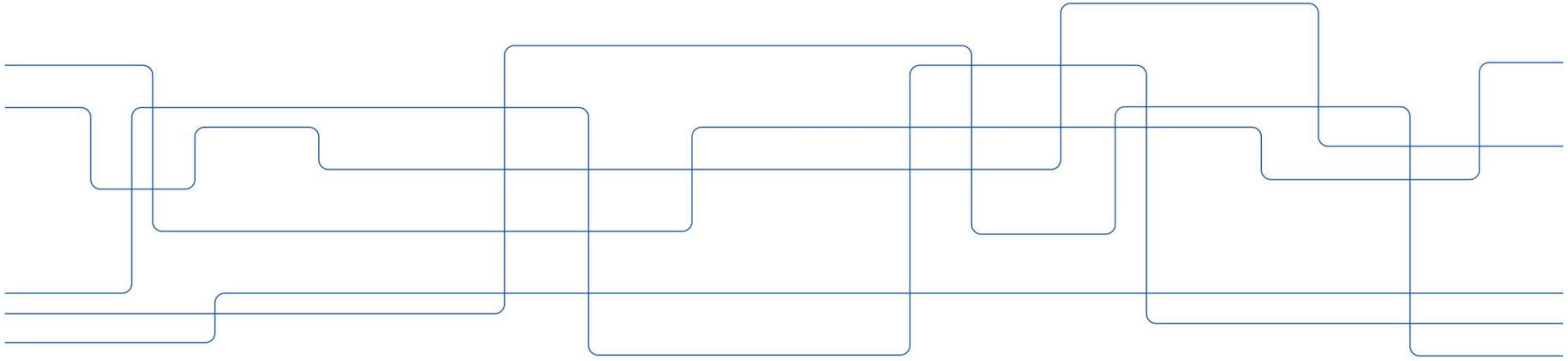
KTH ROYAL INSTITUTE
OF TECHNOLOGY

Lean Production - part 1

Lecture in M2, w36 Thursday 2023-09-07,10:00 – 12:00

Johanna Strömgren & Malin Pops Runsten



Learning objectives Lean Production 1

At the end of this lecture, you should be able to;

1. Express the concept of lean with the theories behind,
2. Consolidate fundamental principles of lean,
3. Define waste and value & differentiate 7+1 types of wastes,
4. Discuss Toyota Production System (TPS) and its constituents (Lean tools).

Agenda

Lecture 1

- Brief history
- Toyota Production System, TPS
- What is lean philosophy?
- Values & Waste
- Value Stream Mapping, VSM

Lecture 2

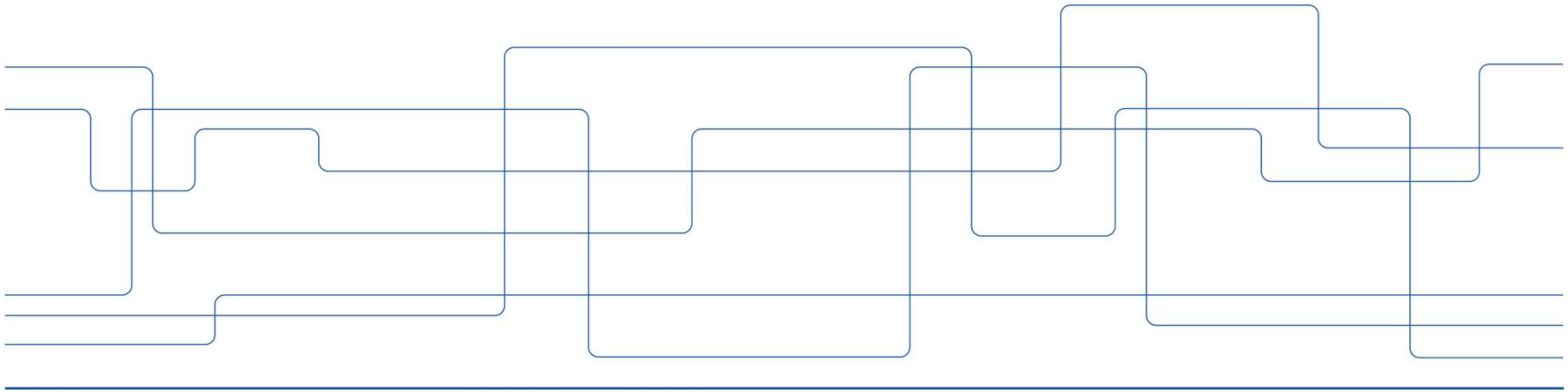
- PDCA
- 5’S
- SMED
- Kanban
- Lean /Agile systematic approach

What is lean for you?

- Write 2-3 words that describes lean
- Join at menti.com and use code: 1493 1334

A philosophy, a way of thinking,
a way of being,
thinking and acting sustainable.
Together!

Brief history



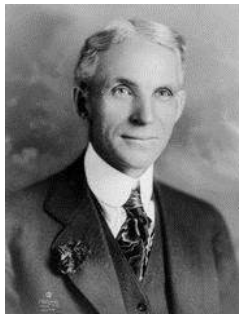
Brief history...

First flow production introduced by Henry Ford in 1913 for *Ford Model T*

2 revolutionary concepts!

1. Assembly line
2. Interchangeable parts

Model T	Before assembly line	After assembly line
Time to produce a car	12 hrs	1 hr
Selling price	$850	$290
Net income	$25 million	$78 million



Henry Ford

Kiichiro Toyoda

- Visionary, technical genius
- <u>Great access</u> in qualified knowledge

- Visionary, technical genius
- <u>Lack of</u> qualified knowledge

Created an organisation for **efficient instructions**

Created an organisation for **efficient learning**

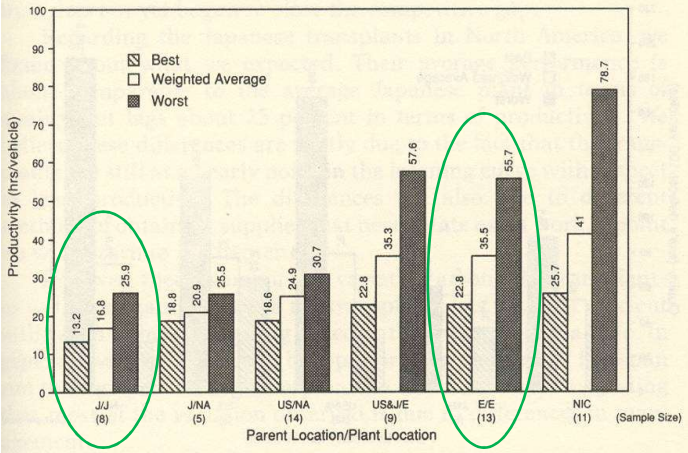
Development

After Ward, 2001

Productivity - study of 80 factories

FIGURE 4.3

Assembly Plant Productivity, Volume Producers, 1989

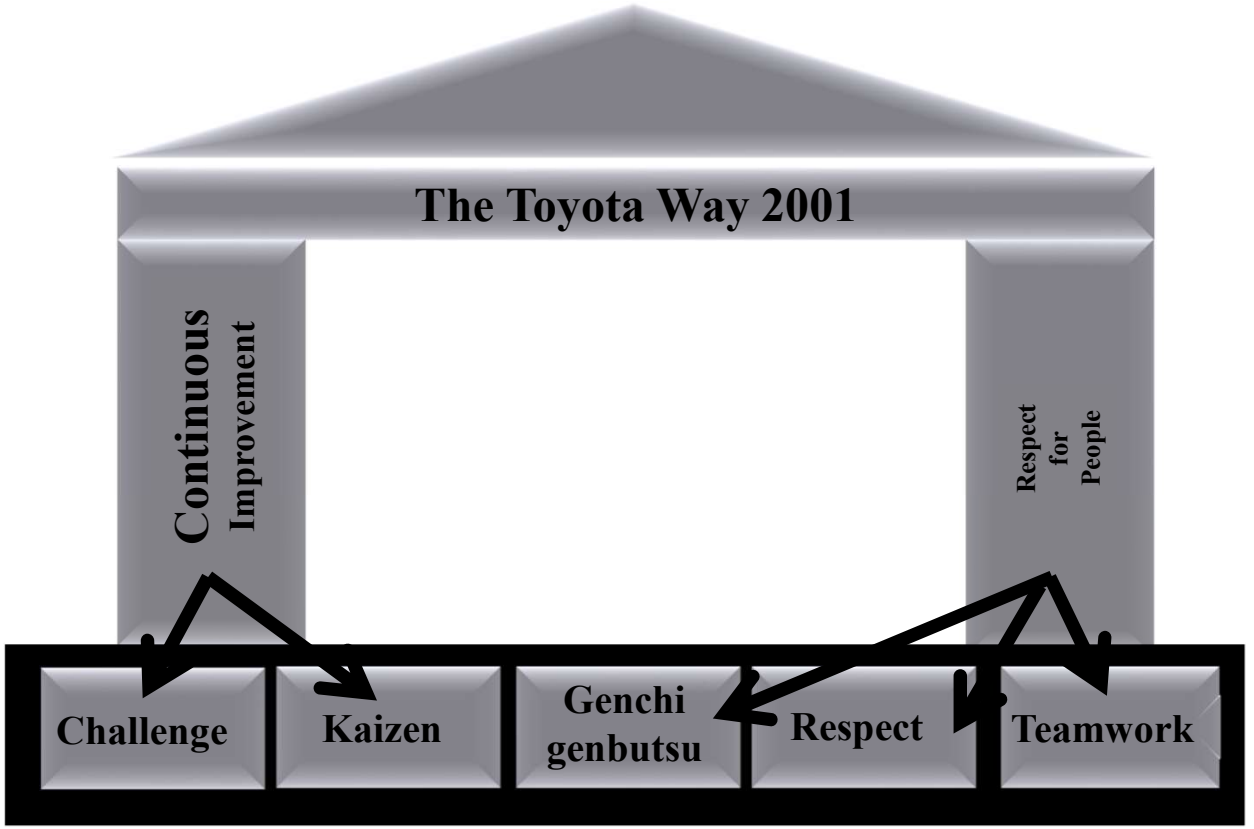


Note: Volume producers include the American "Big Three"; Fiat, PSA, Renault, and Volkswagen in Europe; and all of the companies from Japan.

