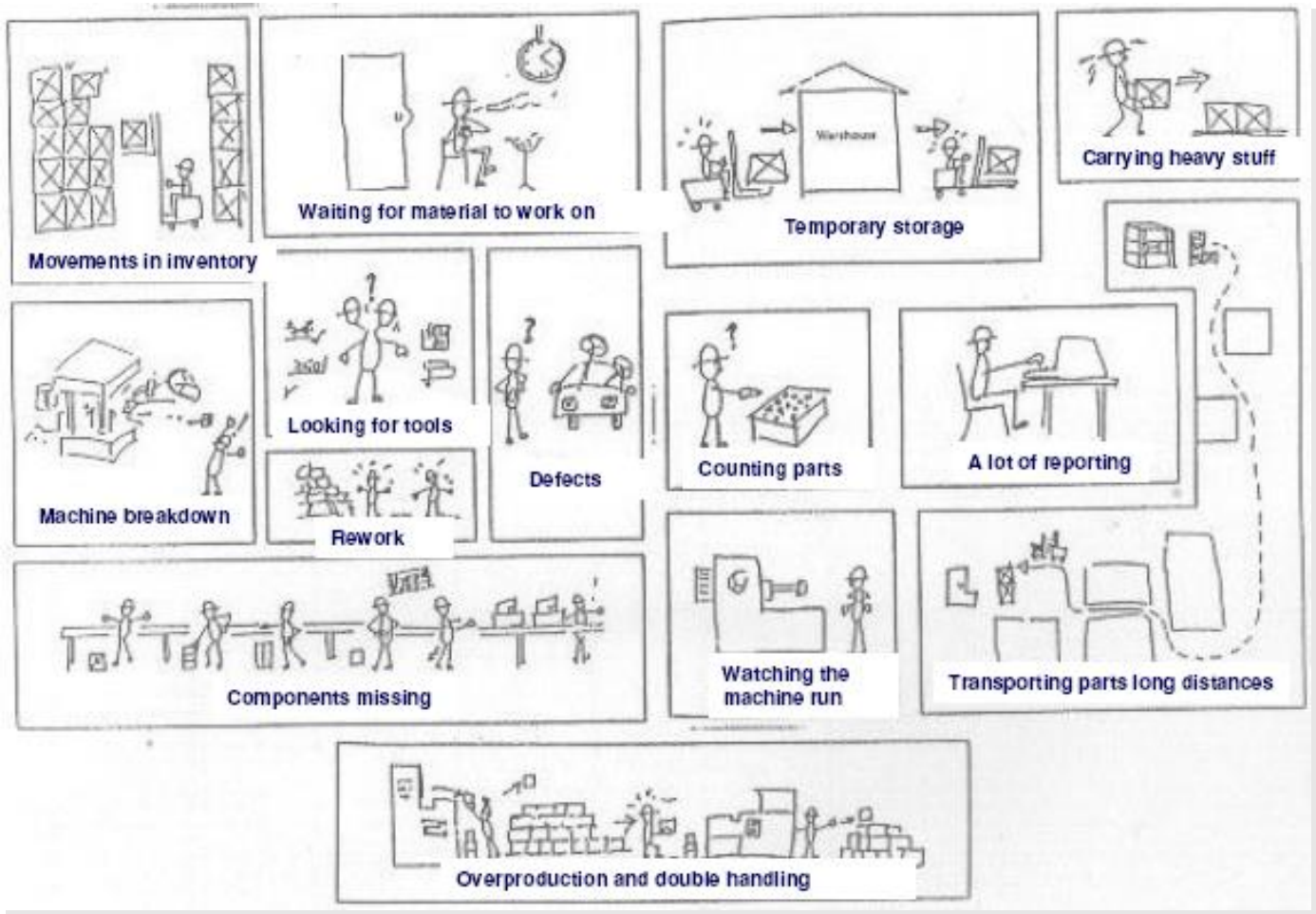


Identify the waste in the Value Stream

We point out where we see the waste in the flows to know where to improve !!

Value Stream Mapping identifies the flows and allows to highlight the ***waste***

Deployments identify the ***losses*** that generate the waste in the flows

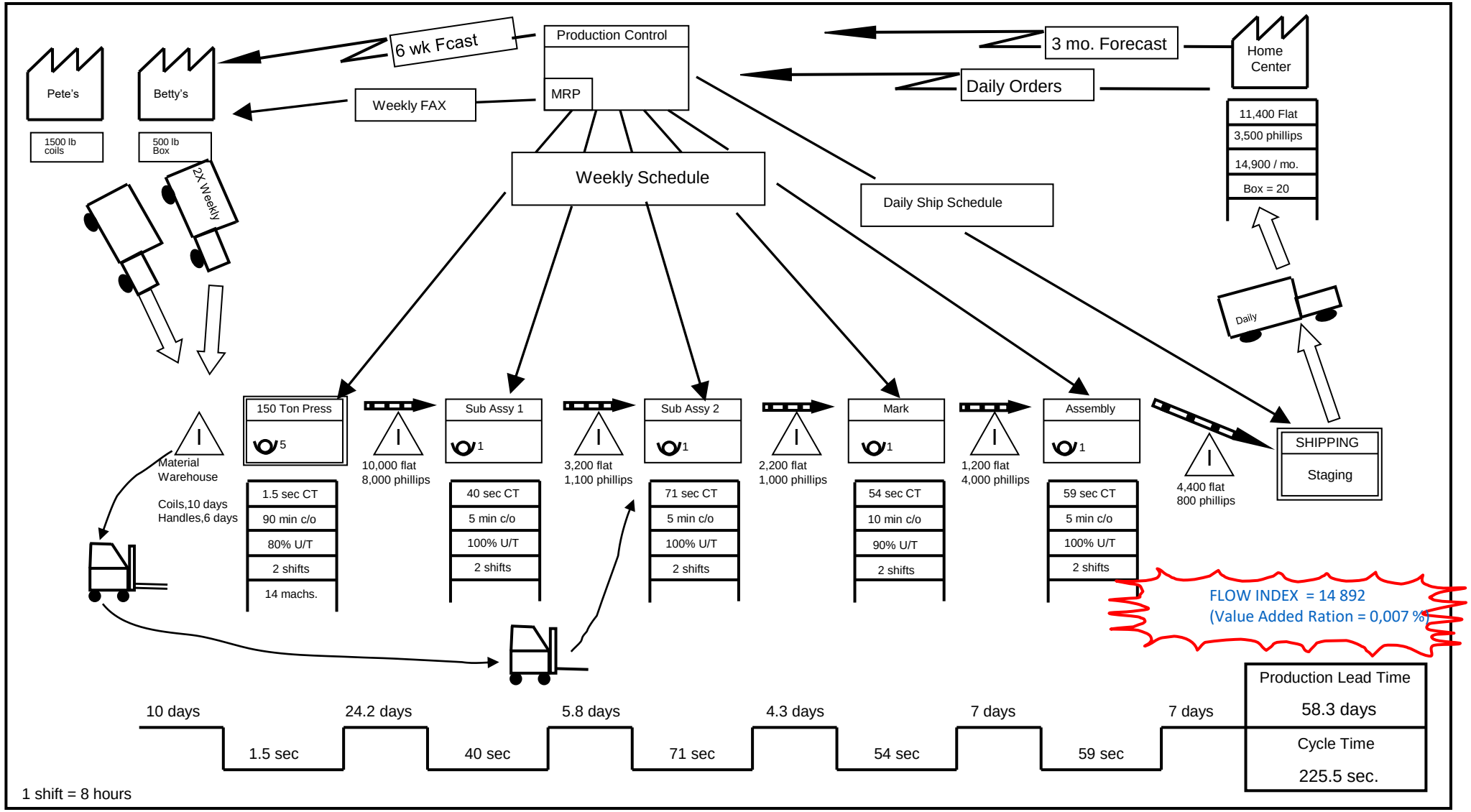
We deploy the losses that generate the waste and work to remove them !!

Root causes of the losses are identified and addressed by ***corrective actions***

