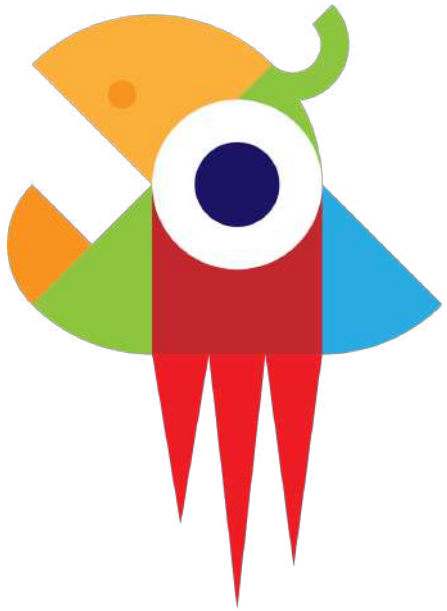
eSTEM

With the support of the Erasmus+ Programme of the European Union

SBL Example: Plane Factory



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Indice

01.

Design Criteria of the SBL Activity

Lecture context

Subject	• Integrated Production Systems
Degree	• Master of Industrial Engineering
Duration	• 3h
Modality	• Online or in a computer room
Students	• 10-13 students per session, 4 sessions
Working groups	• 3-4 people

Design criteria

Lecture aims:	• High engagement level • Good real-world mimic
Learning outcomes	• Basic Lean Manufacturing concepts • Implementing Lean Manufacturing in a Manufacturing process
Scope of the Activity:	• Students and professionals
Initial knowledge:	• Theoretical base of Lean Manufacturing basic concepts

Scope of the activity

The learning activity is aimed at:

- High education centres who want to teach their students Lean Manufacturing (LM) philosophy and the use of process simulation programs through active learning.
- Professionals who want to lead, manage, or participate in the implementation of continuous improvement in their production process through LM tools.

Intended learning outcomes

- **Basic concepts of Lean Manufacturing:**
  - ✓Identify the 7 types of waste
  - ✓Lean tools: 5S, Jidoka, Kanban, Total Productive Maintenance (TPM), Value Stream Mapping (VSM), cell production, etc.
  - ✓Quality concepts
- **Transversal competences such as problem solving**

Initial knowledge

The initial knowledge needed by the participants is a theoretical base of the LM concepts. It can be taught in a previous lesson.

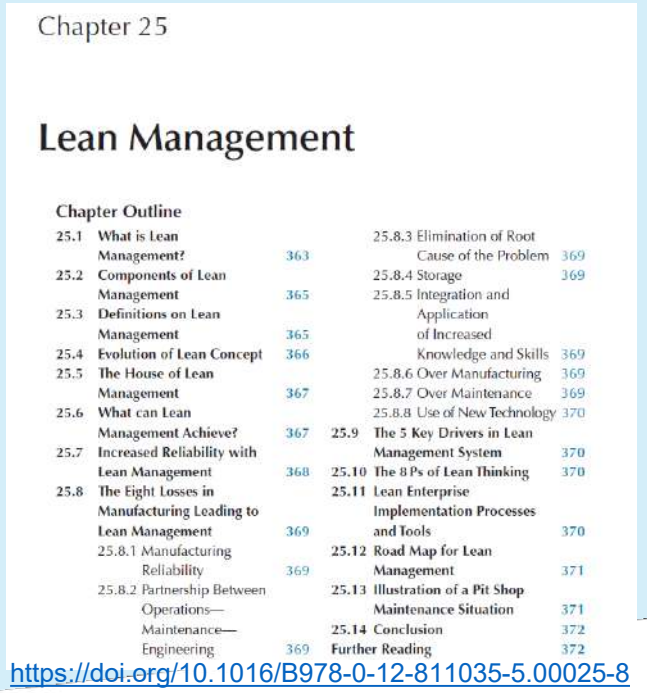
Lean Manufacturing: Methodology that consists in continuous improvement by eliminating waste from a manufacturing process.

02.