J/J = Japanese-owned plants in Japan.
J/NA = Japanese-owned plants in North America, including joint venture plants with American firms.
US/NA = American-owned plants in North America.
US&J/E = American- and Japanese-owned plants in Europe.
E/E = European-owned plants in Europe.
NIC = Plants in newly industrializing countries: Mexico, Brazil, Taiwan, and Korea.

Source: IMVP World Assembly Plant Survey

Källa: The Machine that Changed the World, 1990


The Toyota Way 2001
Continuous Improvement
Respect for People
Challenge
Kaizen
Genchi genbutsu
Respect
Teamwork

SPS – Scania production system

Astra Zenecas production system

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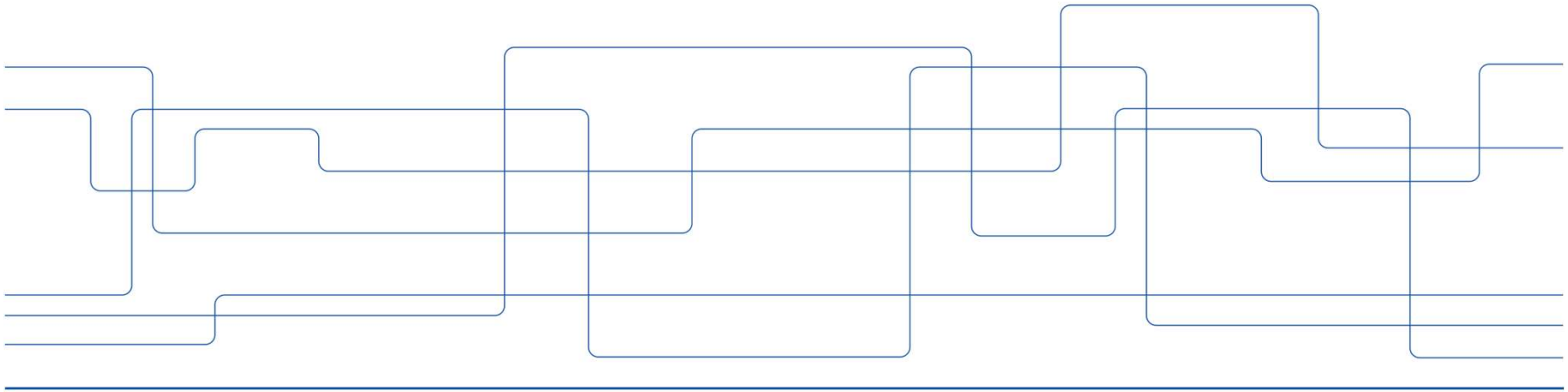
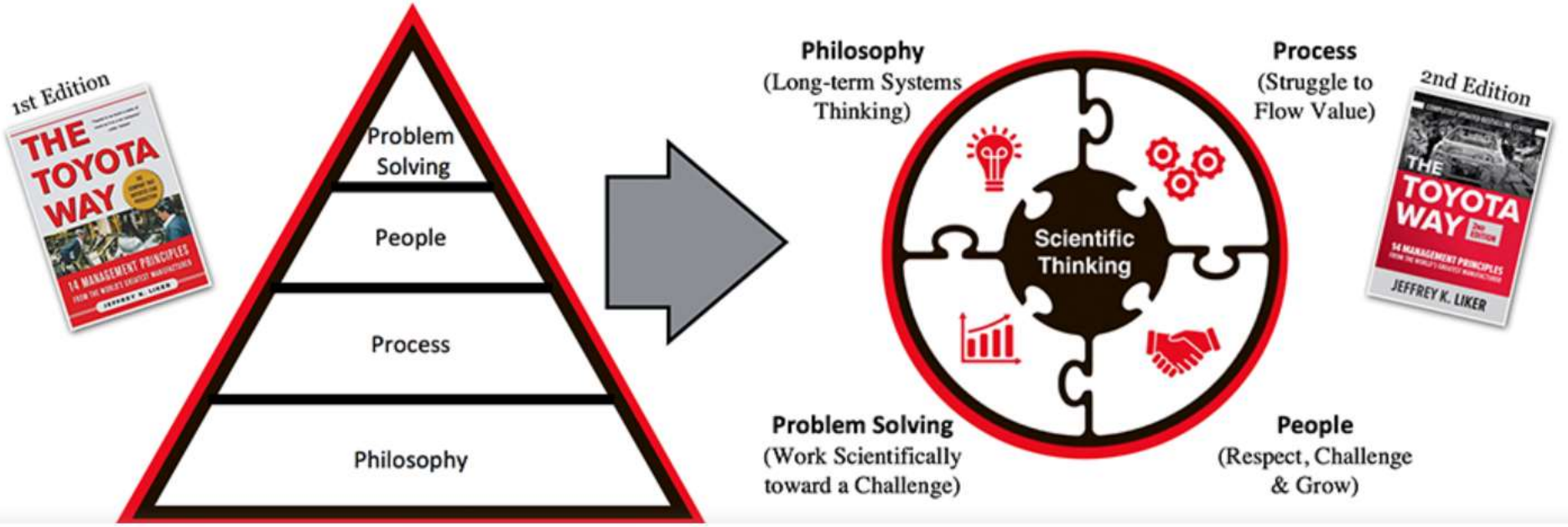
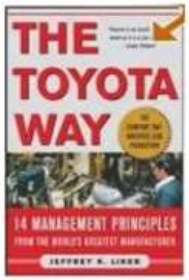
Toyota Production System, TPS