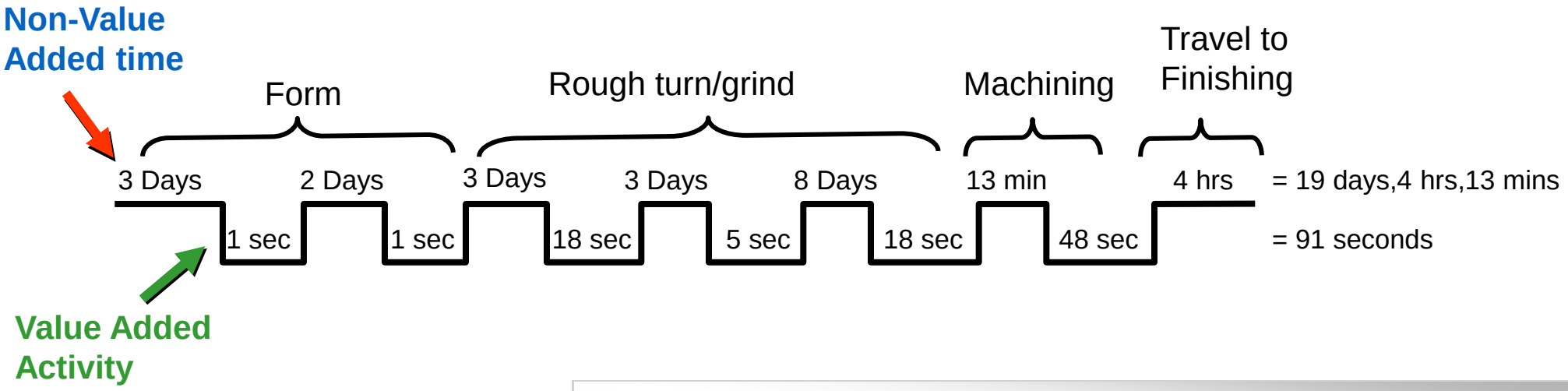
Improvement

Action plan

Current-State Map



Identify Lead Time improvement opportunity



$$\text{Flow index} = \frac{\text{Lead time}}{\text{Value Added time}}$$

Value Added Ratio = 0,02%

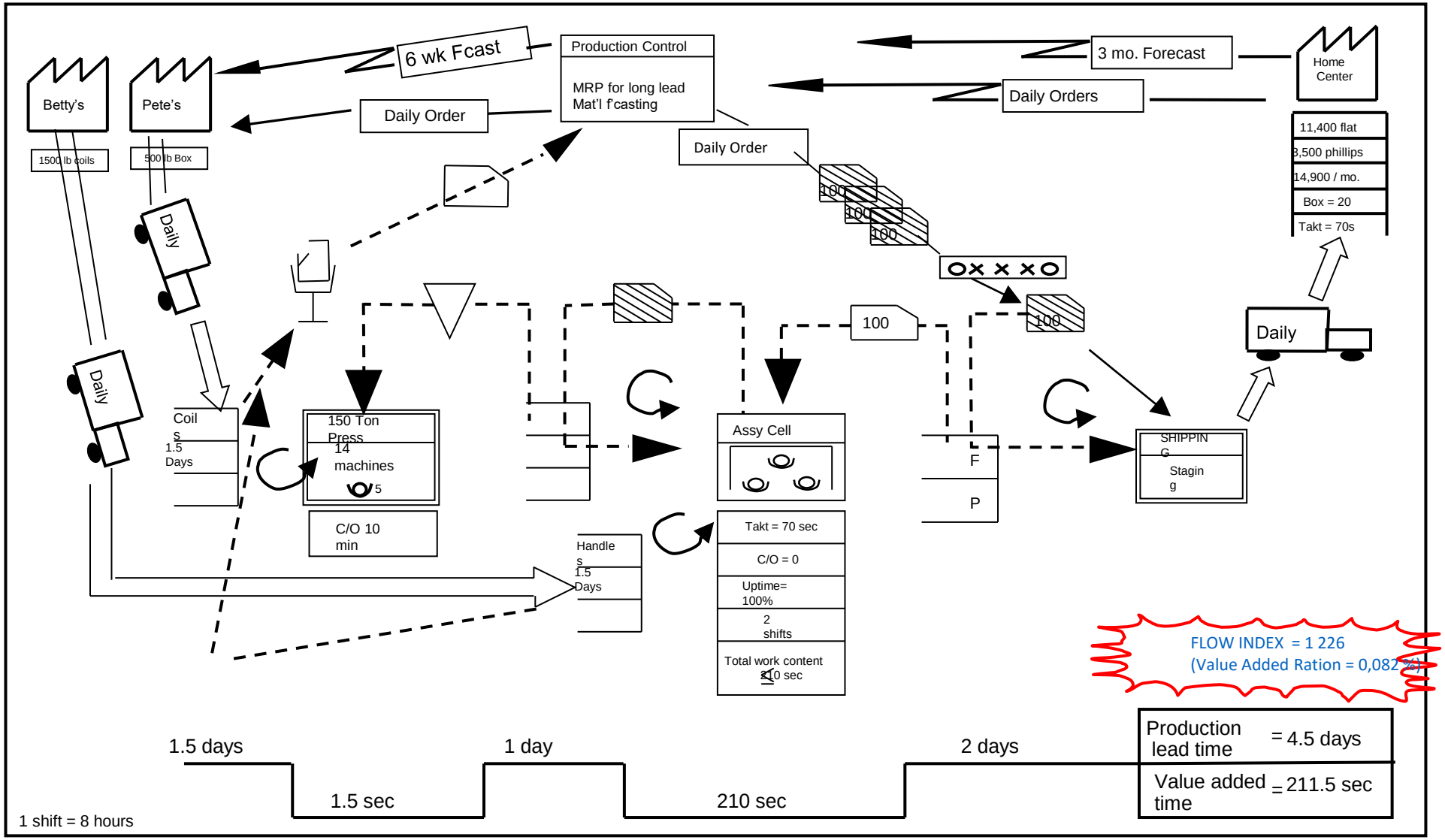
We add value less than 1% of the time

1 day = 8 hours

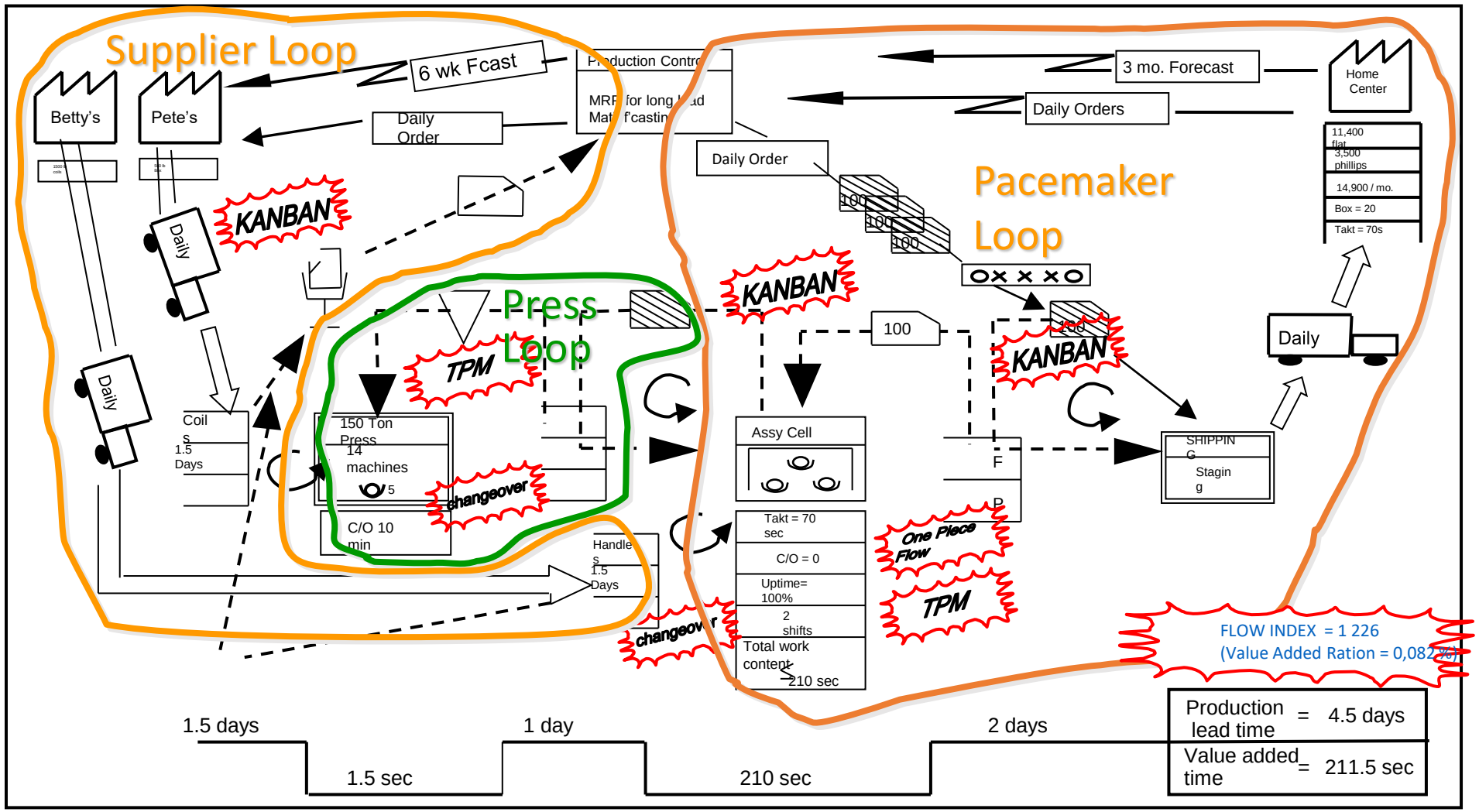
From a sample of 42 companies in the mechanical sector:

- Lead Time 100,0%
- Piece in the Machine 5,0%
- Piece under VA operation 0,9%

Future-State Map



Future-State Map: Value Stream Loops and improvement actions



Waste and losses are hidden

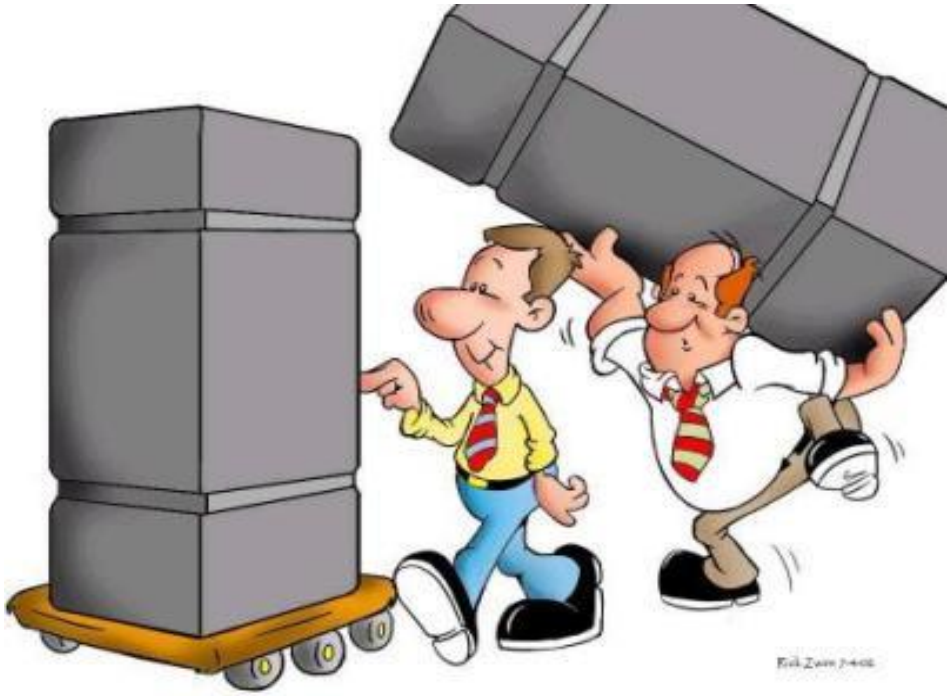
KAIZEN means Continuous Improvement

"Change for the better"

Kaizen is not something punctual,

Kaizen is not a tool...

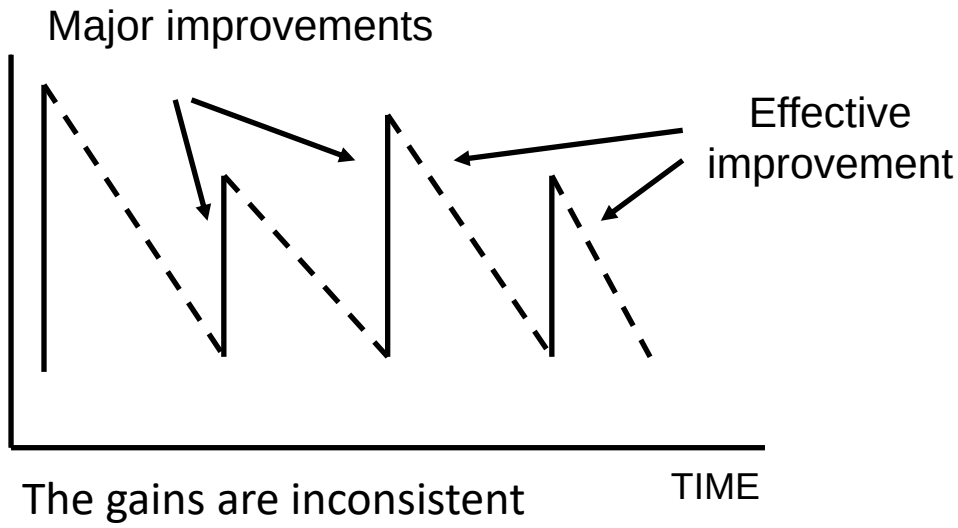
Kaizen is a philosophy and it should by part of the day-to-day



Standardisation is key

Without standardization

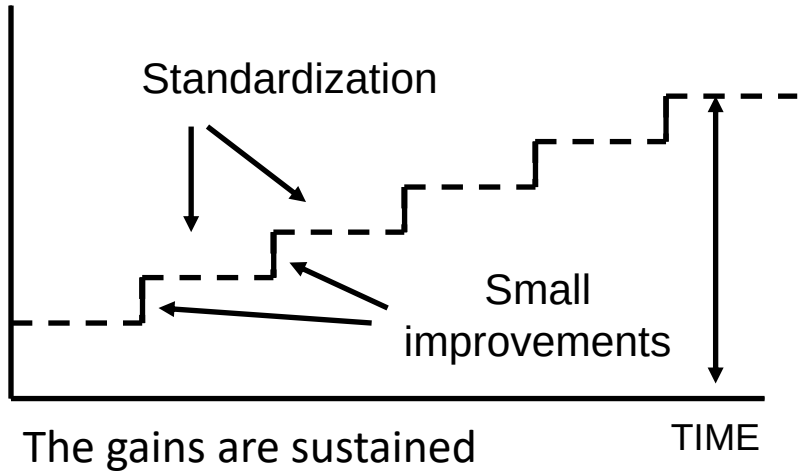
Major improvements become small with time



Repetitive improvement

With standardization

Small improvements become MAJOR gains over time



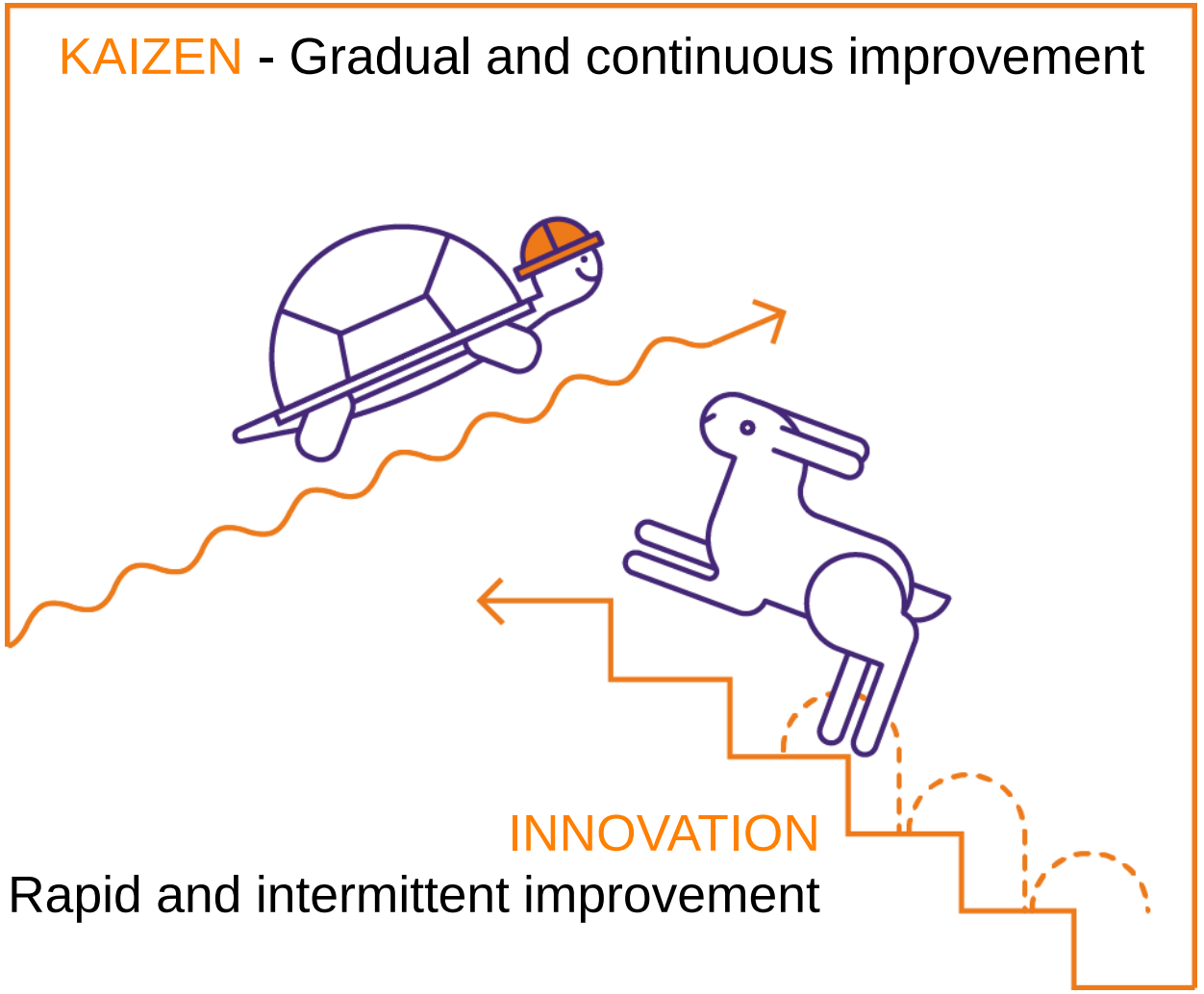
Continuous improvement

Competitive edge through INNOVATION & KAIZEN

- The concept of Kaizen
- Innovation alone is not enough
- Innovation + Kaizen represent the way to acquire a competitive edge…
- To sustain efficiently Innovation and Kaizen you need an improvement oriented organisation