Use of SFLM

SFLM Input

The input of the SFLM are chapters of books about Lean Manufacturing:

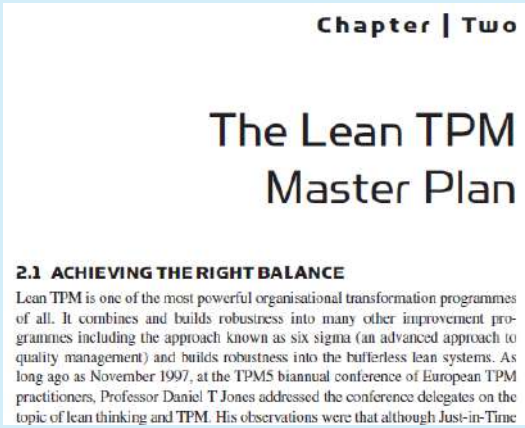


Chapter 25

Lean Management

Chapter Outline

https://doi.org/10.1016/B978-0-12-811035-5.00025-8



Chapter | Two

The Lean TPM Master Plan

2.1 ACHIEVING THE RIGHT BALANCE

Lean TPM is one of the most powerful organisational transformation programmes of all. It combines and builds robustness into many other improvement programmes including the approach known as six sigma (an advanced approach to quality management) and builds robustness into the bufferless lean systems. As long ago as November 1997, at the TPM5 biannual conference of European TPM practitioners, Professor Daniel T Jones addressed the conference delegates on the topic of lean thinking and TPM. His observations were that although Just-in-Time

https://doi.org/10.1016/B978-0-08-100090-8.00002-1

SFLM Output

The output of the SFLM are questions and answers that help in the creation of the scenarios:

Chapter-Two-The-Lean-TPM-Master-Plan_2015_Lean-TPM-Second-Edition-.pdf

Q: In which conditions that is process optimisation , a key part of the ' proactive maintainers ' role?

A: once breakdowns are brought under control

S: That is process optimisation, a key part of the 'proactive maintainers' role once breakdowns are brought under control.

R: 0.0

Chapter-Two-The-Lean-TPM-Master-Plan_2015_Lean-TPM-Second-Edition-.pdf

Q: What TPM is?

A: involving everyone from shop floor to boardroom a team - based and freshly focussed tool for success

S: Involving everyone from shop floor to boardroom, TPM is a team-based and freshly focussed tool for success'.

R: 0.0

Chapter-25-Lean-Management_2017_Total-Quality-Management.pdf

Q: In which conditions lean is about doing more with less?

A: while giving customers what they want

S: Lean is about doing more with less: less time, inventory, space, people, and money, while giving customers what they want.

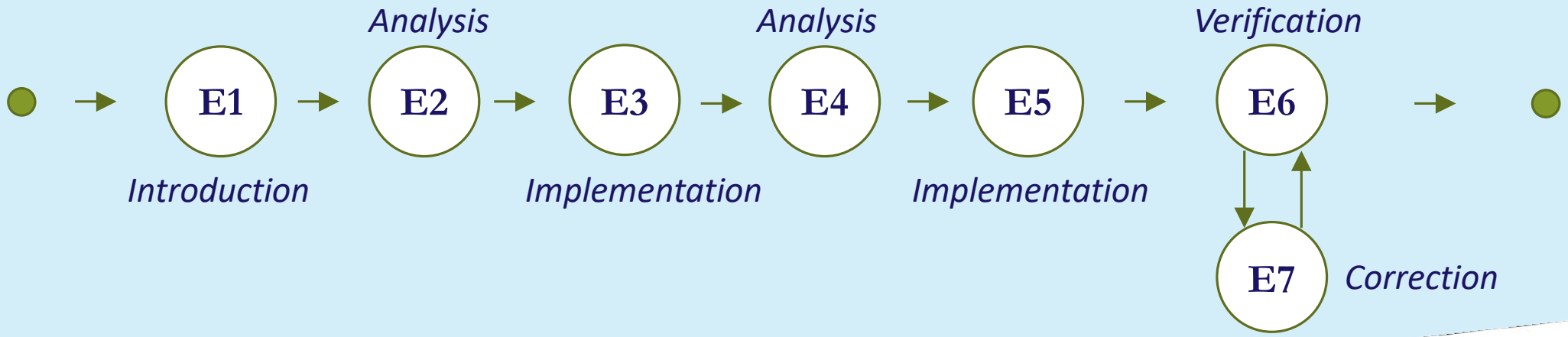
R: 0.0

02.