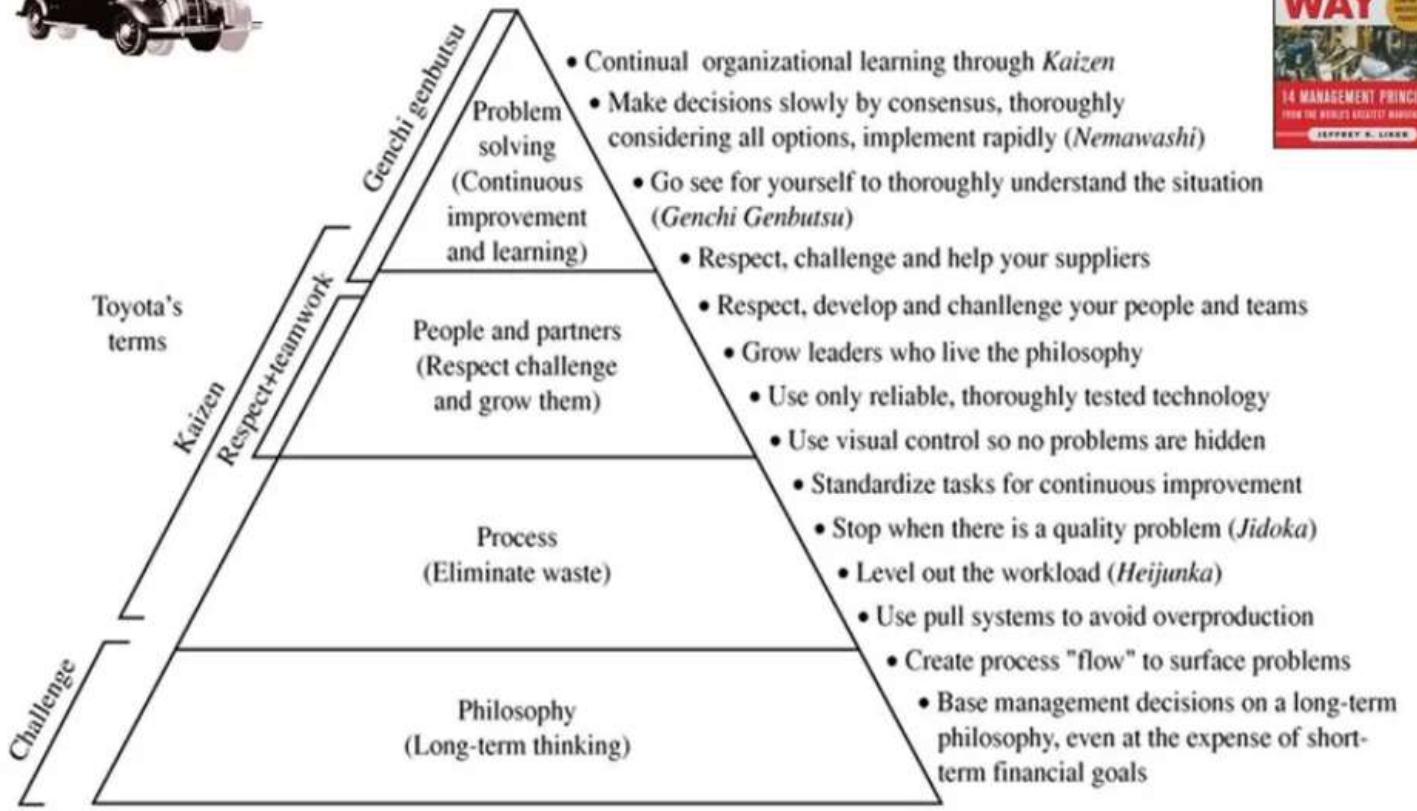


Liker 14 principles



The Toyota Way: 4P & 14 Principles

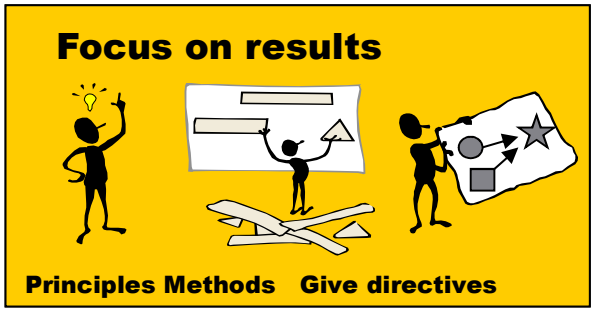


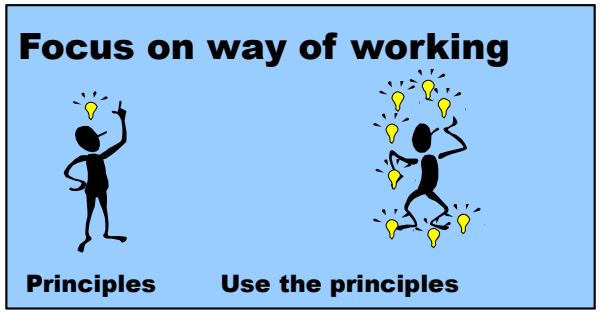


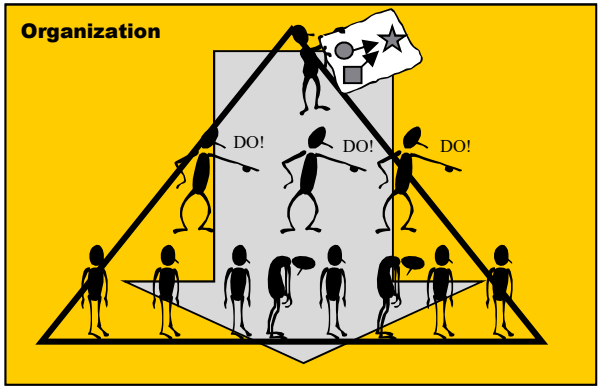
Liker 2004

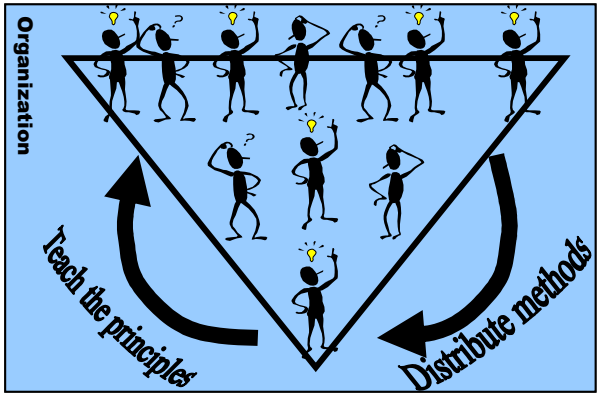
It´s all about people

Turning the pyramid!





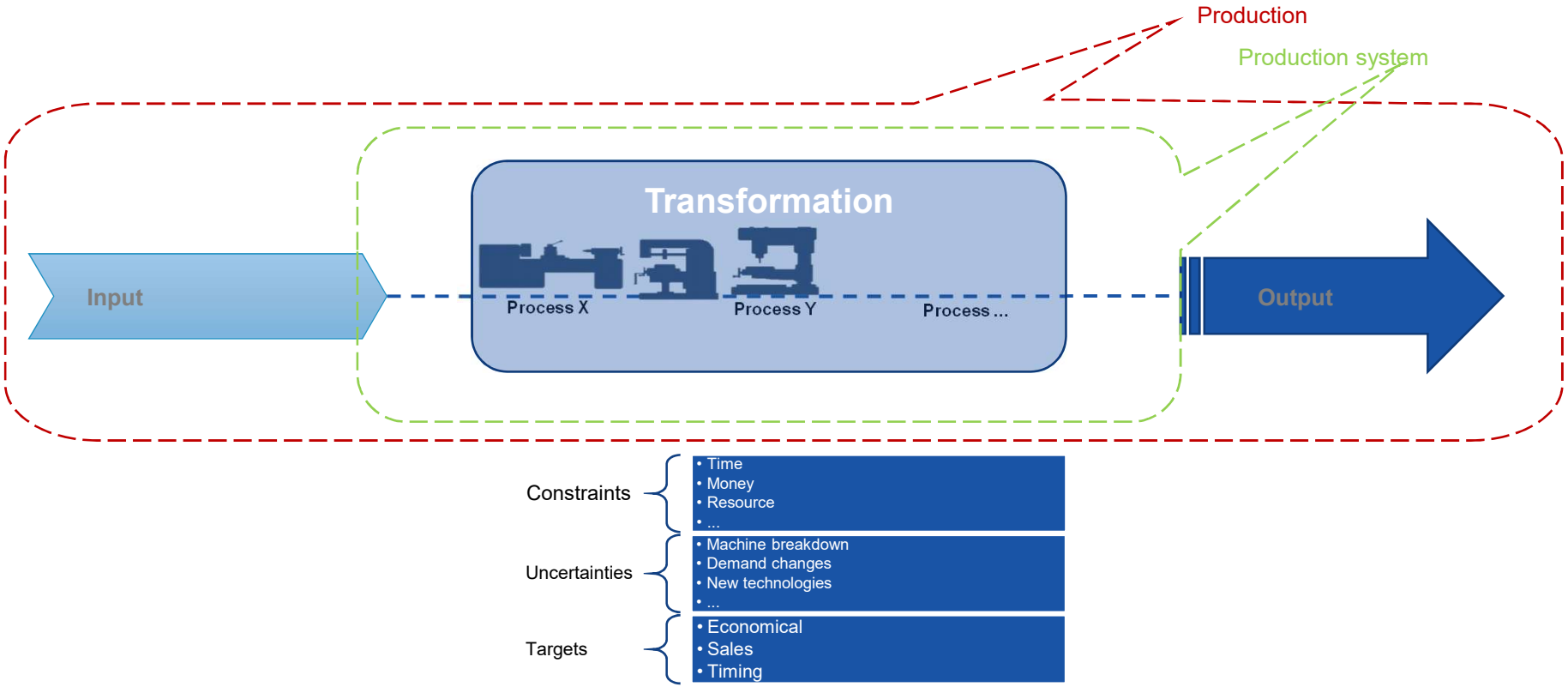




What does Toyota say?

"Our values became a source where all employees could seek guidance. In the values, all the answers about how we should act in various situations were present. Values showed how we should always be. They became our culture."

What is production?

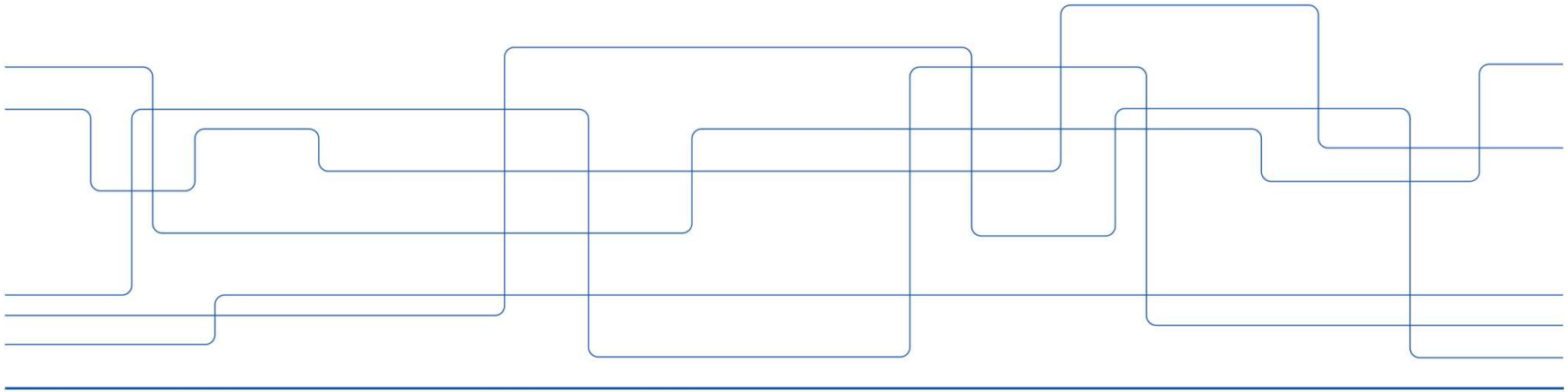


The ultimate objective of production is…

… to produce

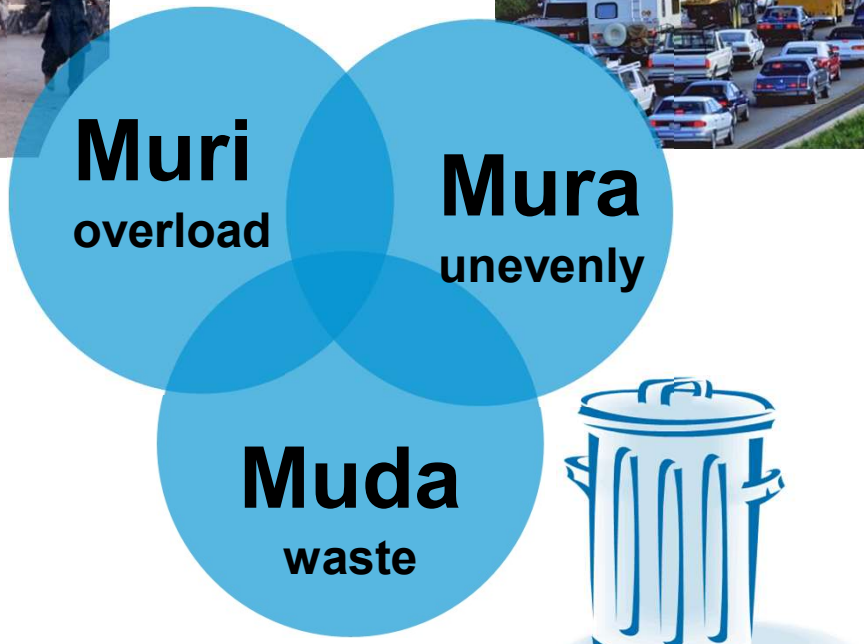
- right product
- of right quality
- in right quantity
- at right time
- by optimum use of resources.

What is lean philosophy?



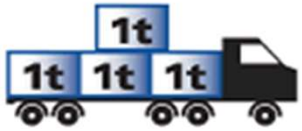
” Lean is a management philosophy which is about teaching us to see and eliminate the various forms of waste which is built into our working methods and focus on what creates value from the **customer's perspective**”

Source: The Toyota Way



(Liker, 2004).