The concept of KAIZEN

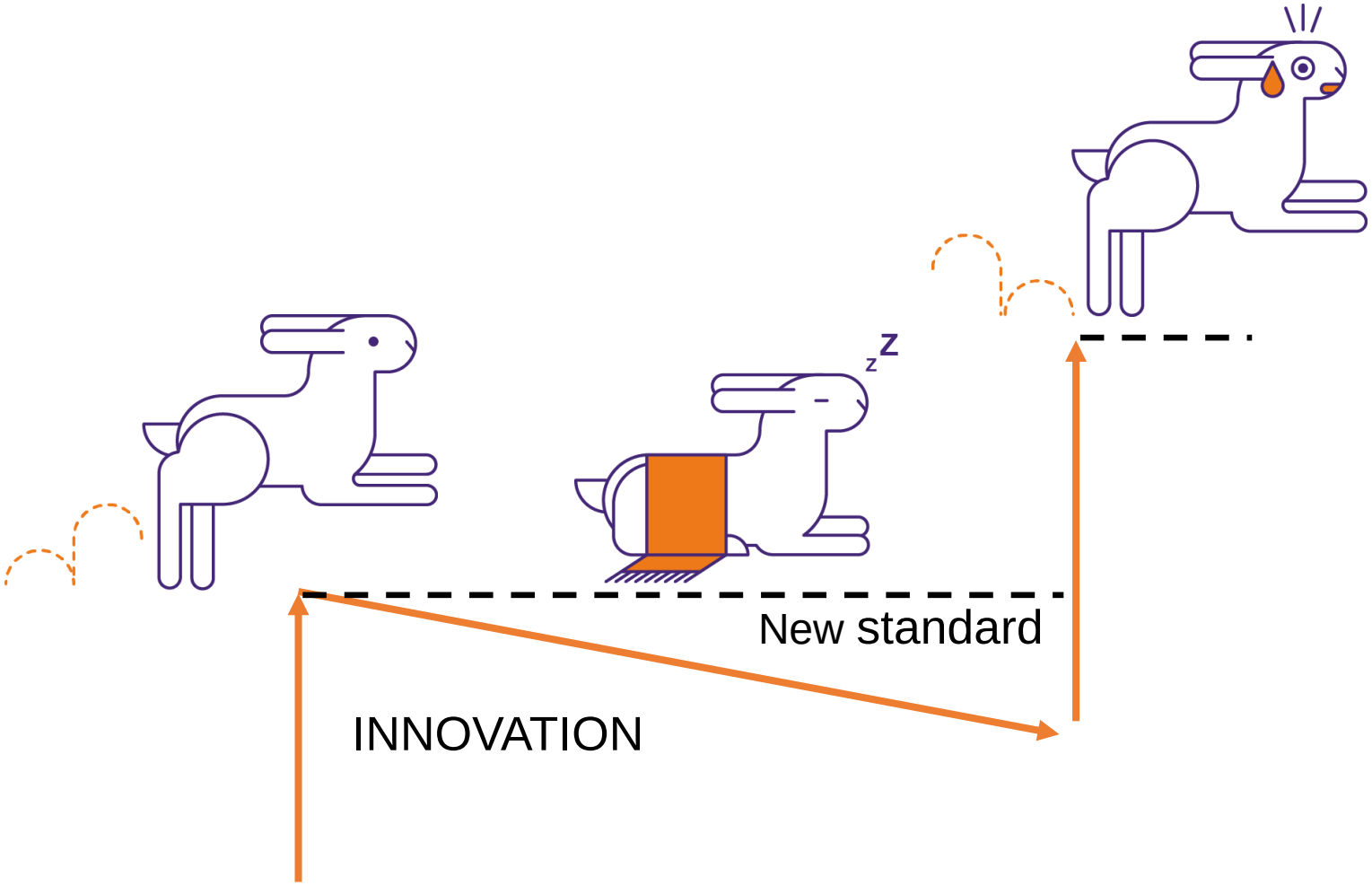
KAIZEN - Gradual and continuous improvement



INNOVATION

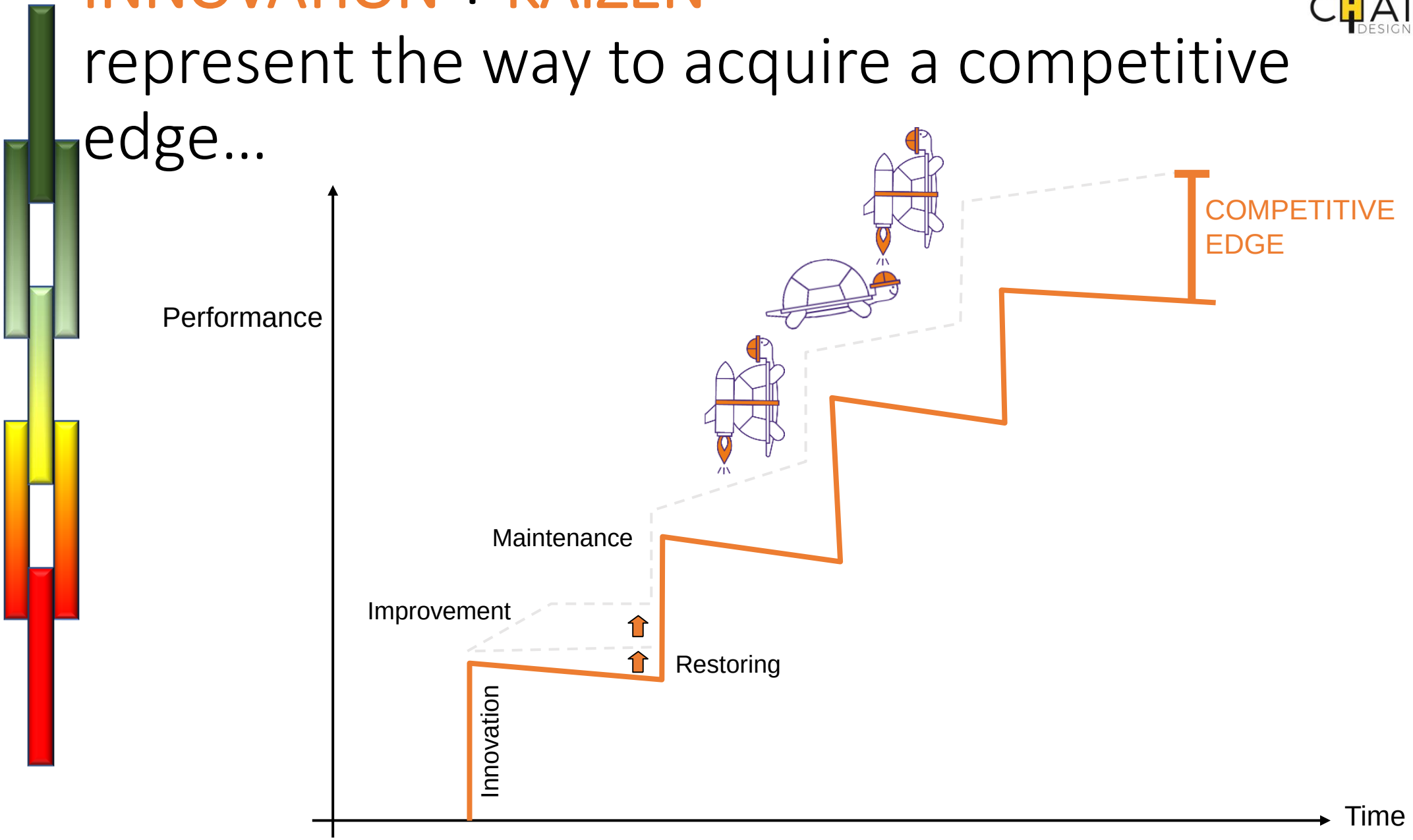
Rapid and intermittent improvement

INNOVATION alone is not enough



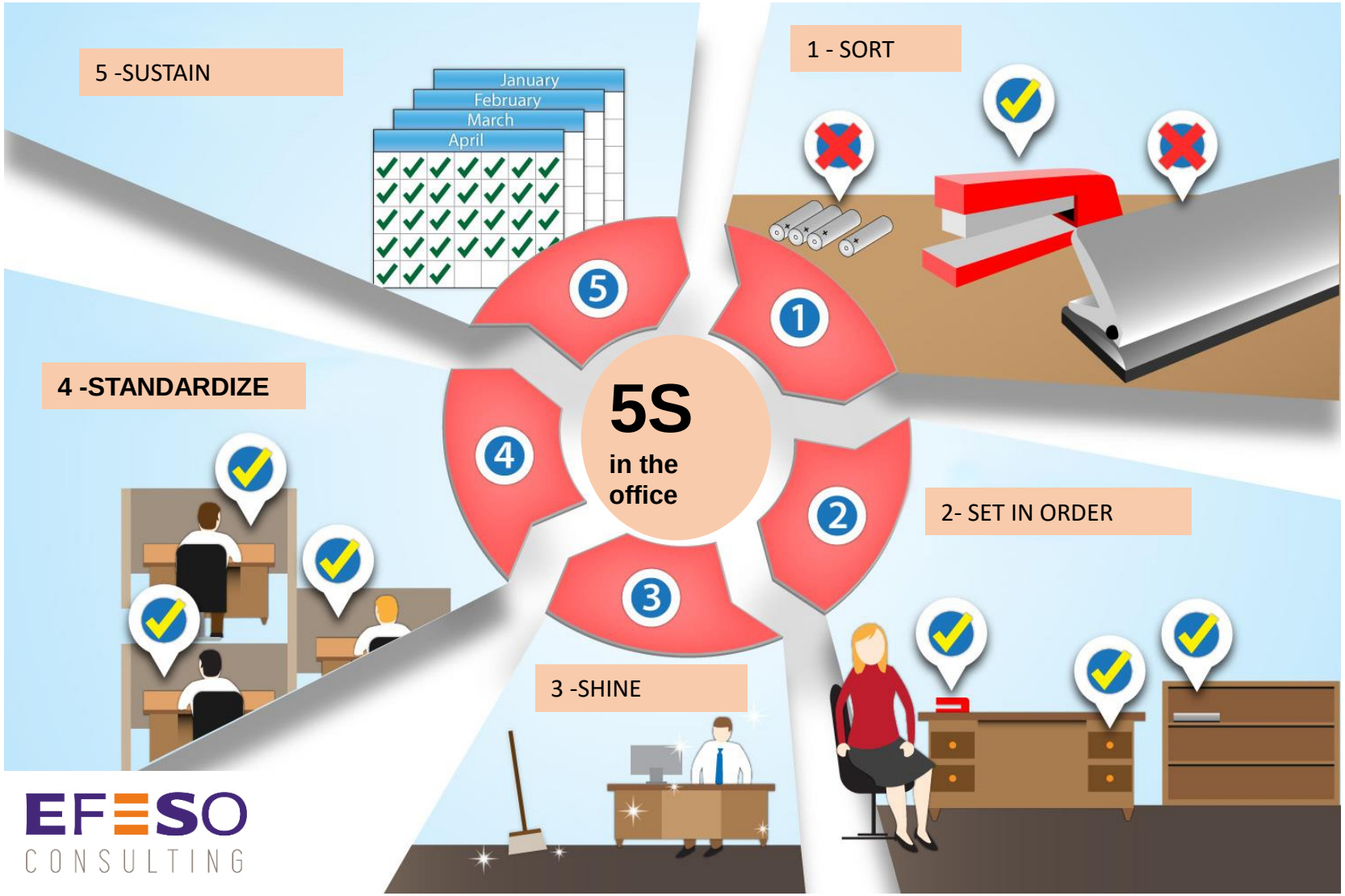
INNOVATION + KAIZEN

represent the way to acquire a competitive edge…



5S

The 5S

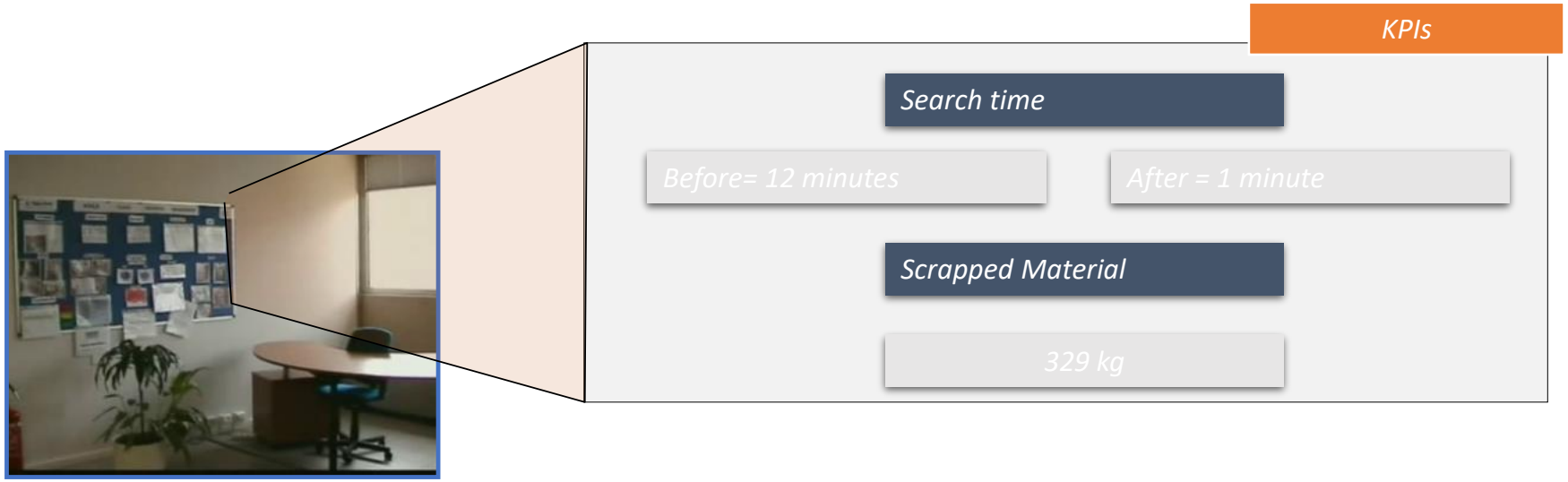

5 -SUSTAIN
January
February
March
April
1 - SORT
4 -STANDARDIZE
5S
in the
office
2- SET IN ORDER
3 -SHINE
EFESO
CONSULTING

5S progress indicators

- Unavailable surfaces (sqm)
- Scrapped material (KG/no./mc)
- Searching time (documents, files, procedure, information)
- Cleaning time
- Inspection time
- Periodical time dedicated to put in order the office and the physical and electronic archives

More indicators:

- NVA time
  - Handling
  - Waiting
  - Walking



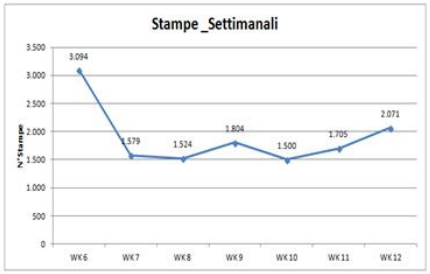
Step 1 - Sort

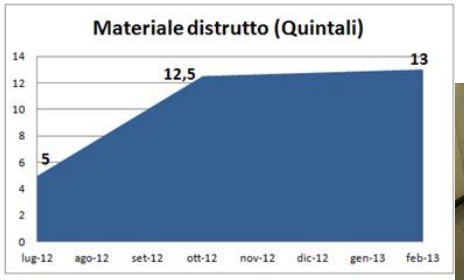
What has to be sorted out?