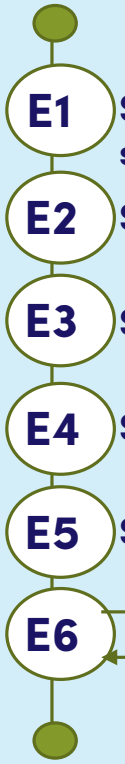
Activity Design

Story Line

Overview:



Story Line



Stage E1: Introduction to the layout and manufacturing process of the Plane Factory (the Factory is simulated in the software FlexSim)

Stage E2: Analysis of the KPIs and identification of waste

Stage E3: Improvement of the Factory with easy-to-implement quality measures that do not require a big investment

Stage E4: Analysis of the effect of the measures in the Factory KPIs

Stage E5: Improvement of the Factory with more complex quality measures that require a big investment

Stage 6: Analysis the effect of all the measures in the Factory KPIs.

Stage 7: Continuous improvement of the Factory.

Story Line

Basic terms:

- Factory layout
- Takt time
- Batching
- Quality Wall
- Push Flow

E1 Stage E1: Introduction to the layout and manufacturing process of a Plane Factory

E2 Stage E2: Analysis of the KPIs and identification of waste

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E4 Stage E4: Analysis of the effect of the measures in the Factory KPIs

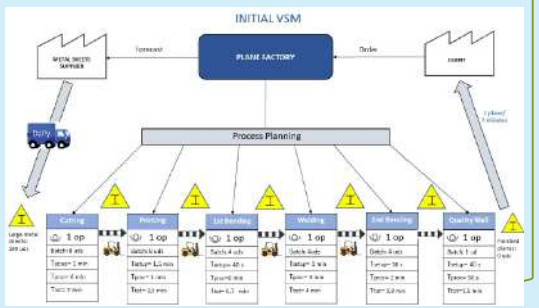
E5 Stage E5: Improvement of the Factory with more complex quality measures that require a big investment

E6 **E7** Stage 6: Analysis the effect of all the measures in the Factory KPIs.
Stage 7: Continuous improvement of the Factory.

Story Line

Basic terms:

- Waste in Lean Manufacturing
- Key Performance Indicators (KPI)
- Work in Progress (WIP)
- Value Stream Mapping