Muri = overload

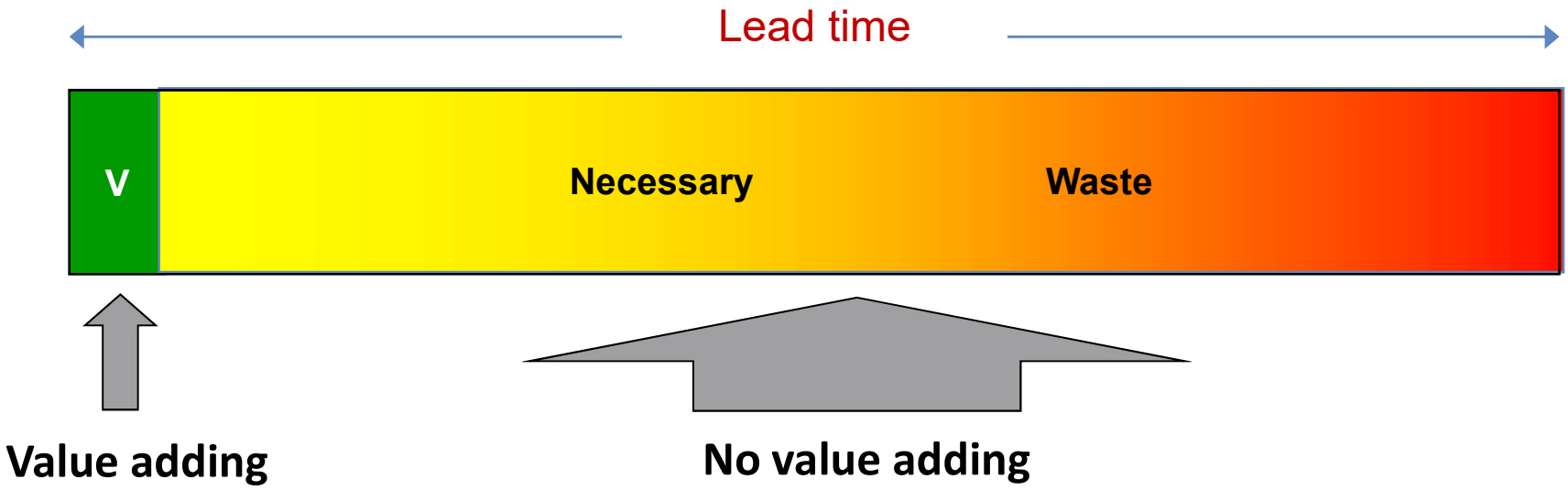


Mura = fluctuation, variation

Muda = waste

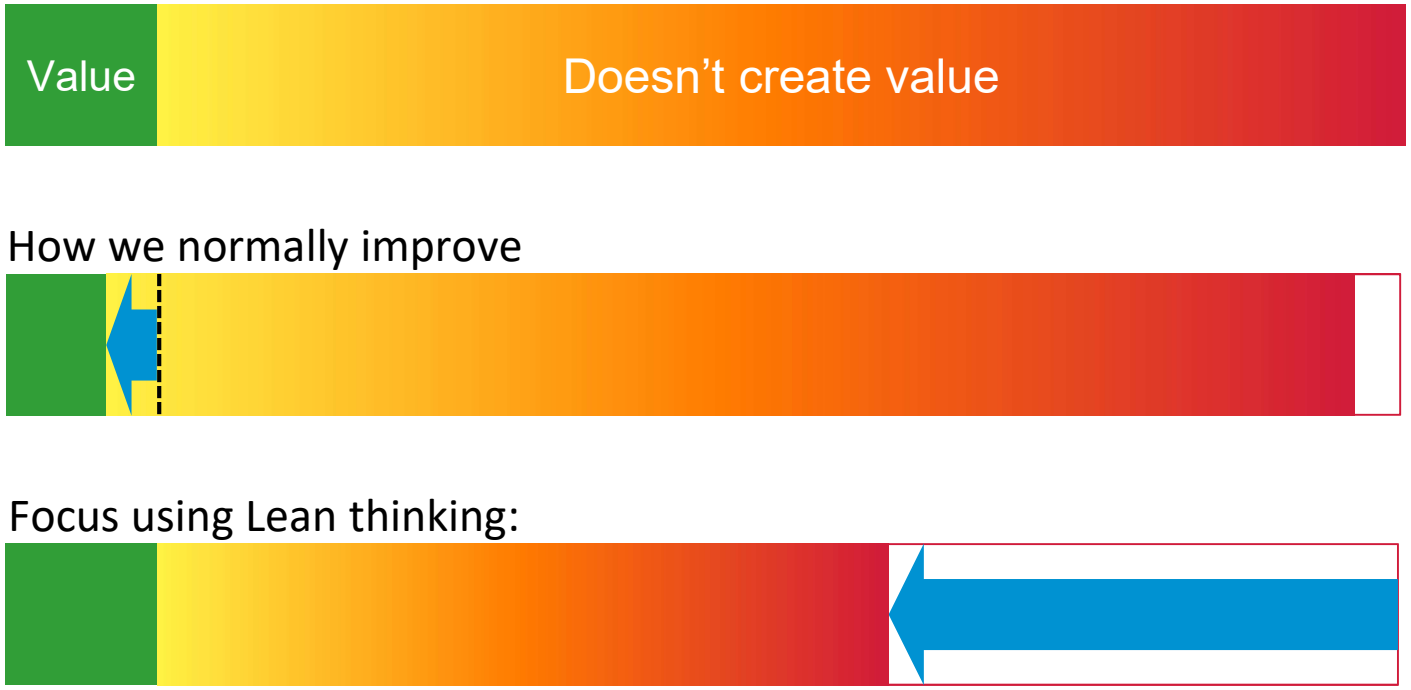
Nor Muri, Mura or Muda

Value adding vs no value adding activities

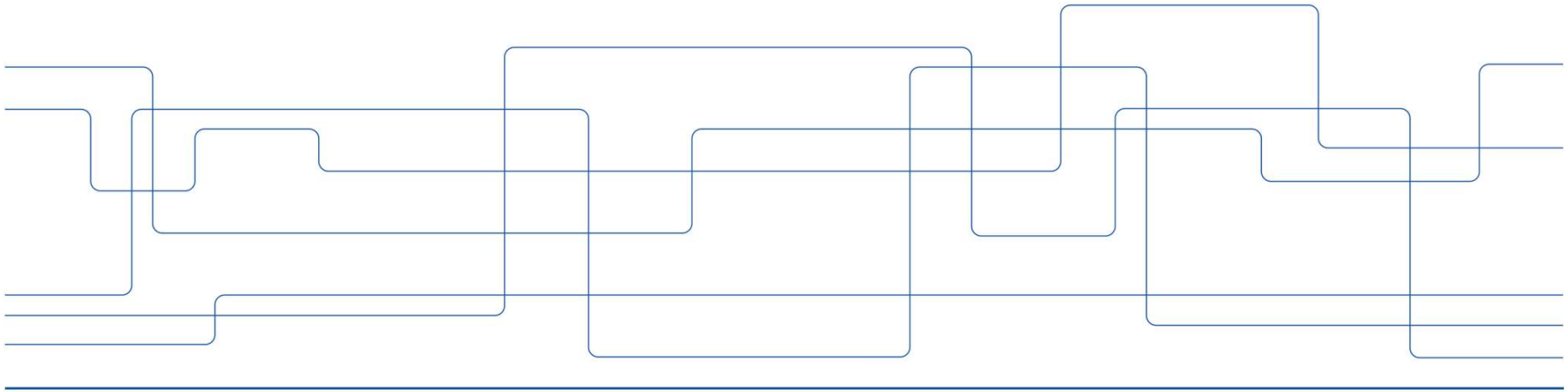


Waste
Every activity that does not add value to the customer's goods and services