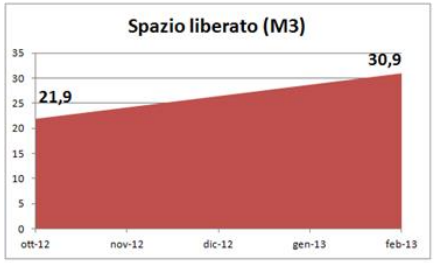
Everything that is not required immediately in the corresponding area.

How should things be sorted out?

1. "*Throw away immediately*", if objects are no longer needed.
2. "*Collecting area*" and "Tag" when no decision can be made right now.



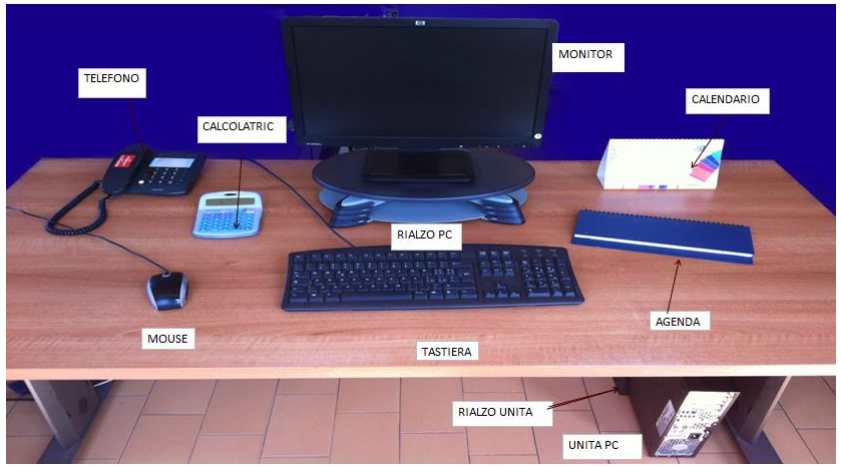


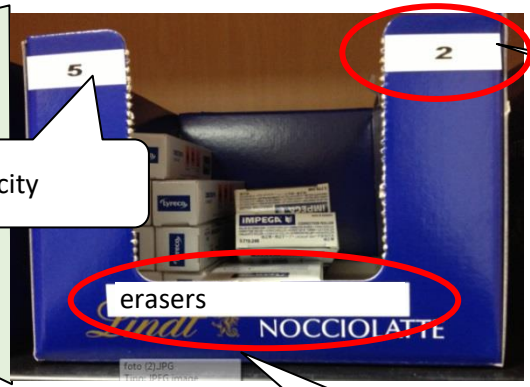


Step 2 - Set in order

Every object gets its defined place:

- best access (gun fighter principle)
- for everybody understandable (marking!)
- storage/supply area as small as possible
- FIFO-principle (First In - First Out)
- marking of max. and min. quantity





Step 3 - Shine

- Thorough cleaning of office by the employee themselves:
  - Cleaning means checking
  - Only a clean office produce quality
    - Make a list of the required standards

Step 4 - Standardize

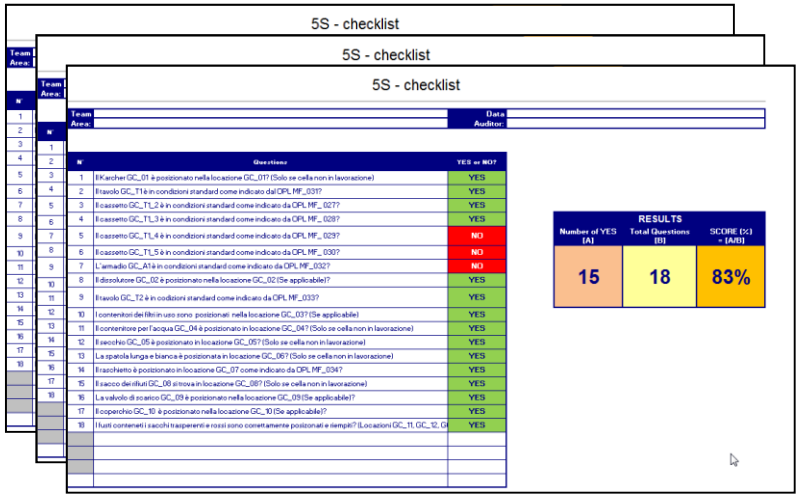
Let the ordered and cleaned state be the standard.

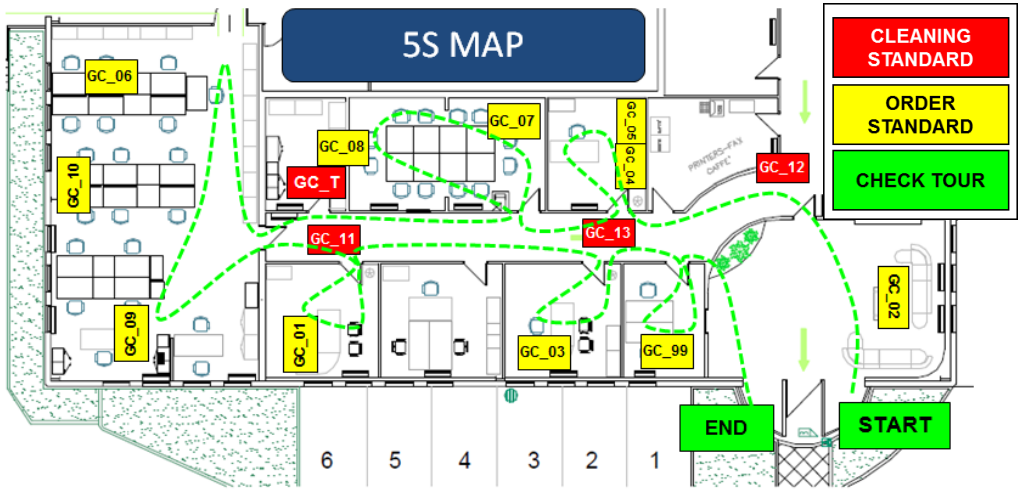
1. Visualization by shadow boards, floor markings
2. Define area of responsibility for order and cleanliness and (main) responsible person
3. On progress level: define a self audit system

Step 5 - Sustain

Maintain the improvement realized:

- We can maintain only what we have standardized
- 5S audit should take not more than 5 minutes therefore it's not easy to design a good audit system (take time for it!)
- The auditor is never the boss. It's a self audit! The auditor should be a different person every week
- If some standard isn't respected probably it's not a good standard. Let's to improve it!





SMED - Single Minute Exchange of Die/ QCO – Quick Change Over / Setup time reduction

[Formula 1 Pit Stops 1950 & Today - YouTube]

Set-up time reduction

Objectives

The importance of set-up time increases with…

- increased variables
- the decrease in the size of the lots
- introduction of Kanban control systems
- a production structure
- a flow-oriented production structure
- just-in-time responsibility with regards to customers
- short response times after customer requests
- short-term planning horizons
- reduced inventories
- full use of machinery potential
- an increased emphasis on installation efficiency
- simplifcation of the preparation process for employee work cycles

Increased flexibility

↓

Shorter cycle times

↓

Shorter delivery times

↓

Shorter response times

Reduced lot size

↓

Less production inventory and fewer finished parts in the warehouse

↓

Smaller production and warehouse areas

↓

Lower storage costs and unmovable capital

Increased plant productivity

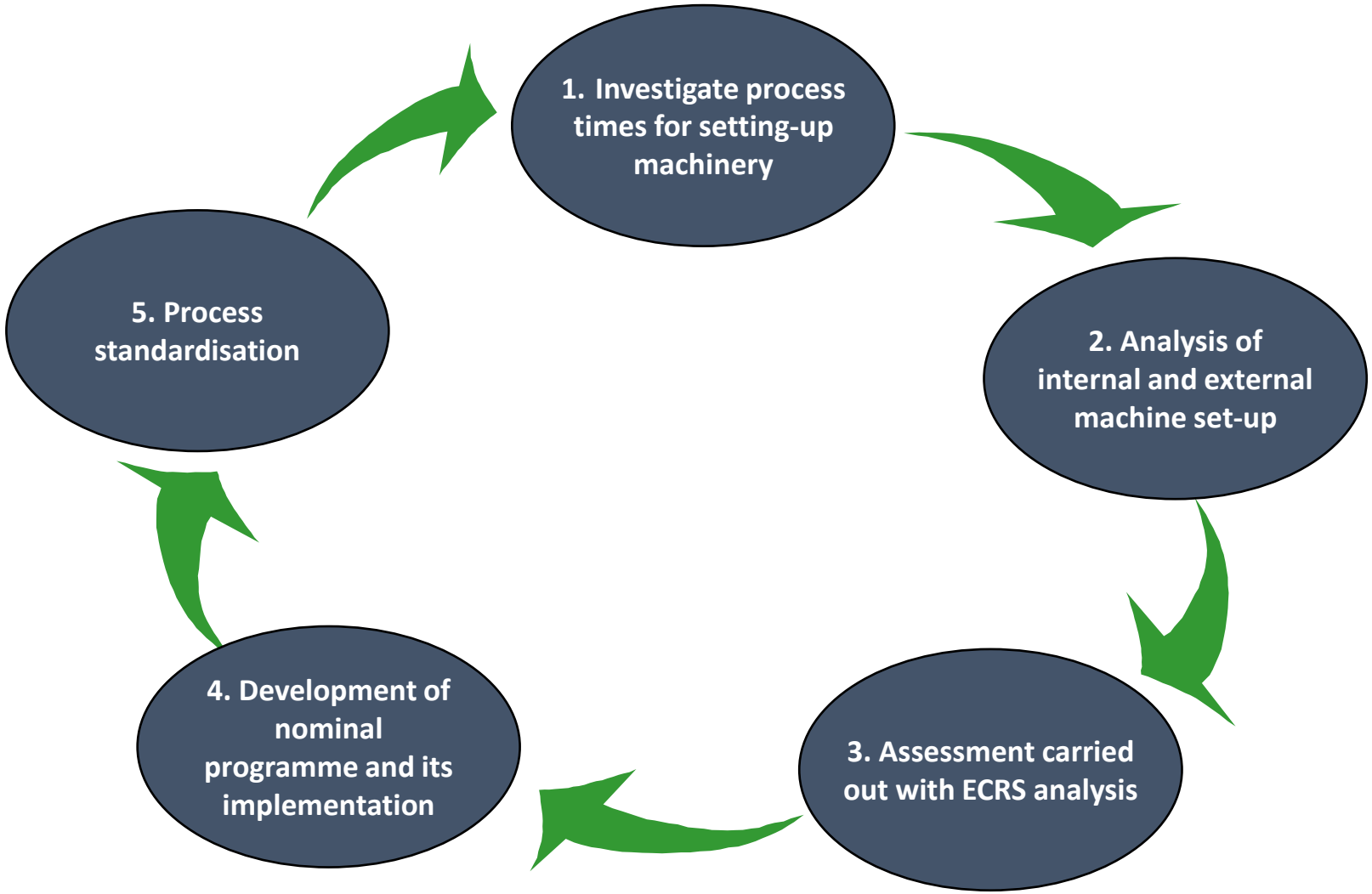
↓

Increased availability

Techniques for the SMED/QCO/STR implementation

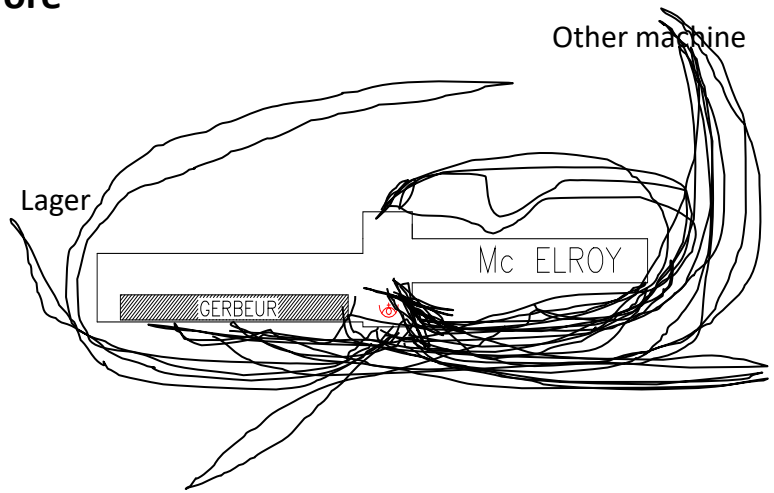
- Separate internal and external activities
- Convert internal activities in external activities
- Optimize internal activities
- Optimize external activities

SMED/QCO/Set-up time reduction

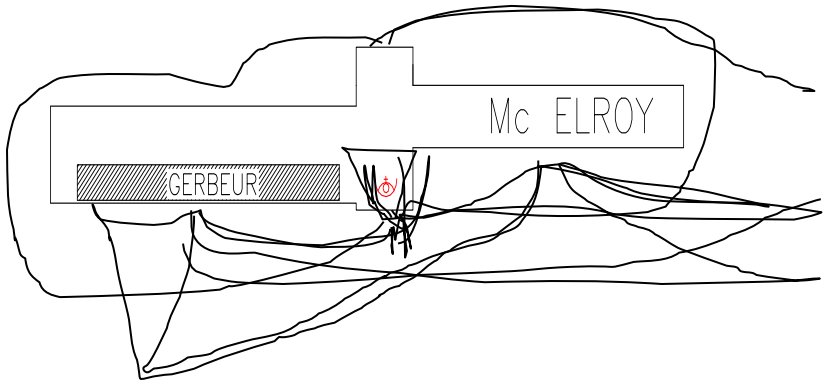


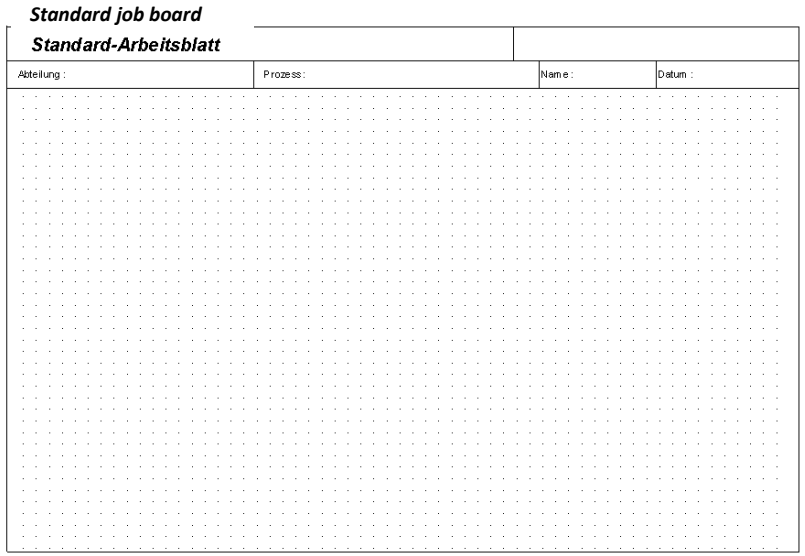
Example of spaghetti-diagram

before



after





By using a standard job board it is possible to accurately show the distances that an operator walks during the set-up process. See the sketch on the left. During the analysis of the actual timings, the distances are measured in metres.