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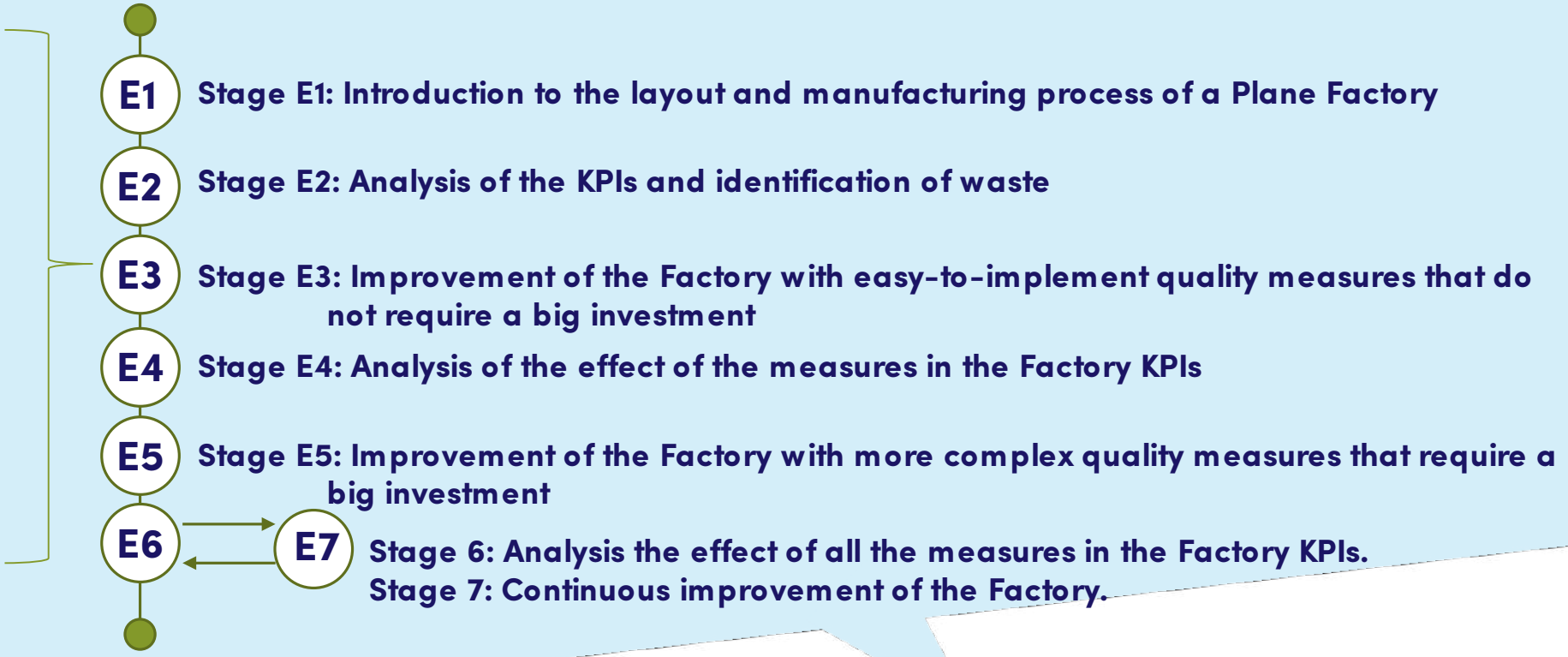
E5 Stage E5: Improvement of the Factory with more complex quality measures that require a big investment

E6 / **E7** Stage 6: Analysis the effect of all the measures in the Factory KPIs.
Stage 7: Continuous improvement of the Factory.

Story Line

Basic terms:

- 5S
- Jidoka
- Poka-Yoke
- Total Productive Maintenance (TPM)



Story Line

Basic terms:

- KPI
- WIP
- Productivity

KPIs (indicadores)	Situación inicial		Situación final	
	Cantidad rojos	Cantidad verdes	Cantidad rojos	Cantidad verdes
Nº averías rechazadas muro de calidad	20		0 (se elimina el puesto de inspección)	
Productos defectuosos rechazados por el cliente	3		0	
Productos útiles para vender (Stock final)	3		4	
Clientes satisfechos	18	18	39	39
Rotura de stock	38		0	
WIP (Work in progress)	1539		67	
Productividad	0,48 piezas producidas/ operario-hora		3,04 piezas producidas/ operario-hora	
Espacio ocupado (m2)	166,76 m		86 m	
Operarios	6		3	
Lead Time	22 días y 319 min		1 día y 53 min	

E1 **Stage E1: Introduction to the layout and manufacturing process of a Plane Factory**

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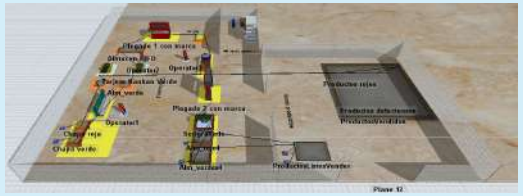
E5 **Stage E5: Improvement of the Factory with more complex quality measures that require a big investment**

E6 **E7** **Stage 6: Analysis the effect of all the measures in the Factory KPIs.**
Stage 7: Continuous improvement of the Factory.