Efficiency versus Effectivity the lean way



Value and waste

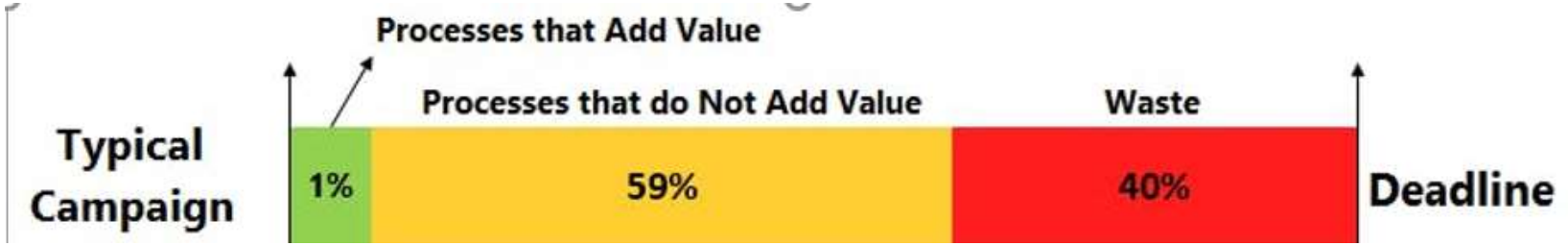


Fundamental lean principles

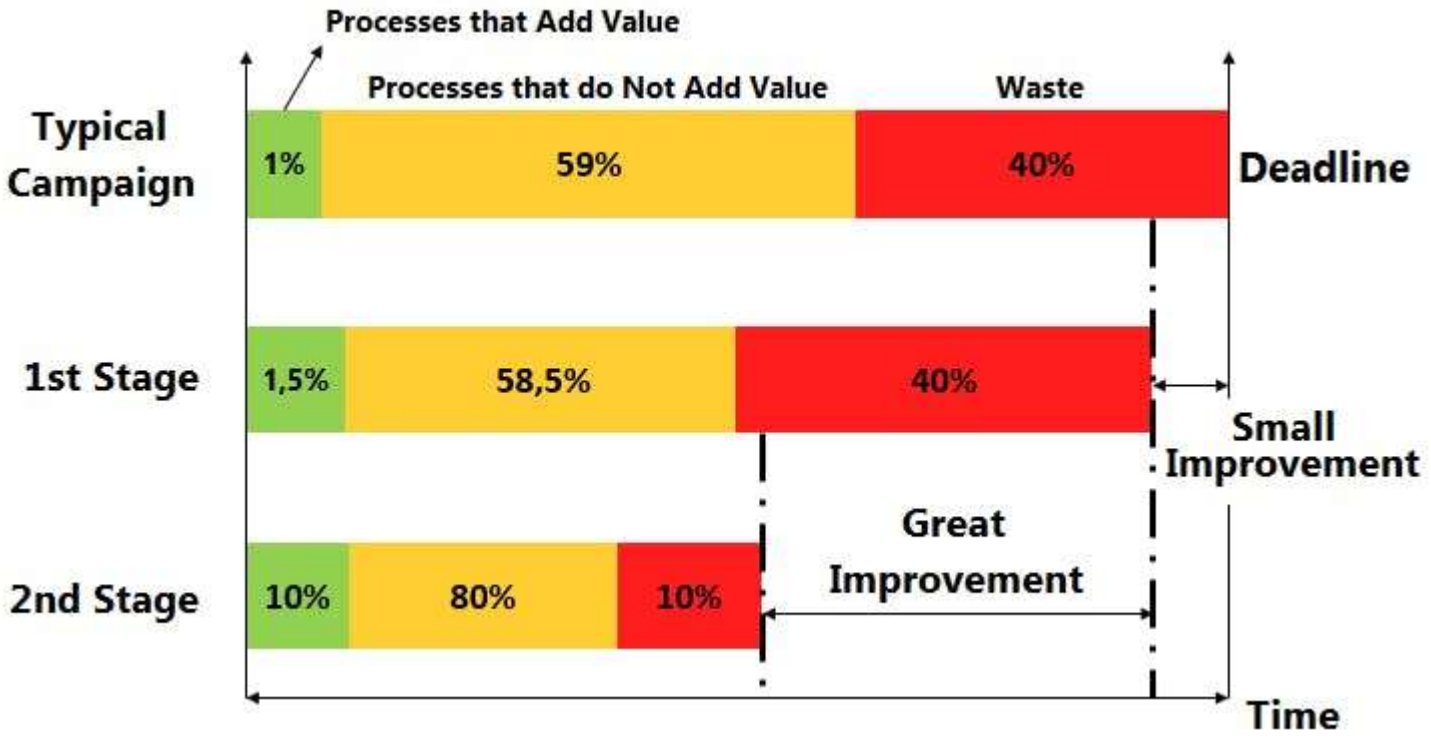
1. Identify value from the standpoint of the end customer by product family.
2. Identify all the steps in the value stream for each product family
3. Make value flow continuously
4. Let customers pull value from the next upstream activity
5. Pursue perfection: Pursue continuous process of improvement striving for perfection

Toyota Production System, Ohno

Value and Non Value



Value and Non value



7 + 1 Waste

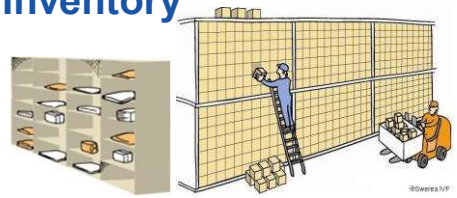
Waiting

Movement

Overproduction

Unnecessary processes

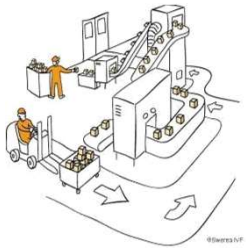
Inventory



Defects and rework

Unused creativity

Transport



1. Inventory

Transactions not processed, design data which is not organized or not fully utilized

Warning signs

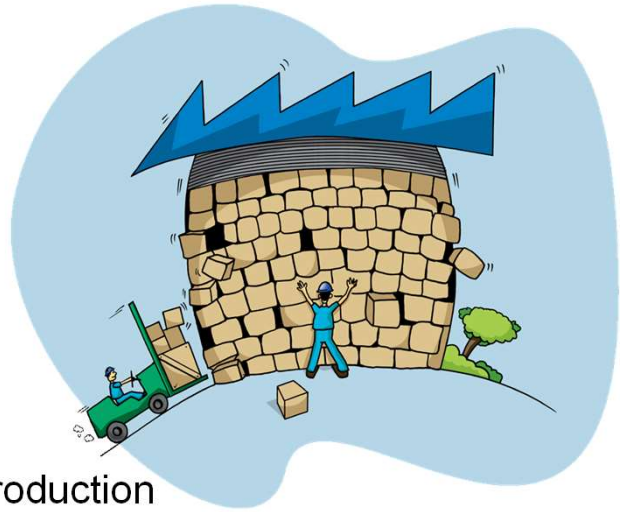
- Extra space for receiving material
- Last-in-first-out (LIFO) instead of First-in-first-out (FIFO) mentality
- Constant or large amount of rework when a problem is discovered
- Increased resources allocated for administrative processes

Environmental

- Excess storage space need heating, light etc.
- Long lead times may make e.g. rust protection necessary, increases use of chemicals
- Packaging material may be needed for storage reasons
- All rework consume resources, increase scrapping

2. Overproduction

Preparing extra reports, reports not acted upon, multiple copies in data in storage, no standardization



Warning signs

- Extra equipment, space, personal
- Tendency to hide problems
- Big blocks of work
- Unclear project plans

Environmental

- All unnecessary work consumes materials
- Long prep or ramp up time cost energy use at non production
- Obsolete material consumed resources
- Excess use of chemicals and other materials when processes are not optimised

3. Unnecessary transports

Extra steps in the process, distance travelled, data hand-offs

Warning signs

- Extra personnel
- Different office locations (for same work)
- Empty desks
- Unreliable copiers, etc.

Environmental

- All transportation consumes energy and creates emissions
- Large spaces and moving out and in between buildings– excess energy consumption, especially open ports etc.
- Transportation of hazardous materials creates risks and need extra precautions
- More packaging materials to protect details and risk for damage creates waste

4. Defects and rework

Re-work, mistakes, quality errors, incorrect data entry, miscommunication

Warning signs

- Extra personnel to review, rework and repair
- Complex processes
- Dubious quality
- Missed deadlines
- Reduced profit margins

Environmental

- Defect material becomes waste
- Spills and emissions due to bad equipment
- More production – more resources used
- Bad quality = bad products = producing more future waste (more frequent replacement needed) – more production
- Space for repair area consumes energy etc.

5. Unnecessary processes

Multiple sign-offs, inspection, rework, redesign, poorly run team meetings

Warning signs

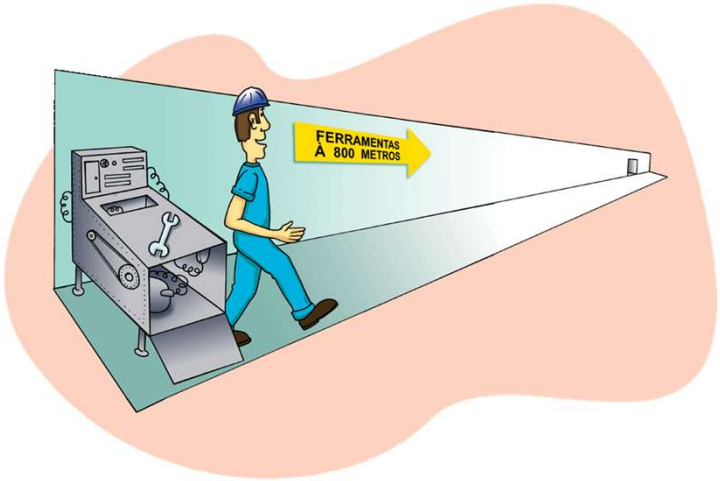
- Do more activities than is necessary
- Improvements unknown to customer
- Endless refinement of elegance and details
- Extra paper or electronic copies
- Information overload
- Work that could be combined with another process

Environmental

- Unnecessary processes consumes unnecessary resources

6. Movement

Extra steps, travel from office to office desk to desk, unnecessary analysis or testing



Warning signs

- Search after tools or forms
- Go to several people or extra effort to get info
- Too long distance between info and access

Environmental

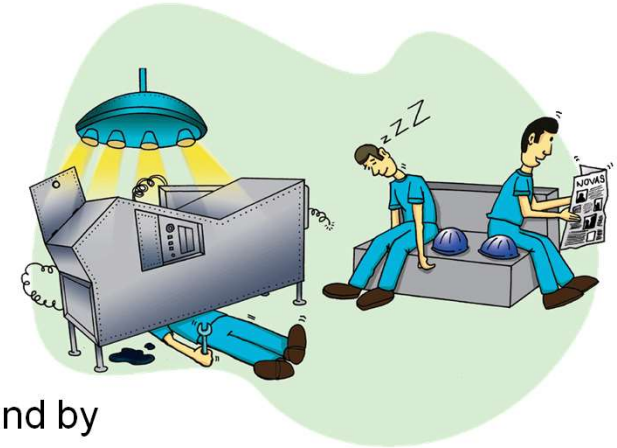
- All aspects of transportation
- Often a problem at waste sorting: too few bins or placed too far away creates extra movements, or bad sorting result. Apply lean thinking to create efficient system
-

7. Waiting

Processing monthly not as the work comes in (i. e. closings, billings, collections, for other functions or disciplines

Warning signs

- People waiting for equipment, tools, information
- Inadequate interest for short delays
- Unplanned delays or postponement of work



Environmental

- Equipment and space consumes energy also at stand by
- Risk for component damage or spoiled materials

7+1. Unused or underutilized creativity

Warning signs

- Few improvement suggestions
- Lack of will to implement X
- Lack of passion and enthusiasm
- Poor morale
- Lack of team activities
- Lack of employee involvement
- Doing MY job mentality