Set-up time reduction - ECRS

Main points

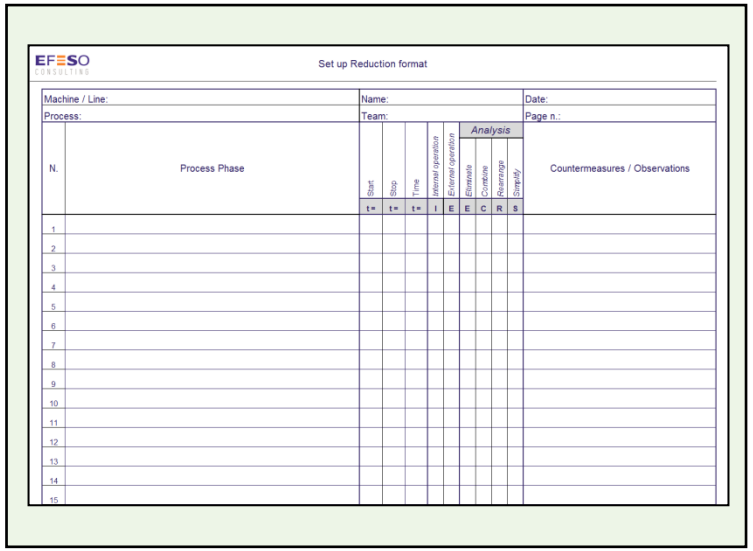
Eliminate: can this set-up phase be eliminated?

Combine: can this set-up phase be effectively combined with other phases?

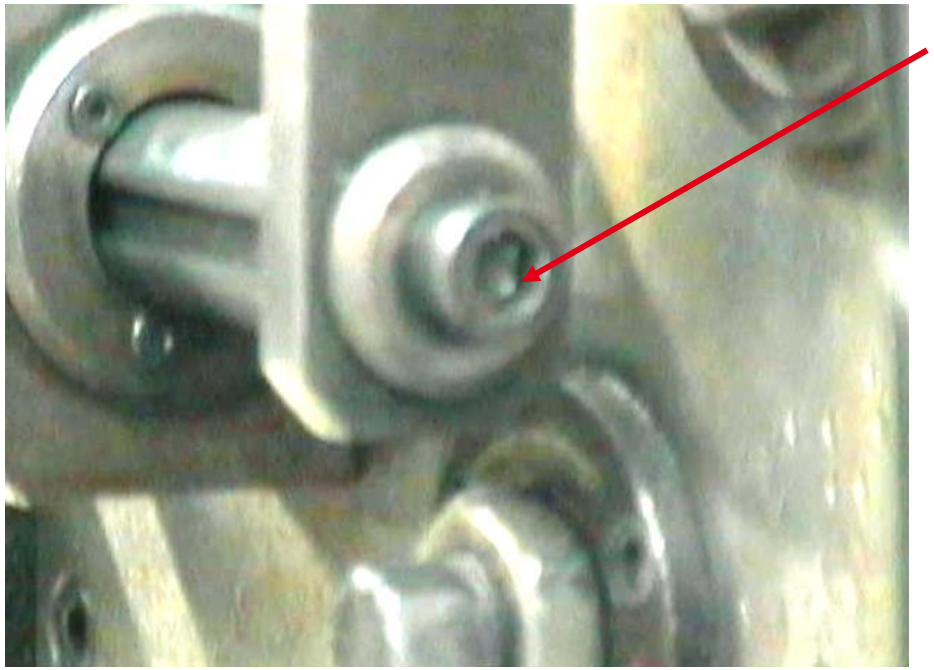
Rearrange: can this set-up phase be combined if properly modified?

Simplify: can this set-up phase be simplified with improvements?

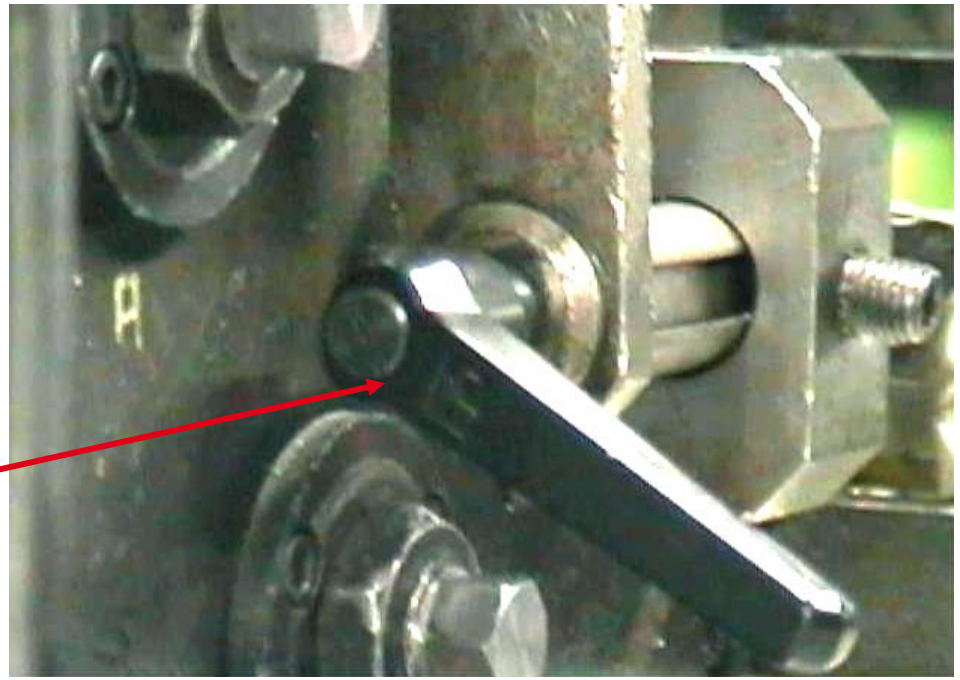
Tool



Example of simplifcation



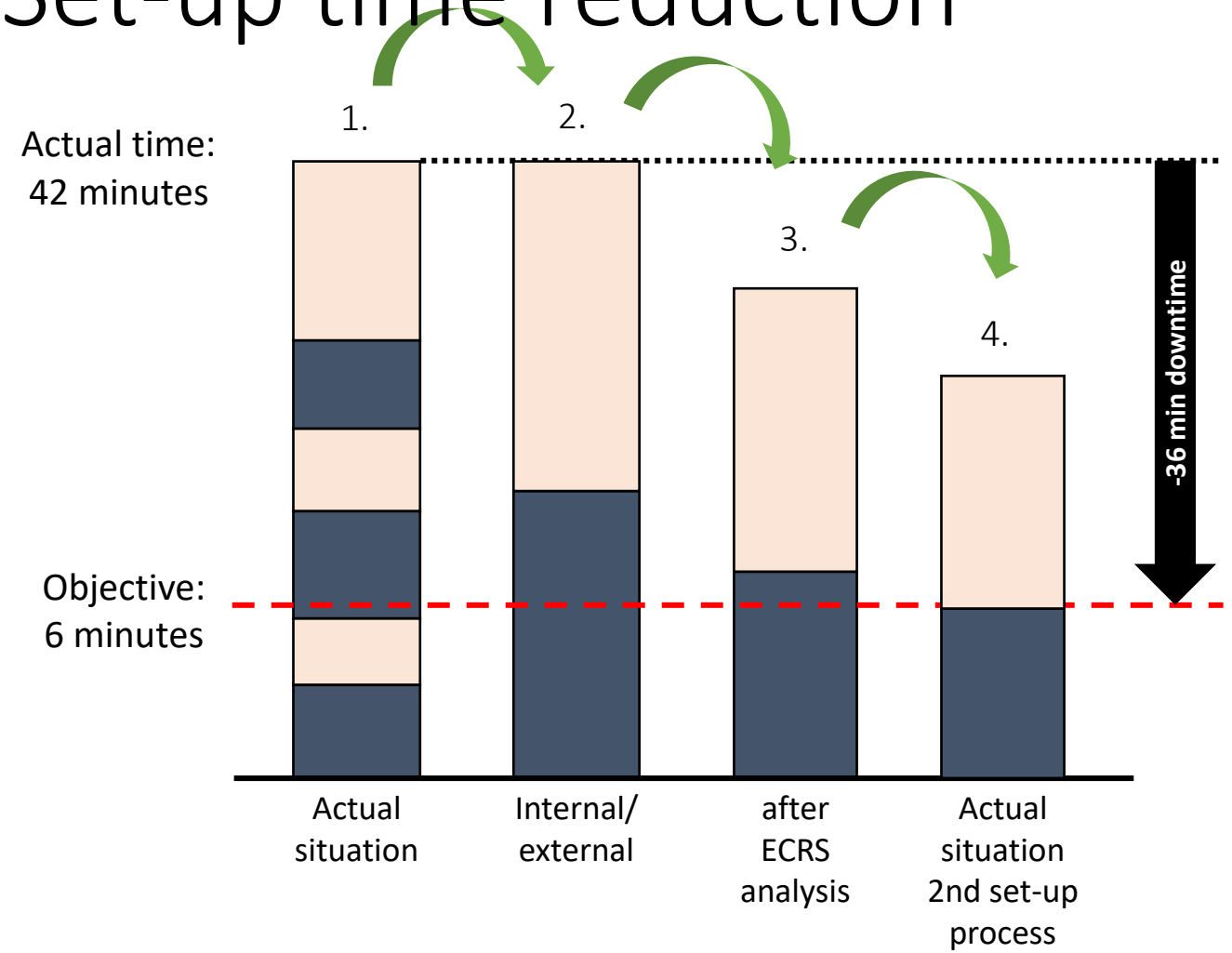
"Screws are our enemies": if possible, avoid screws



It's much better to work with quick-release fasteners:

- locking lever
- clamping device with lever

SMED/QCO/Set-up time reduction



Internal set-up: steps can only be taken when the machines have been stopped

External set-up: steps taken without stopping the machine

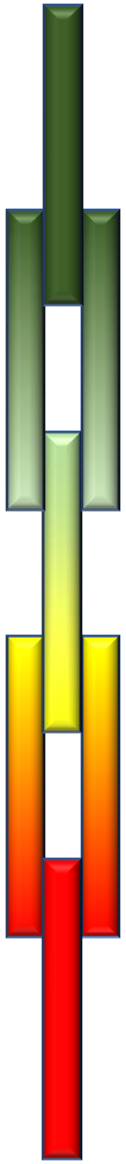
The importance of standardisation

- It guarantees that a process is always performed in the same way
- It guarantees safety

Short adaptation times 'require' the following standard procedures:

- standard process procedures (cycles)
- standard design procedures
- standard procedures for clamping devices and mechanisms
- standard control procedures
- standard cleaning procedures

Poke Yoke – Mistake Proofing

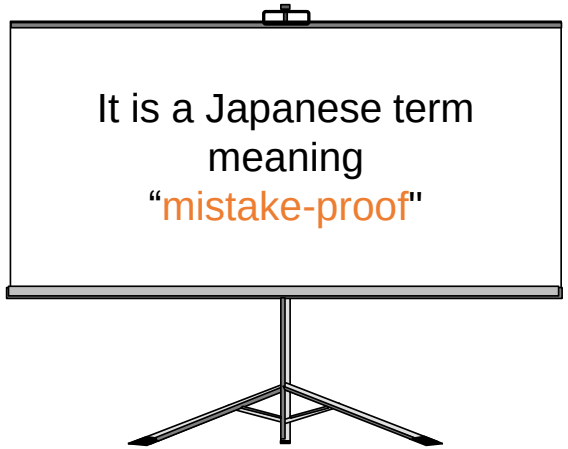


The Meaning of Poka Yoke - example

Poka Yoke

- The meaning of “Poka Yoke"
- Approach to errors
- Defects caused by human errors
- Causes of human errors
- Basic Poka Yoke functions
- Detection Poka Yoke devices
- Examples of Poka Yoke
- Exercise

The meaning of "Poka Yoke"



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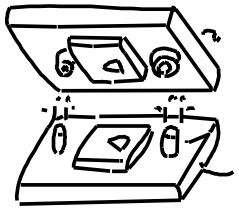


Guide pins for different sizes

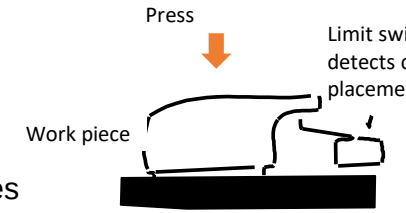
2

Error detection and alarm

These are devices that help avoid defects normally due to human errors.