Story Line

Basic terms:

- Kanban
- Pull Flow
- One piece-Flow
- Cell Production
- Line Balancing
- Task precedence



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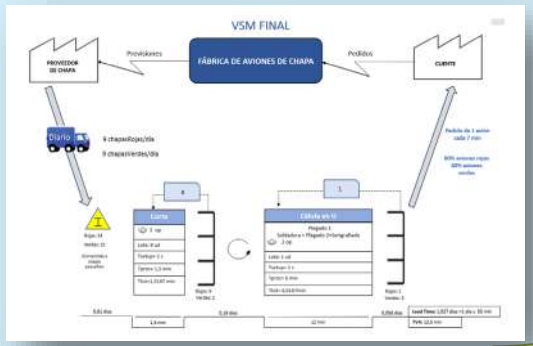
Stage 7: Continuous improvement of the Factory.

Story Line

Basic terms:

- VSM
- KPI
- Continuous improvement



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04.

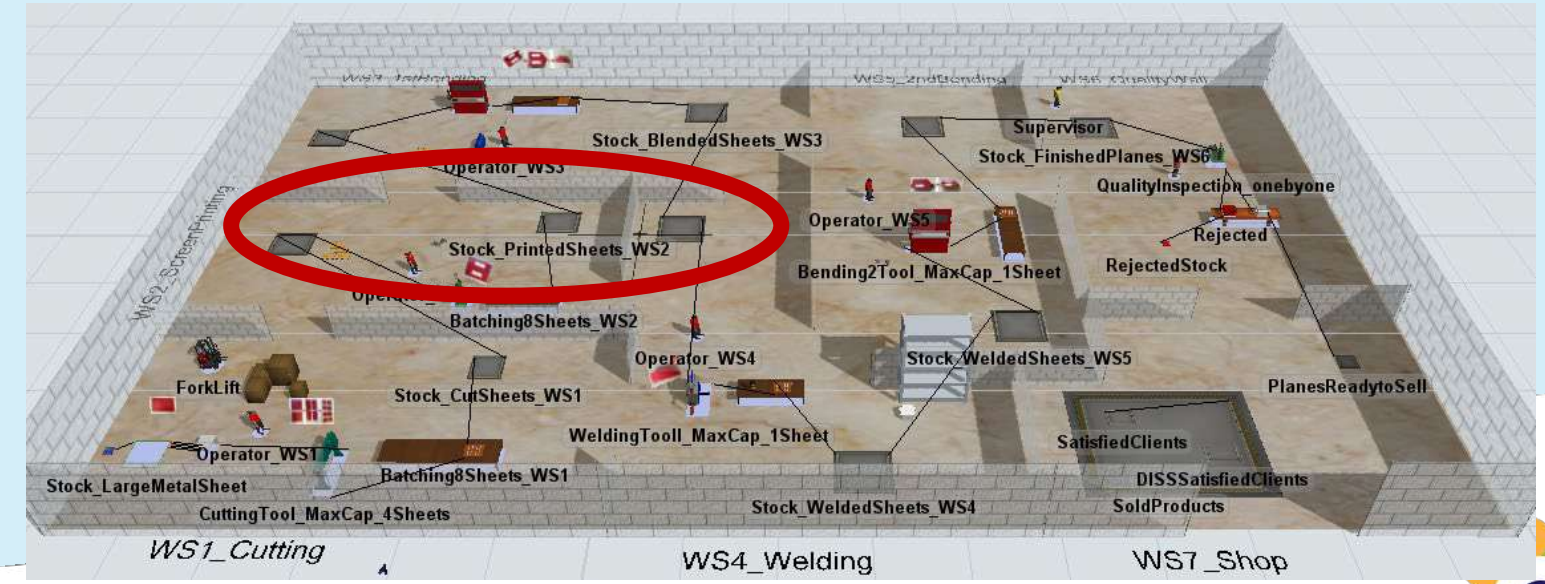
Implementation of the Activity

Implementation of the activity

- Understand the manufacturing process of the Plane Factory
- Analyse the initial situation and draw its VSM
- Identify waste and propose solutions
- Improve the situation by implementing Lean Manufacturing tools
- Analyse the proposed solution and draw its VSM
- Compare the initial and the final situation