Environmental

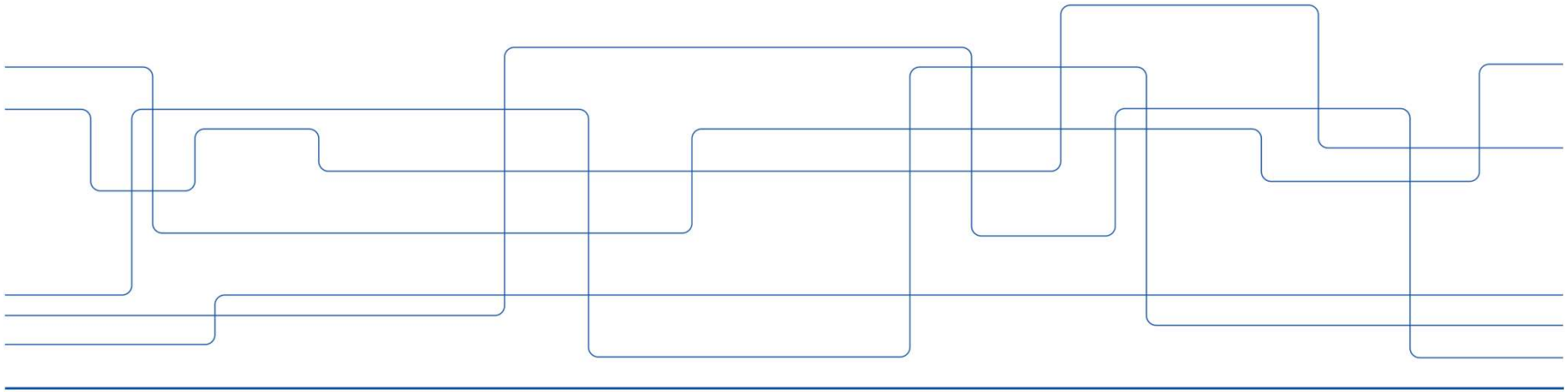
- All employees can participate in improvements
- Collect ideas to facilitate waste handling
- All employees can be used to report leakages (typically water, process chemicals and pressurised air)
- Often easy to create engagement for environment, this can be used to support other improvements

Group work – 5 minutes

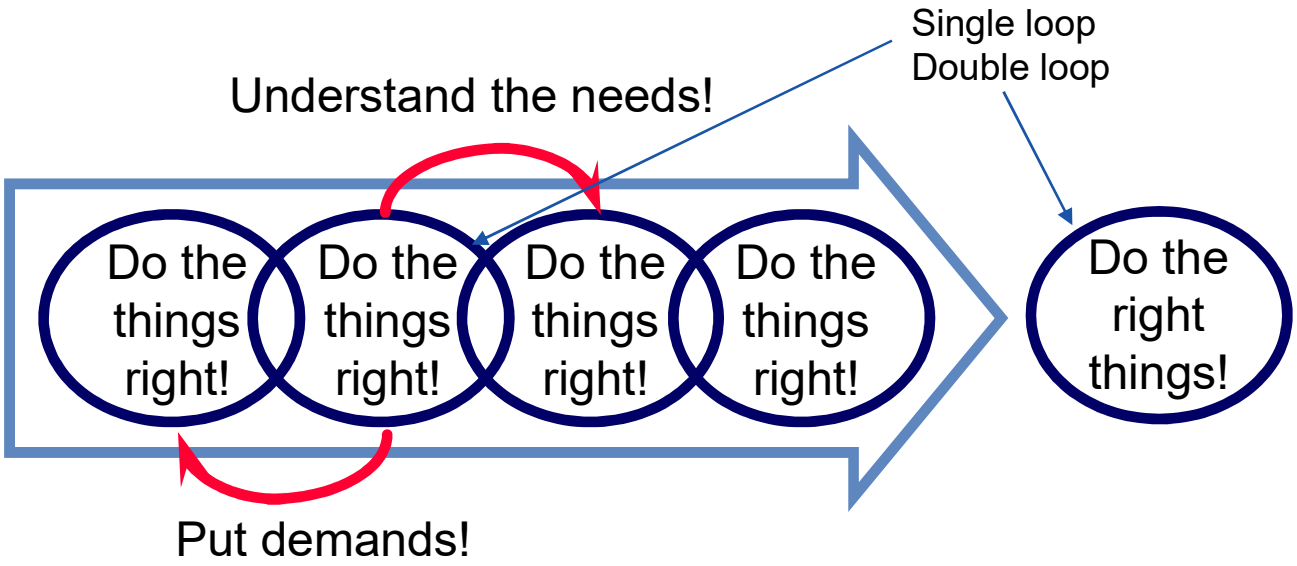
Work in pairs

Identify and give examples of waste for every case below

Value Stream Mapping, VSM



Process Orientation



Doing things right and doing the right things are also known as **Efficiency and effectiveness**.

Difference between Process and Value Flow

Focus:
Security

Input → Activity → Output

Difference between Process and Value Flow

Focus: **Security**

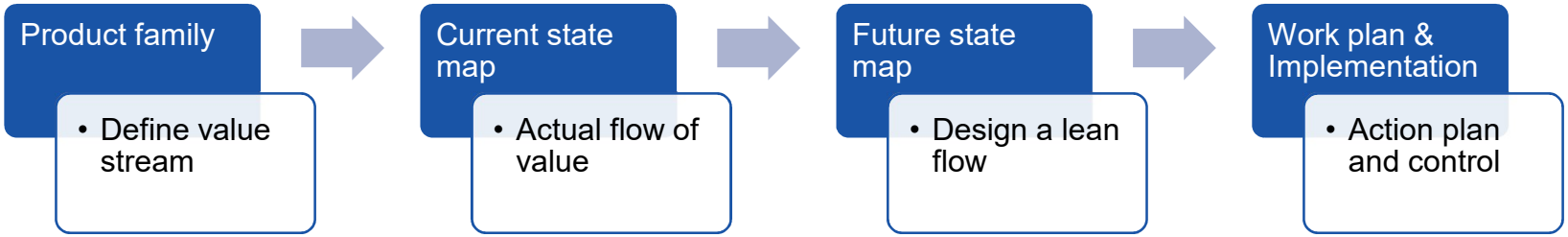
Input → Activity → Output

Focus: **Value**

Purchase Requisition → Requisition review → Solicitation process → Evaluation and contract

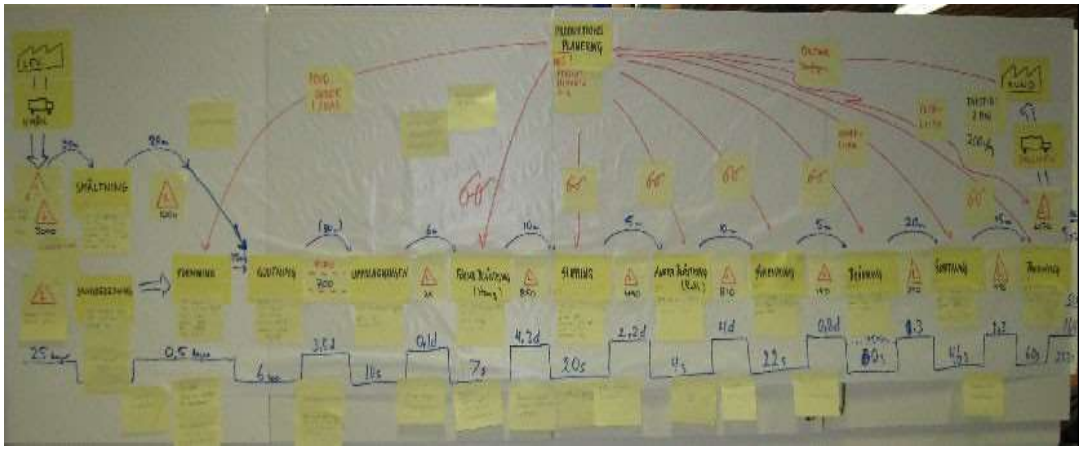
Main steps when performing VSM

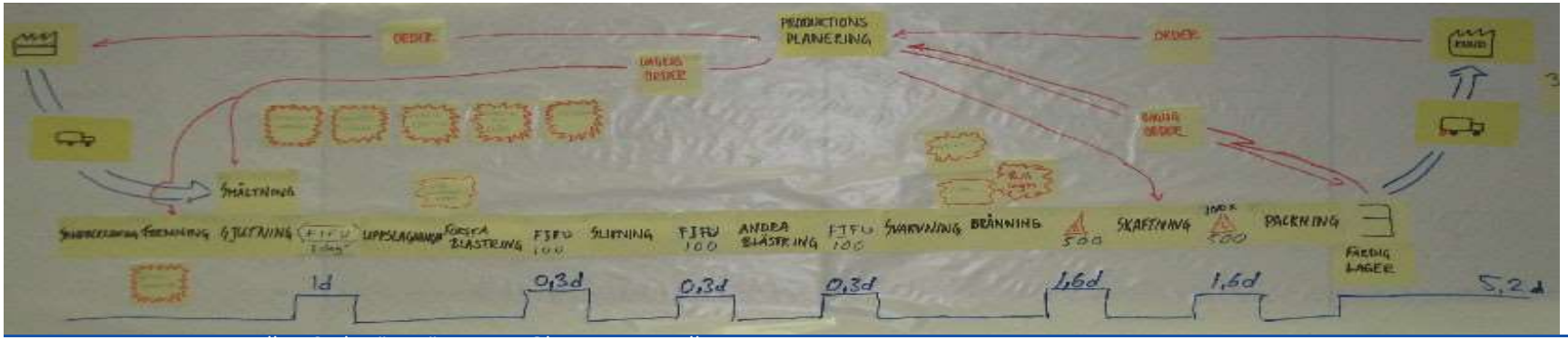
1. Choose a **product** or **product family**.
2. Follow the product's or product family's journey from door to door and collect data. Draw a map of the **current value stream**.
3. Then, draw a map of a **future state** that illustrates a more value-adding flow.
4. **Implement** changes to achieve the future state.