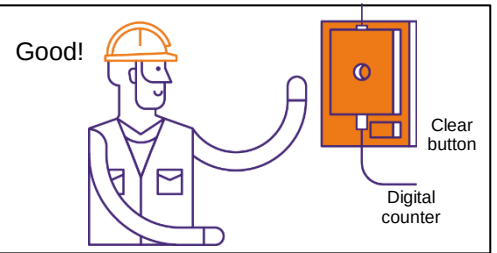
Some examples:

3



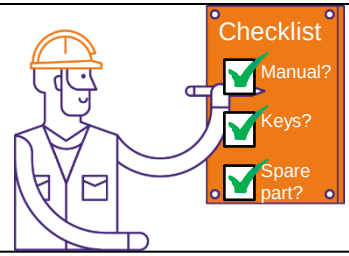
Limit switches

4



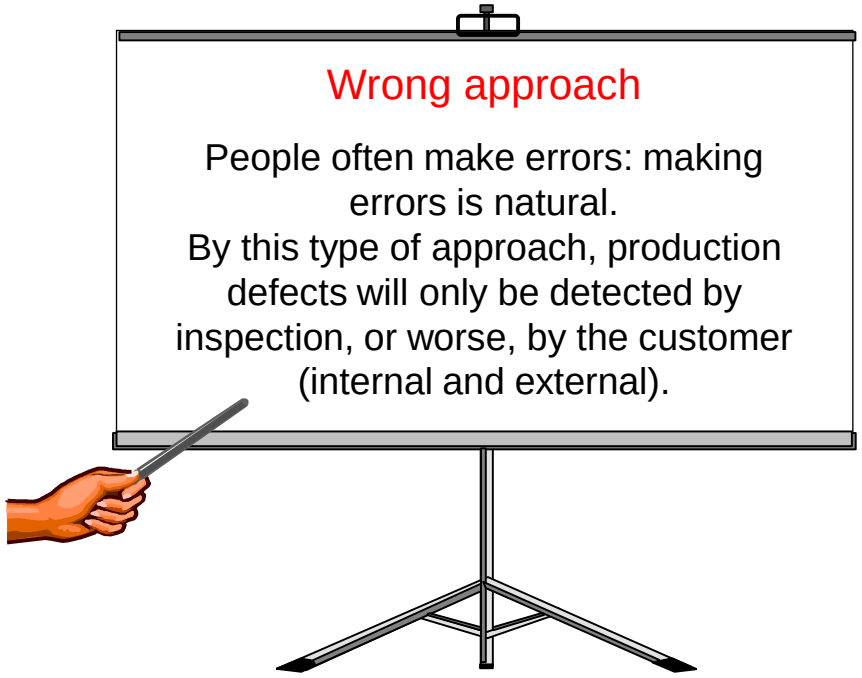
Meters

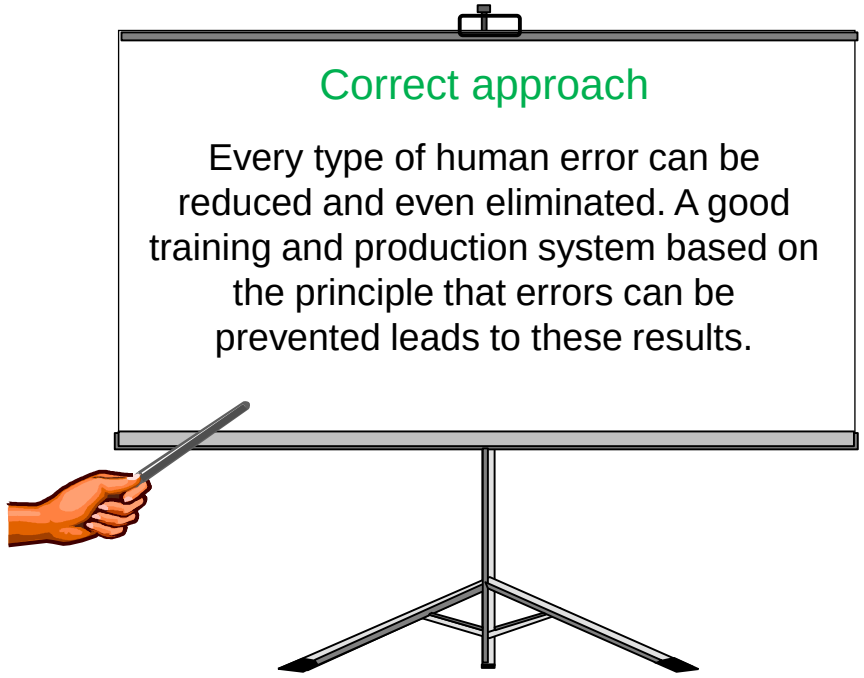
5



Check lists

Approach to errors

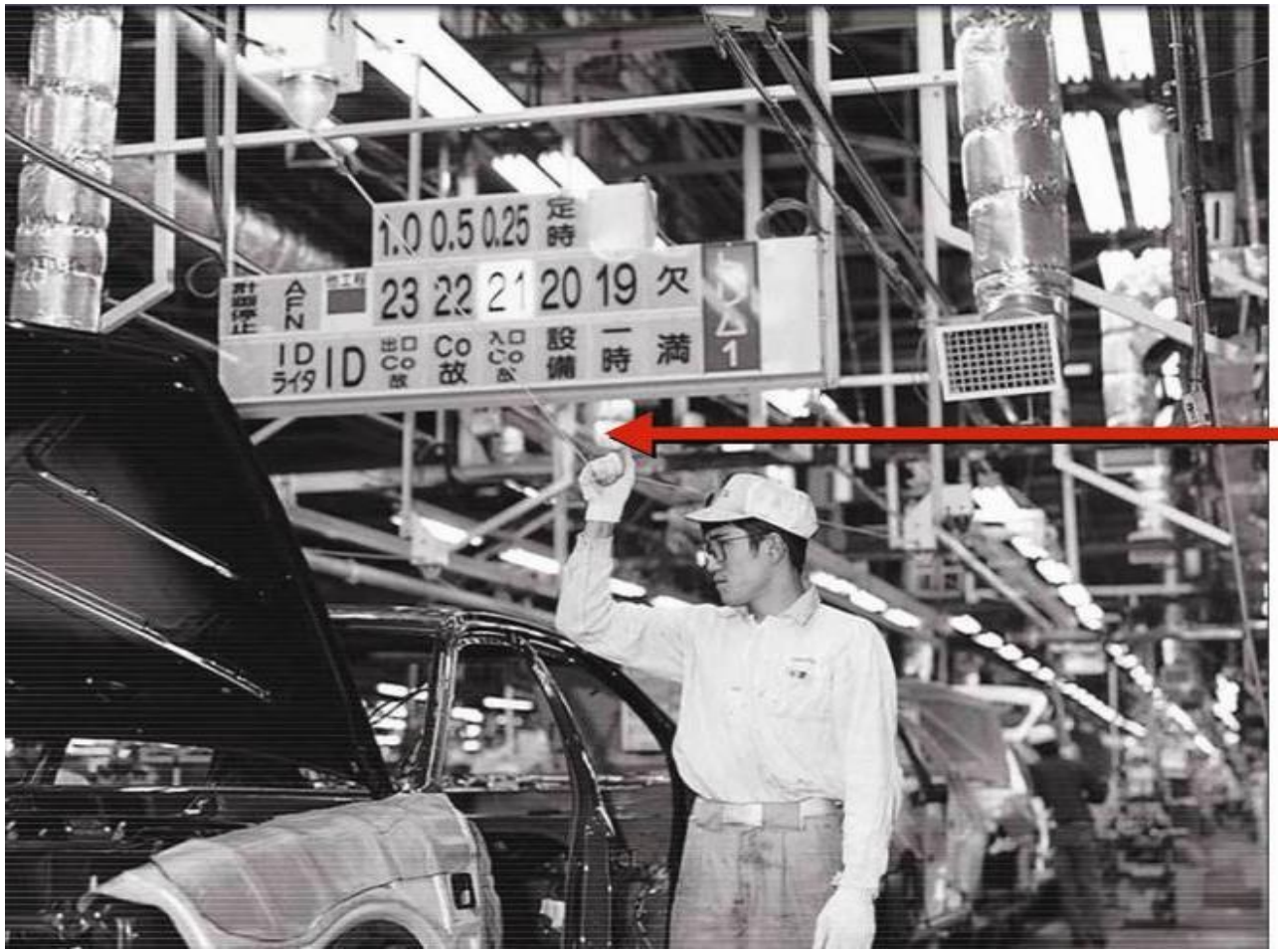




AndOn

Autonomy to the operator

Give autonomy to the operator or to the machine to stop the processing at the slightest sign of abnormality.



Core idea:

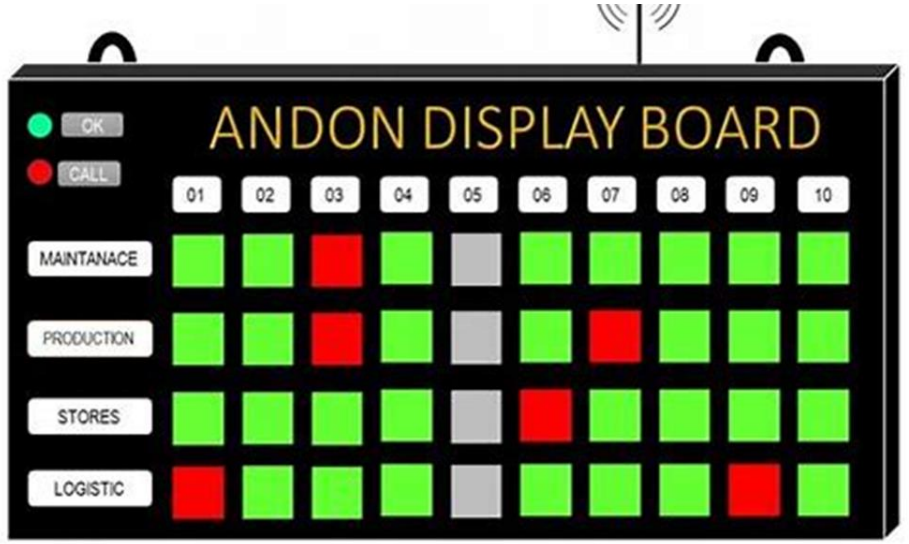
- Prevent the generation and propagation of defects
- Eliminate any abnormality in the process and in the production flow
- Increase productivity with additional human value

What Andon is

It is one of the six visual management tools used to:

- visually manage the production flow
- timely report production flow anomalies

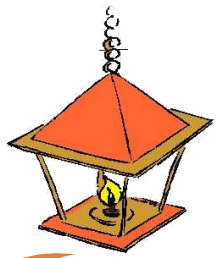
Sight and sound (light signals and sirens) are used to report production line malfunctioning.

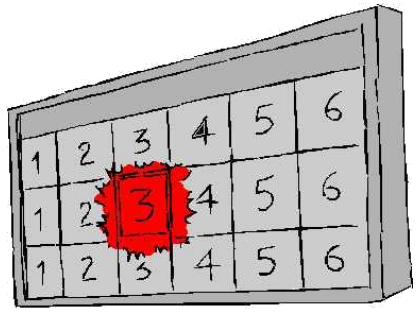


Andon: watching in order to see

In Japanese, the ideogram for “to watch” shows an eye and a hand together. This means that you have to keep watching all the time and intervene as soon as the need arises to do so..

In Japanese, Andon means “lantern”...

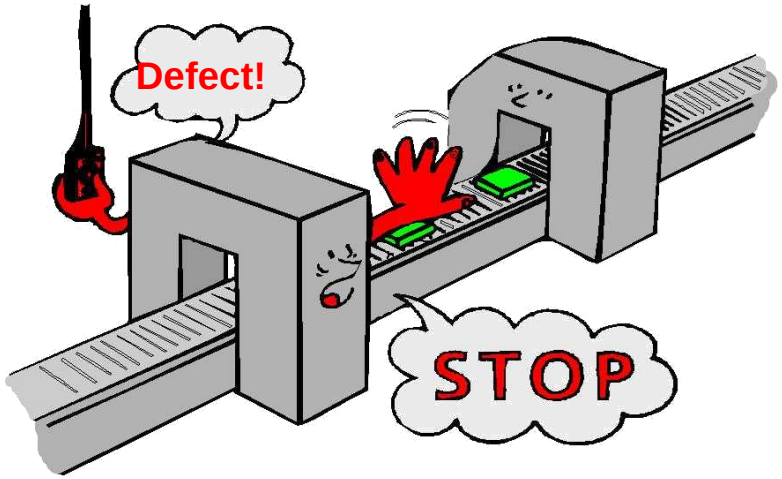




... And, in a figurative sense, it means “neon sign”

Andon devices must be located at the start of the production line (or where they can be seen by everybody).

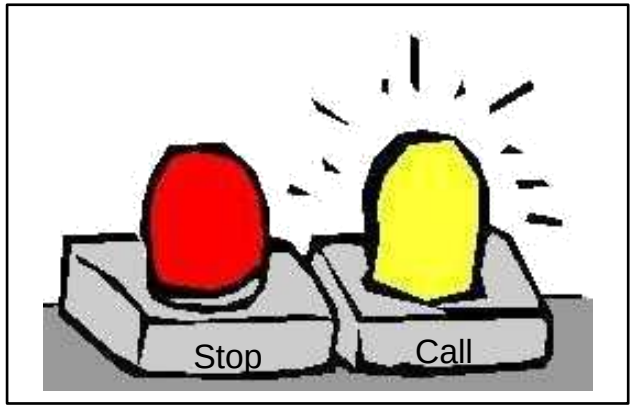
When an anomaly occurs, an operator activates Andon, reporting the need for prompt intervention by supervisors or maintenance operators.