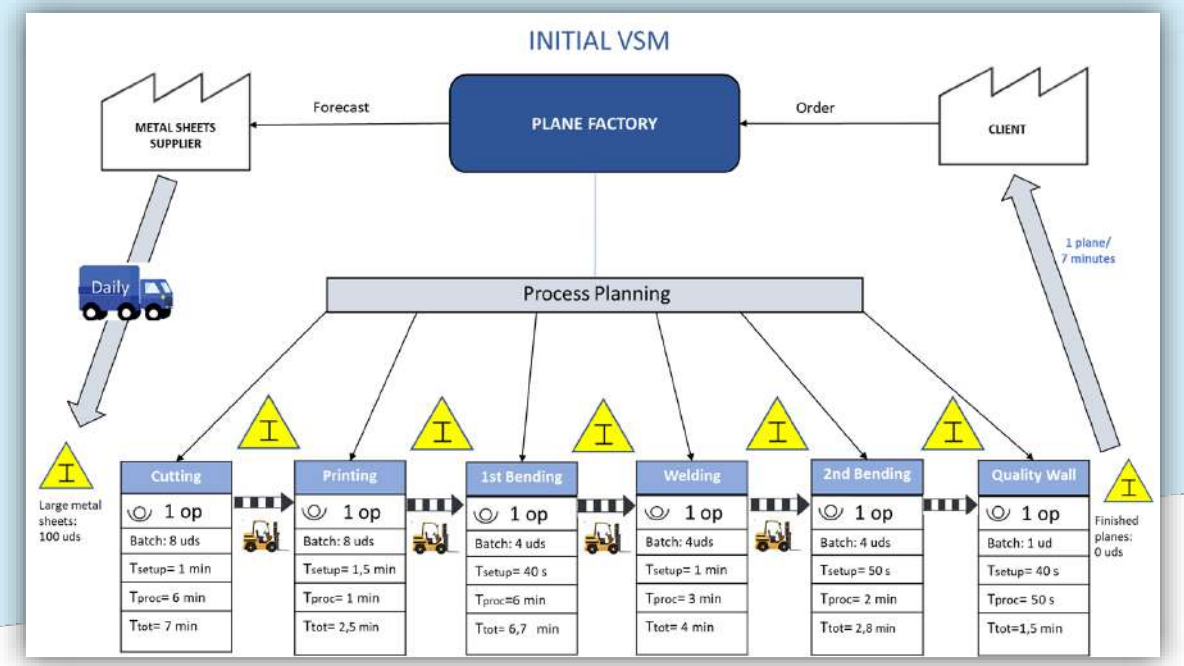
1. Understand the manufacturing process of the Plane Factory

Before the class, the students read the activity statement which explains the manufacturing process of the Plane Factory. In class, each group (3 students per group) works on a FlexSim program with the layout of the Plane Factory already configured, except from one workshop. They have to model the missing workshop in order to get familiar with the simulation software.



2. Analyse the initial situation and draw its VSM

The VSM allows to create a detailed visualization of all steps in the manufacturing process. It is a representation of the flow of goods from the supplier to the customer throughout the factory.