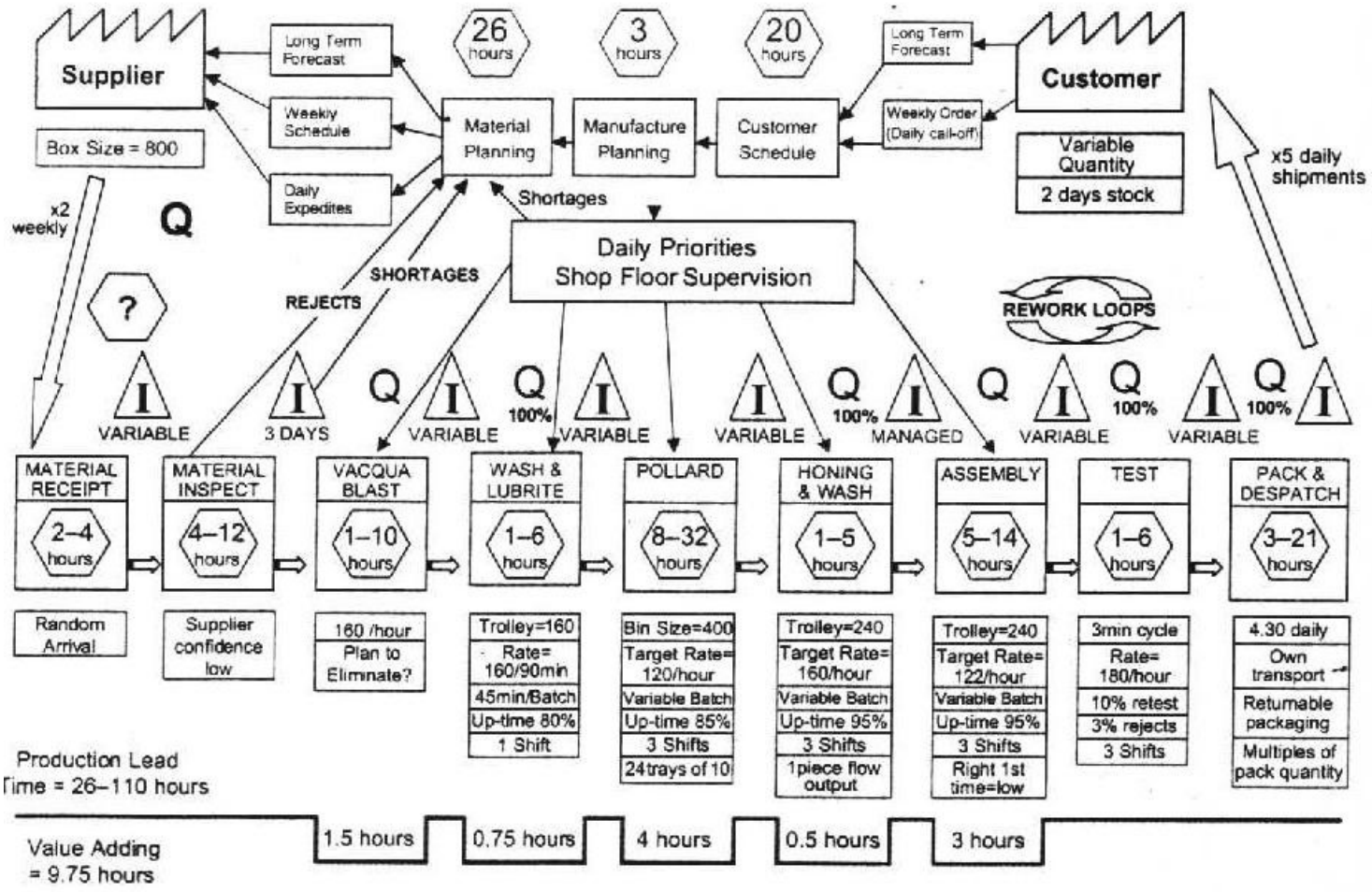


Source: material from Lean Forum and Learning to see
Lars Medbo, Carl Wänström, Peter Olsson, Per Medbo, Chalmers

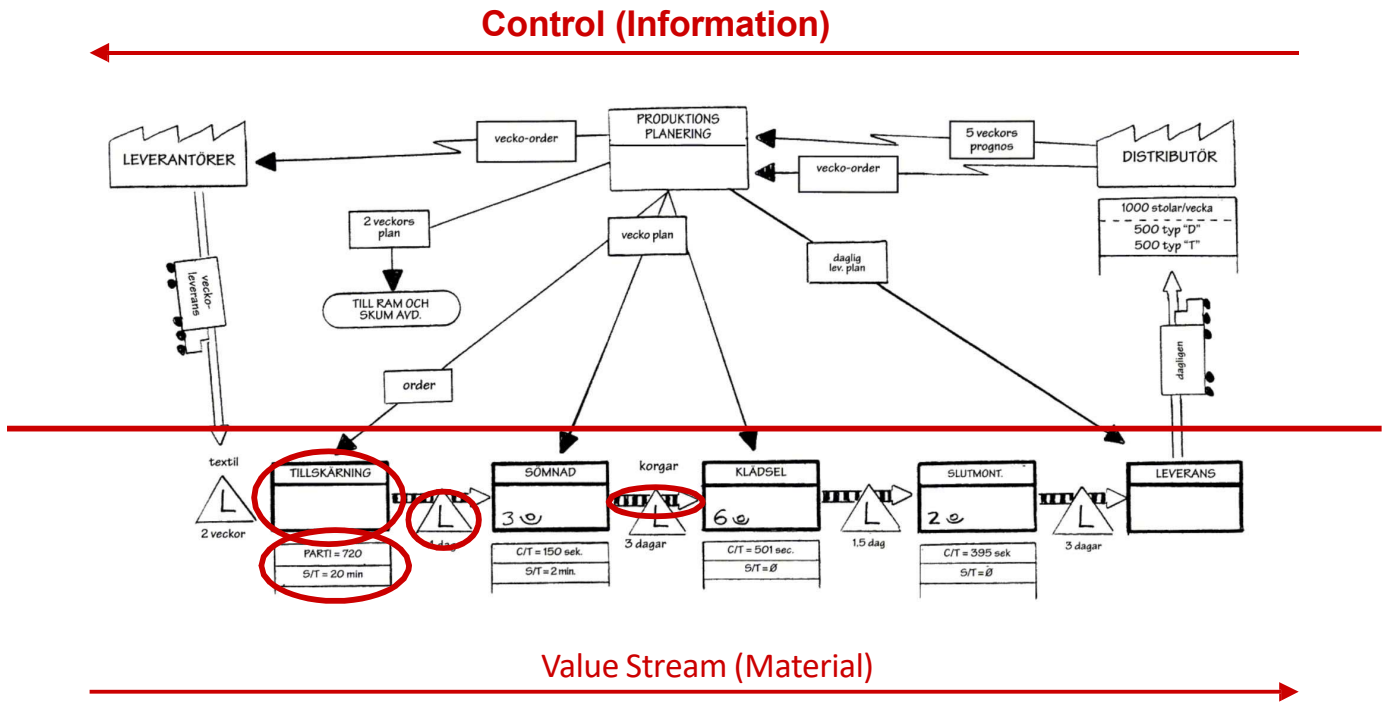
An example of current and future state



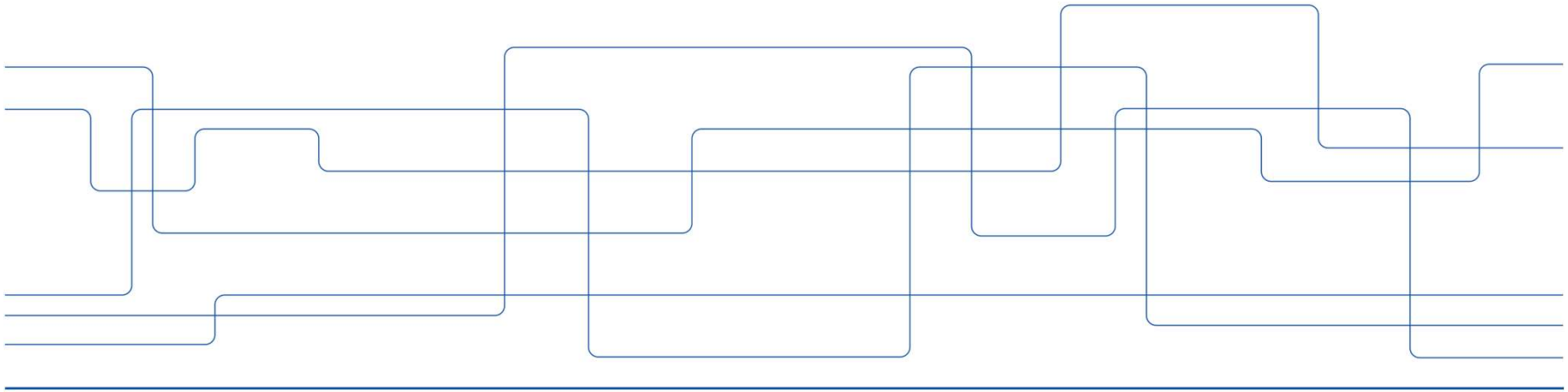



Supplier
Long Term Forecast
Weekly Schedule
Daily Expedites
Box Size = 800
x2 weekly
Q
?
26 hours
3 hours
20 hours
Material Planning
Manufacture Planning
Customer Schedule
Long Term Forecast
Weekly Order (Daily call-off)
Customer
Variable Quantity
2 days stock
x5 daily shipments
Shortages
Daily Priorities
Shop Floor Supervision
REJECTS
SHORTAGES
REWORK LOOPS
I VARIABLE
I 3 DAYS
Q
I VARIABLE
Q 100%
I VARIABLE
I VARIABLE
Q 100%
I MANAGED
Q
I VARIABLE
Q 100%
I VARIABLE
Q 100%
I
MATERIAL RECEIPT
2–4 hours
MATERIAL INSPECT
4–12 hours
VACQUA BLAST
1–10 hours
WASH & LUBRITE
1–6 hours
POLLARD
8–32 hours
HONING & WASH
1–5 hours
ASSEMBLY
5–14 hours
TEST
1–6 hours
PACK & DESPATCH
3–21 hours
Random Arrival
Supplier confidence low
160 /hour
Plan to Eliminate?
Trolley=160
Rate= 160/90min
45min/Batch
Up-time 80%
1 Shift
Bin Size=400
Target Rate= 120/hour
Variable Batch
Up-time 85%
3 Shifts
24trays of 10
Trolley=240
Target Rate= 160/hour
Variable Batch
Up-time 95%
3 Shifts
1piece flow output
Trolley=240
Target Rate= 122/hour
Variable Batch
Up-time 95%
3 Shifts
Right 1st time=low
3min cycle
Rate= 180/hour
10% retest
3% rejects
3 Shifts
4.30 daily
Own transport
Returnable packaging
Multiples of pack quantity
Production Lead Time = 26–110 hours
Value Adding = 9.75 hours
1.5 hours
0.75 hours
4 hours
0.5 hours
3 hours