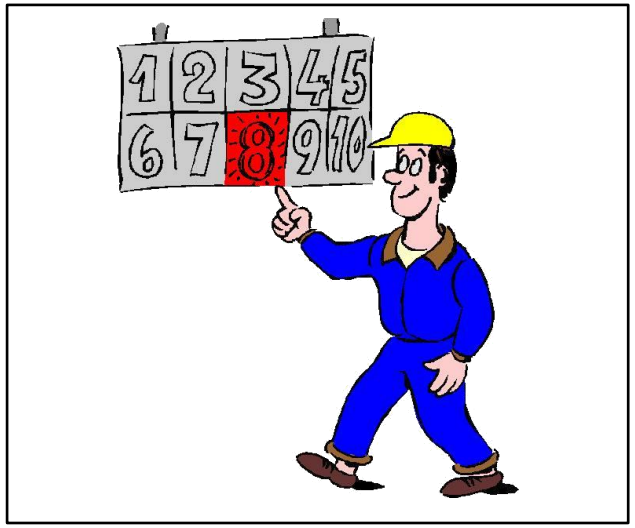


Andon components

An Andon system is made of:

- a red flashing lamp (to stop the line) and a yellow flashing light (to call for help)
- a sound signal (bell)
- a backlit board showing all manufacturing process steps and relevant tasks (quality check, cutting tool replacement, moving spare parts, machine breakdown, etc).
- a red and a yellow button, within the reach of every operator
- a green button, used by the supervisor to restart the line.

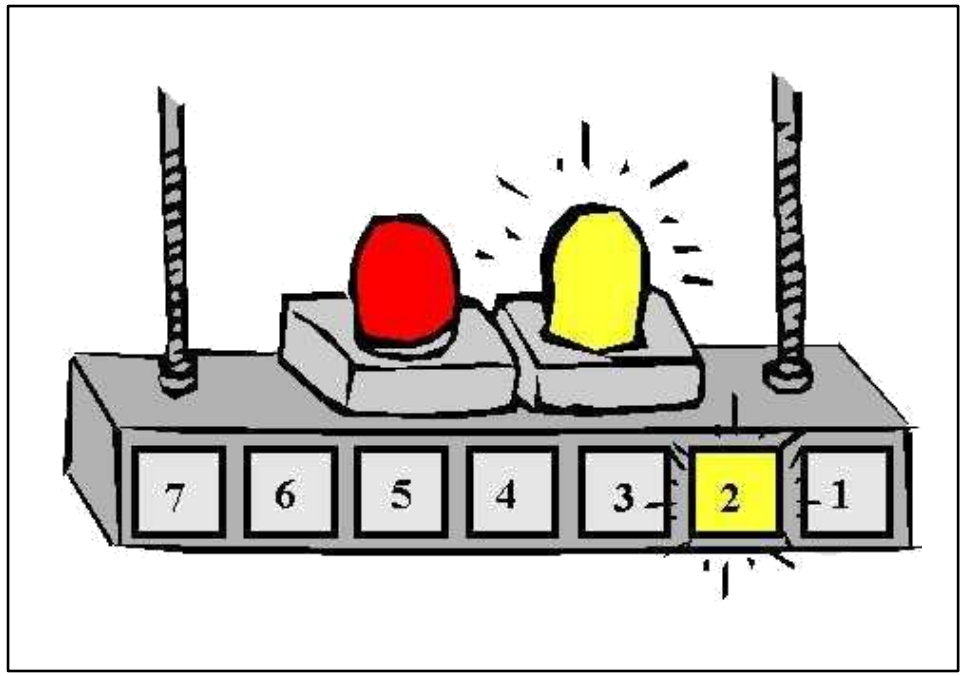




Instructions for use

Operators activate the Andon system under the following circumstances:

- Red button (line arrest)
  - unsafe operation
  - defective parts
  - machine breakdown
  - missing parts
  - processing delay (to mark the step at which the line must be stopped)
  - to prepare for set up
- Yellow button (call)
  - part supply request
  - to call the supervisor for help, temporary replacement, set up notice, etc.



Major functions

Andon line stop and call functions belong to either of three major groups:

- Checking for anomalies and reporting them to the production supervisor
- Viewing line status
- Requesting supply/support

FLOW

Pull vs Push

Push production:

- Company is unable to predict customer demand
- Company doesn't have capability to meet demand within specific time frame
- Inventory control is largely manual. Can go out of control
- Potential loss of sale through wrong SKU mix in inventory.

Pull Production:

- Company has an good idea of demand
- Manufacturing has capability to ramp up or down by 20 – 30%
- Inventory control is strong. It is kept within planned levels.
- Minimal loss of sale

Are you ready for “Pull” system

Your first steps toward establishing Lean (before using a pull system) should be:

1.Establish a 5S practice

2.Implement a total productive maintenance (TPM) program (if you are an equipment-intensive business)

3.Standardize work

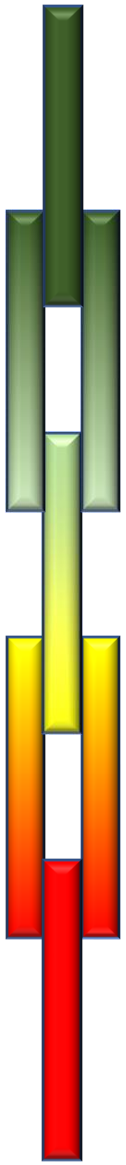
4.Instill kaizen thinking and practice kaizen events

5.Level your production

6.Establish flow by eliminating production constraints and creating flow cells

After you have completed these six steps, you’re ready to implement a pull production system.

Signal



Pull System

In the ***Pull System*****, the supplier** will produce only when there is **demand from** his customer.

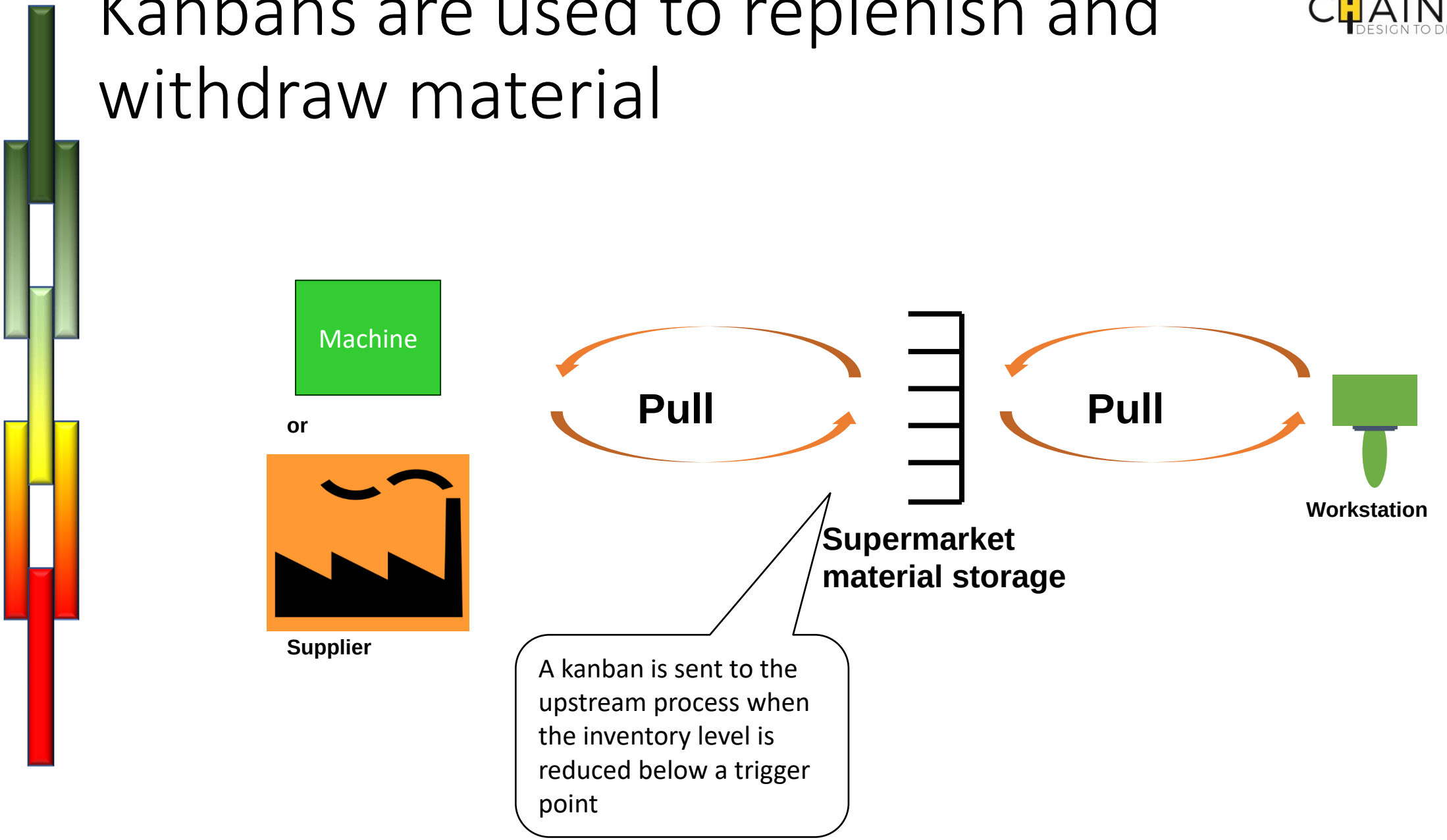
Kanban (Signal / Visual card / Sign board / Bill board..)

From the North American supermarkets → To the factory floor

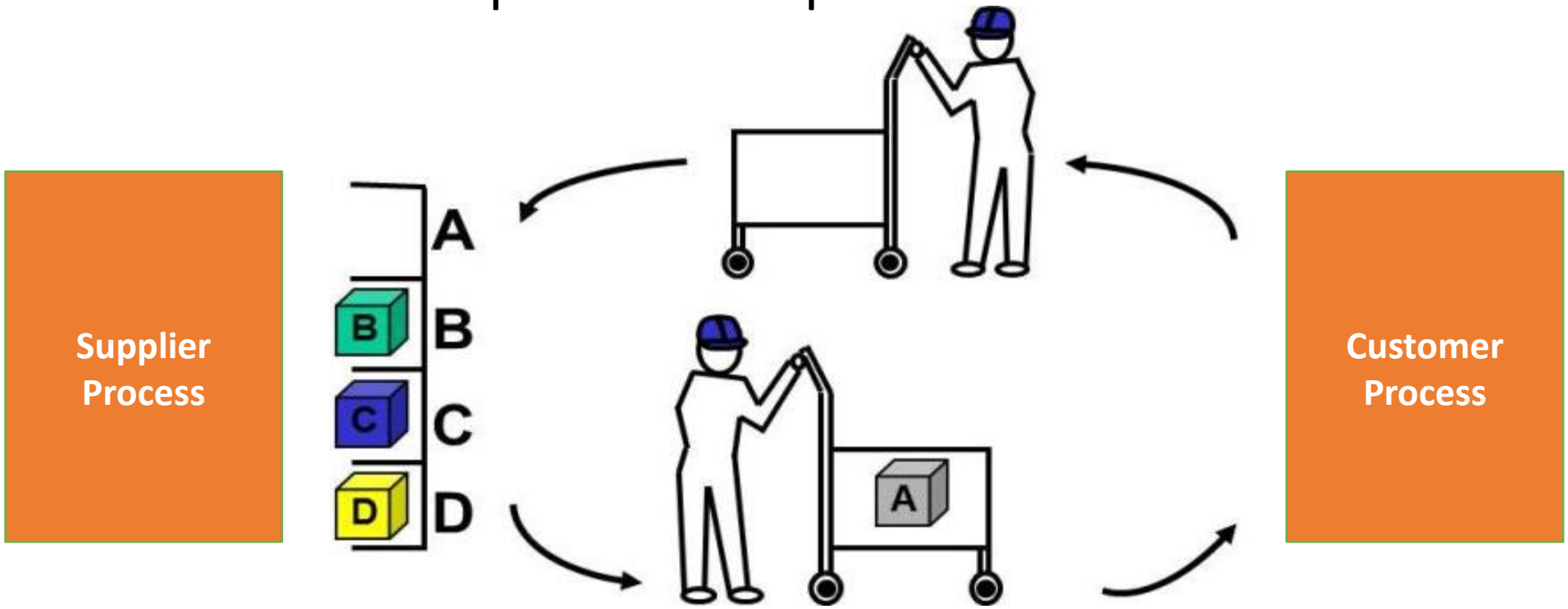
- Tool used as signaling customer-supplier
- Enables the pull system
- “Kanban is an organized system of inventory buffers” – TPS

- Currency?

Kanbans are used to replenish and withdraw material



With the use of Kanban, there is no need for a schedule of independent production



Kanban is used to optimise the inventory at any stage to the planned level.

Supermarkets are used to control the size of buffer inventory

- Supermarket is a controlled level of inventory with a specific location for each item
- It is used to buffer from one process to the next when processes, reliability, equipment or other functions don’t allow one piece flow

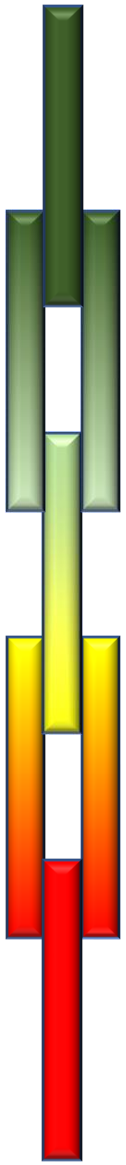
Kanban rules

- Produce only the amount withdrawn by the customer process
- Remove only the necessary material from the supplier process
- Do not send defective products to the customer process

Complex?


Wiping Solution
NON WOVEN
KITCHEN TOWEL
Wiping Solution
NON WOVEN
KITCHEN TOWEL
Wiping Solution
NON WOVEN
KITCHEN TOWEL

Kanban history and principles



- Why Kanban?

What can it do for you?

Create Transparency

- What tasks & issues are we currently working on?
- Do we have overload situations or bottlenecks?

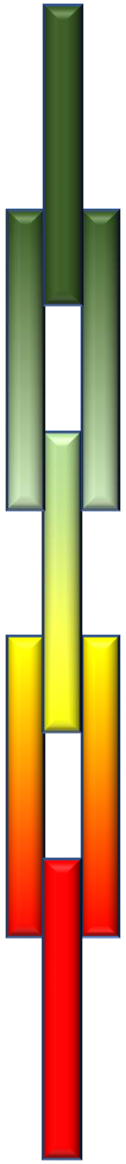
Create Measurability

- How fast can we solve issues for the customer?
- How fast are different steps

Enable educated adaptability

- How can we improve our process?
- Where should we start improving?