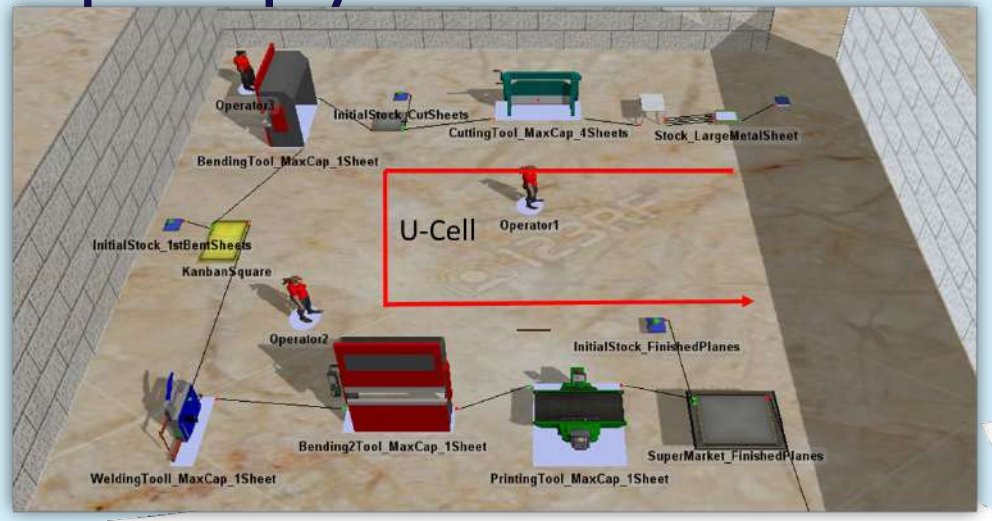


3. Identify waste and propose solutions

According to Lean philosophy there are 8 types of waste, which have been depicted in the factory. Waste can be eliminated or minimized by using LM tools.

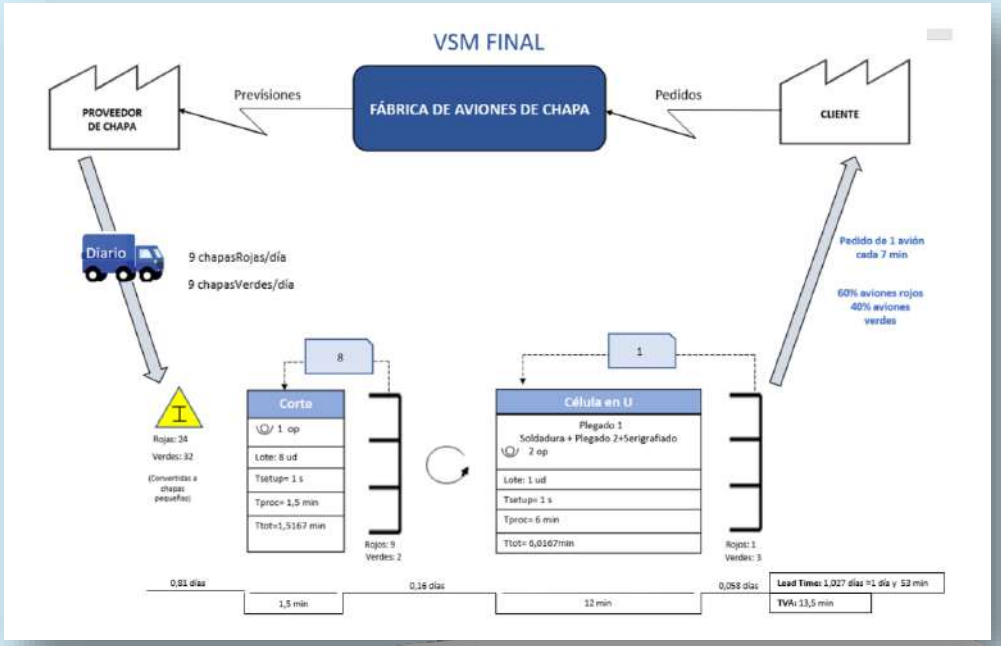
4. Improve the situation by implementing Lean Manufacturing tools

Afterwards, the groups can start to improve the factory situation by applying LM and quality tools, and implement them. They are able to simulate the factory each time they change the layout to observe the effect that it causes. Thus, the factory optimization should be an iterative process, starting with the simpler measures and following the continuous improvement philosophy.