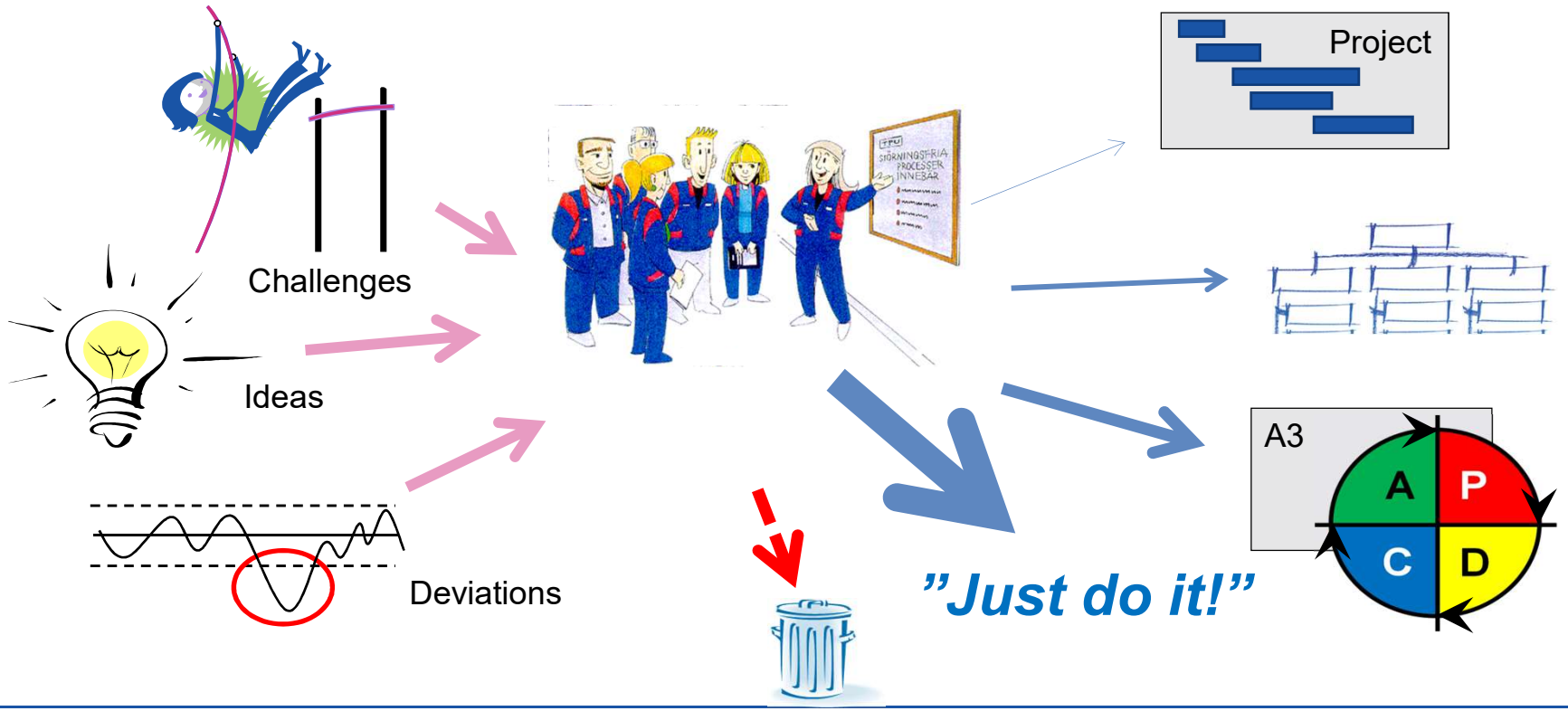
Mapping is done for two different main flows



Summary



System for improvements



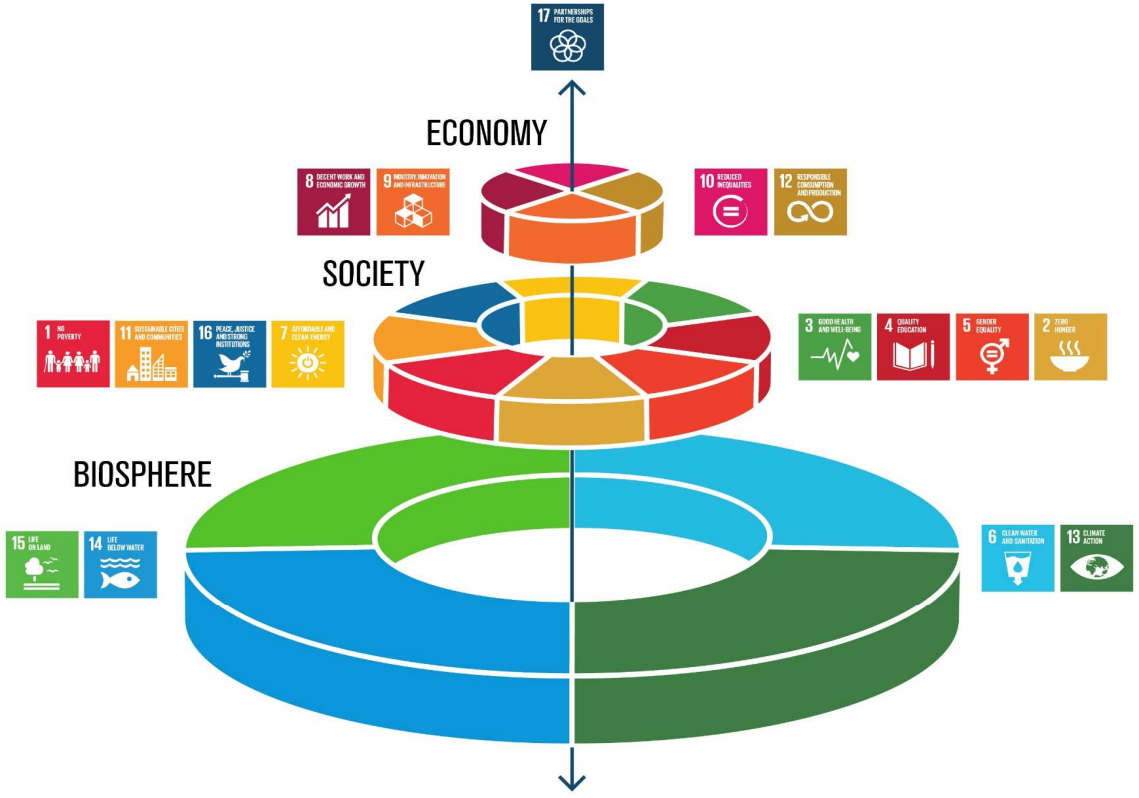
Lean is

- A way of thinking
- A philosophy based on principles
- Structured improvements
- A culture
- Respect for people

Lean is not

- A method
- A management trend
- “Rocket science”
- Cutting costs
- Work harder
- Only for manufacturing

Agenda 2030 (adopted in 2015)

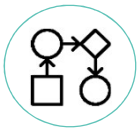


Summary:
Combine lean/agile and sustainability

Less scrap Fewer defects Less spoilage	→	Reduced environmental waste
Fewer defects Less overproduction Simpler products Right-sized equipment	→	Reduced use of raw materials
Less storage Less inventory space needed	→	Reduced materials, land and energy consumed
Less overproduction Less lighting/heating/cooling Less unneeded space Less oversized equipment	→	Less energy use
Less over-processing More efficient transport and movement	→	Lower emissions

(US EPA)

Key competences for sustainable development



Systems Thinking Competence

Futures Thinking Competence

Values Thinking Competence

Strategic Thinking Competence

Interpersonal Competence

Wiek, A., Withycombe, L., & Redman, C. (2011). Key competencies in sustainability: a reference framework for academic program development. *Sustainability Science*, *6*(2), 203–218.

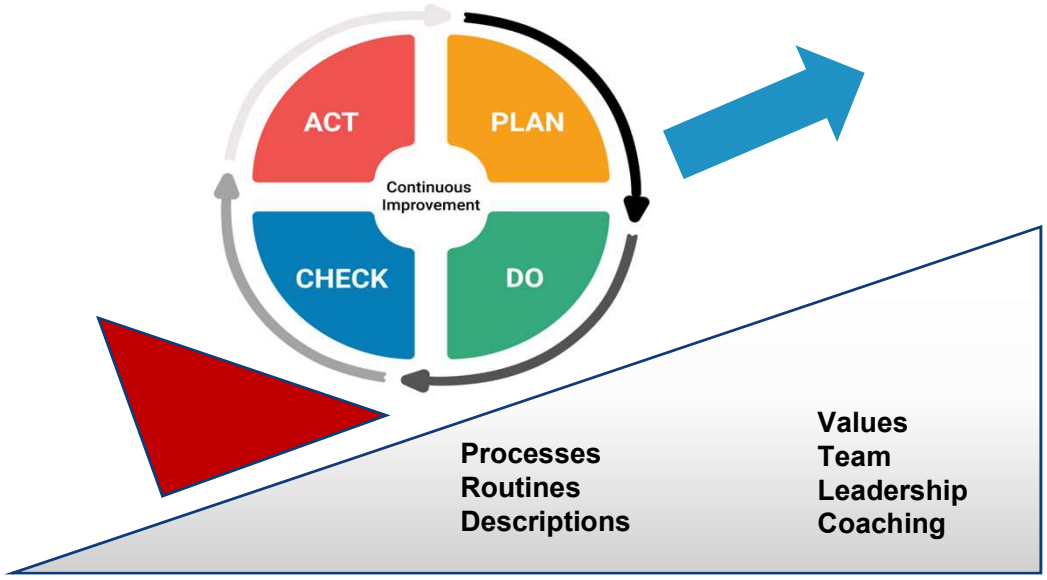
Learning objectives Lean Production 1

At the end of the lecture, you should be able to;

1. Express the concept of lean with the theories behind,
2. Consolidate fundamental principles of lean,
3. Define waste and value & differentiate 7+1 types of wastes,
4. Discuss Toyota Production System (TPS) and its constituents (Lean tools).

Learning objectives Lean Production part 2

- Characterize the fundamental principles of lean philosophy and tools
- Utilize appropriate lean tools to continuously improve shop floor performance



Thanks for today!

Remember to schedule time for your homework

We are looking forward to see you again!