Kanban history and principles



Where does it come from?

KANBAN

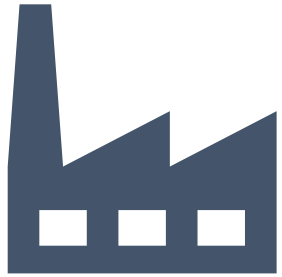
- Started in the 40's in Japan (Toyota/Taiichi Ohno)
- Created as a simple planning system, it should control and manage work and inventory at every stage of production
- The principal aim is to increase throughput, identify bottlenecks and reduce lead times.
- It became a pillar of lean manufacturing, lean development and the base of the Kanban Method

KANBAN METHOD

- An IT and software idea, first employed by D.J. Anderson in 2004
- Uses Kanban to improve development, delivery and service processes, independent of the domain

Kanban history and principles

The core of Kanban is the concept of “Flow”



Taiichi Ohno (1912-1990) introduced kanban to Toyota factories in mid-20th century

Each stage in a process sets out its wares for the next stage to choose from

Production components are pulled as needed, rather than pushed

Kanban history and principles

Kanban aims to maximize Flow, not utilization

Kanban history and principles

The six core Kanban practices

01 Visualize the flow of work

02 Manage flow

03 Limit Work in Progress (WIP)

04 Make process policies explicit

05 Implement Feedback Loops

06 Improve collaboratively, evolve experimentally (using scientific method)

Types of Kanban 1

Triangle Kanban:

- Every part / bin does not have a Kanban card
- Penultimate part has a Kanban card.
- This Kanban card is good enough to signal production to the preceding process
- Toyota used Triangle cards and hence Triangle cards

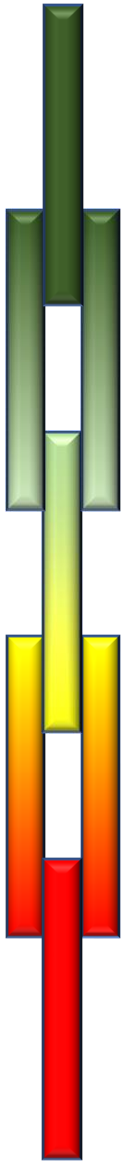
Two card Kanban: (Typically for large items)

- Every part / container has two cards
- Cards are separated at point of storage eg: super market / store
- One card is with bin at a storage location, Second used card for sequencing & with location id.

Two bin Kanban:

- 2 bins are with specific quantity of same material is the starter
- When 1 bin is completed it is sent back to preceding process for refilling – same material & quantity
- In a flow system the 2 bins are rotated

Types of Kanban 2



Production Kanban:

- Basic type
- Signals the need to produce

Withdrawal Kanban:

- For movement
- Alert that item is ready for movement
- Sent back to prev section once consumption starts
- Eg: store to line

Supplier Kanban:

- Adaptation of previous type to suppliers

Emergency Kanban:

- Used in case of emergencies eg: defectives

Express Kanban:

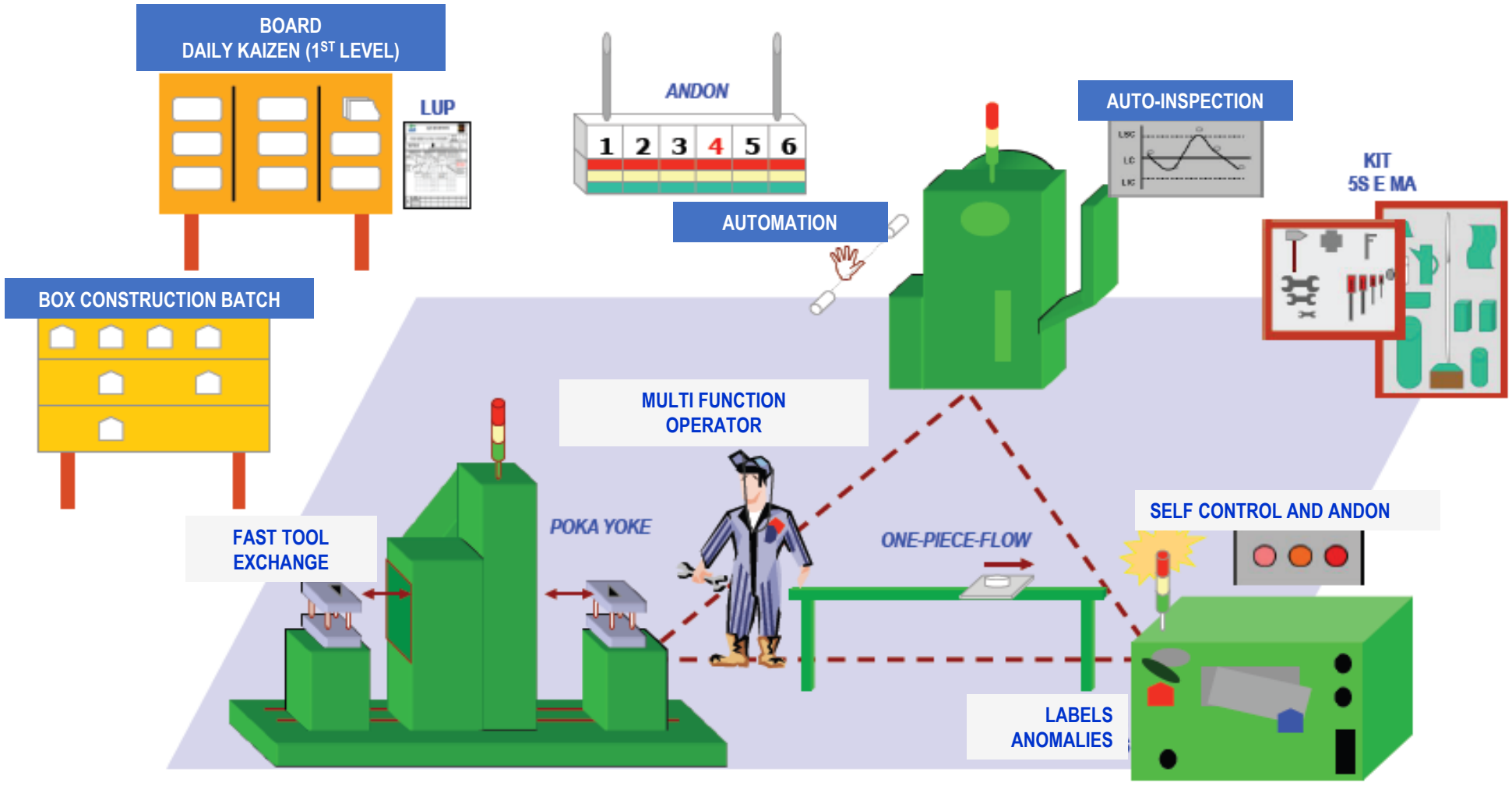
- Rarely used
- Used in cases of shortages
- Extreme cases of very high market pull for a SKU
- Rush spares requirements

Through Kanban:

- Combination of Production & Withdrawal Kanban
- Used when supply & user teams are working in close proximity
- Eg: Sub assembly line to Final assembly line

:

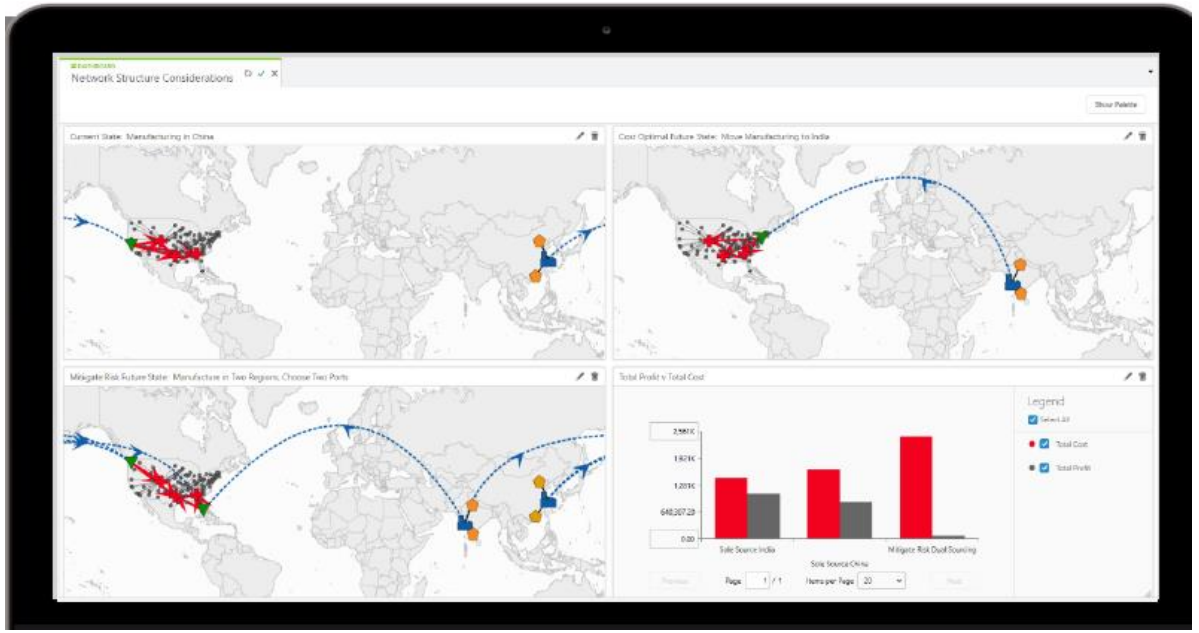
Lean - practical Application on the plant floor



Create a digital twin of the Value Chain

Implement a decision-making process that is capable of being effective under uncertainty conditions and use it to stress-test and simulate possible alternative configurations

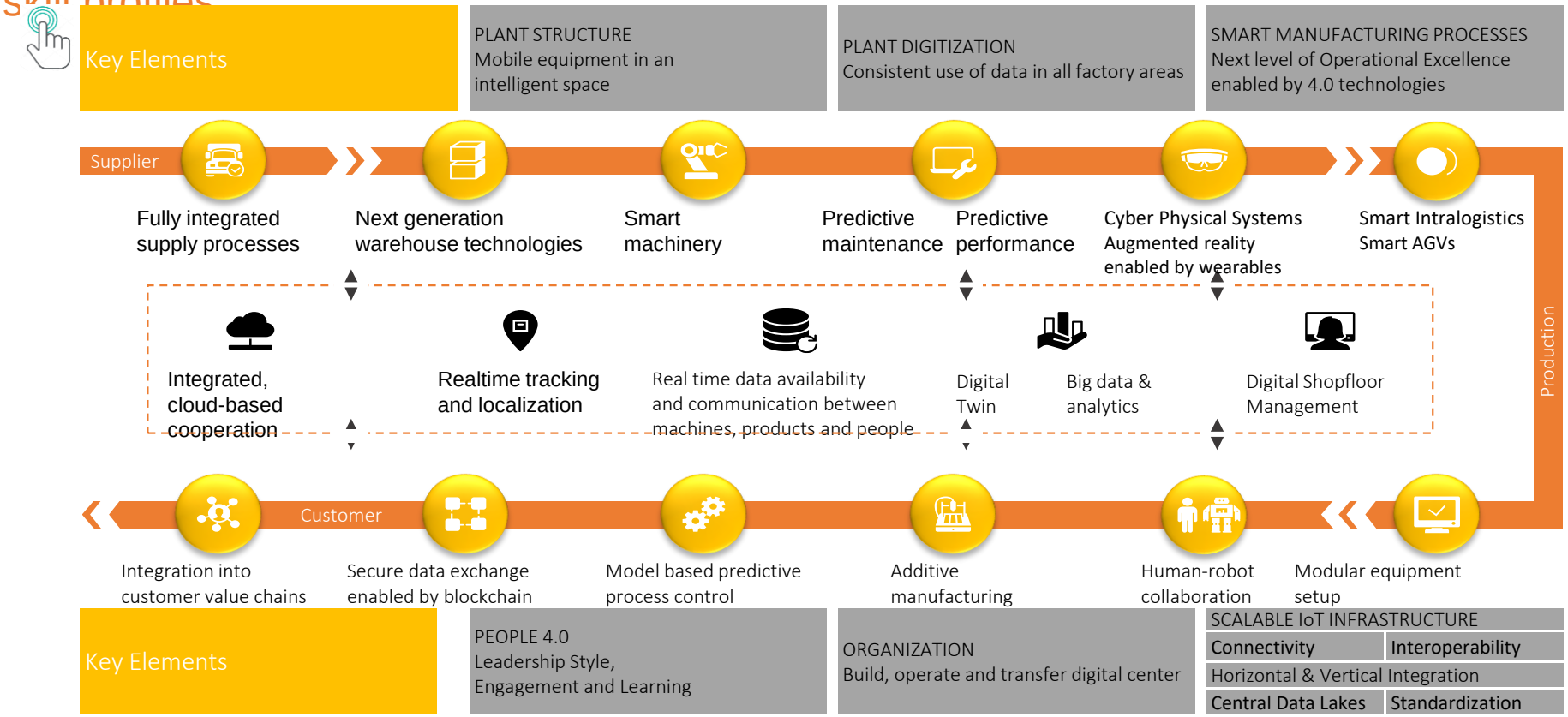
- Develop your models, data analysis and scenarios to enable you to evaluate risk and develop playbooks for quicker adaptation amidst disruption.
- Application that brings risk and resilience analytics for contingency planning to the broader organization
  - Perform financial and liquidity stress-test and conduct rolling forecasts
  - Engage with shareholders and assess vulnerability
  - Revise target-setting and objectives (e.g. sales targets, production plans, KPIs)
- Communicate financial resilience to key stakeholders



React quickly to new variables, on the shortest of notice, with models to quickly determine the best response

Organization redesign based on the Ideal of a “Factory of the Future” …

Design “Value- & Zero-based” organization and align processes; Develop new capabilities and skill profiles



THE CHAINWORKS™
DESIGN TO DELIVER

THANK YOU FOR YOUR ATTENTION