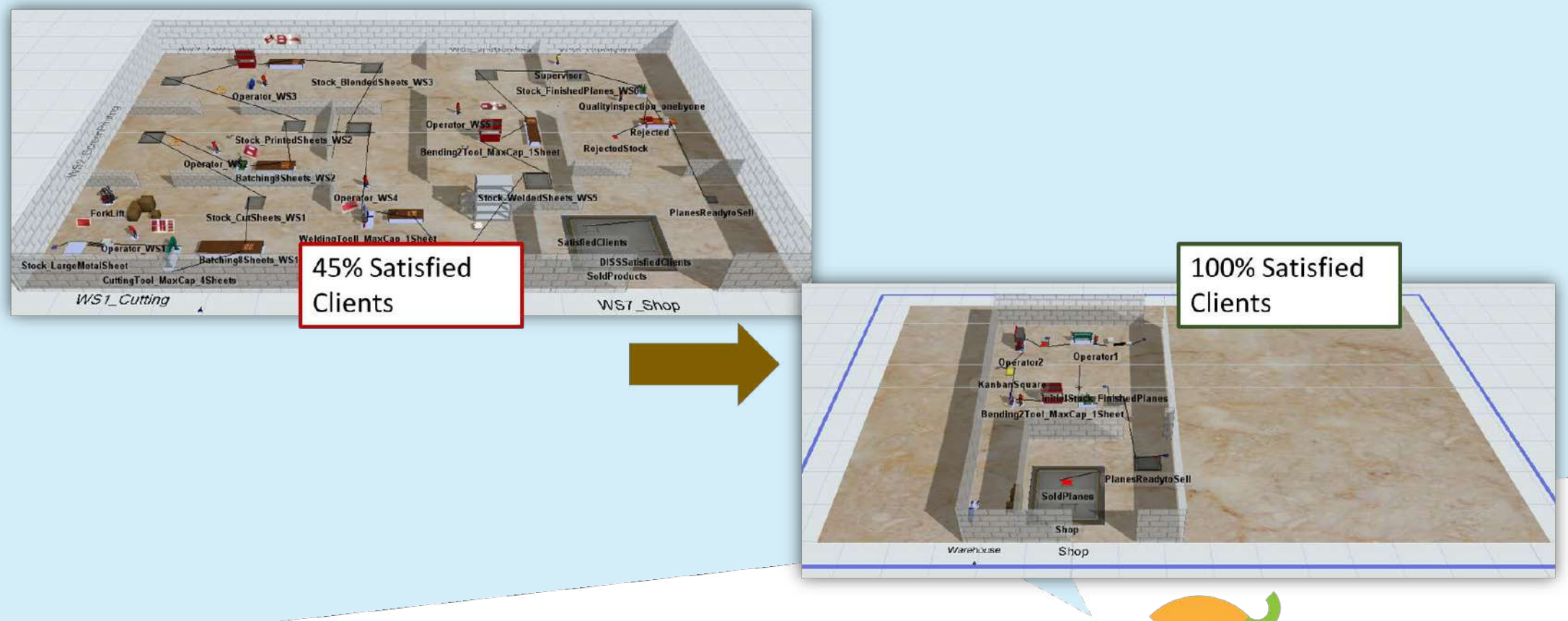


4. Analyse the proposed solution and draw its VSM

The groups analyse the results of their solution using the KPIs and drawing the VSM of the final layout.



5. Compare the initial and final situation



04.

Results and Conclusions

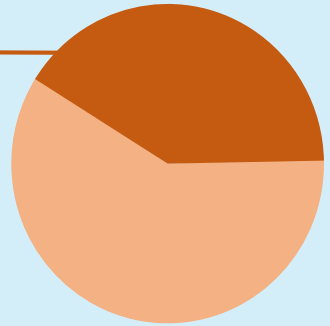
Results and conclusions

➢ **Responses of the students to the survey:**

- Before the activity:

40%

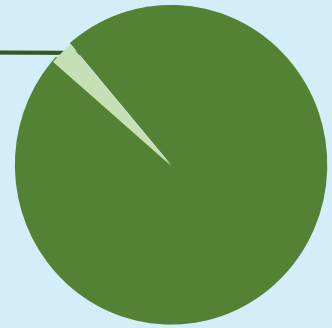
Do not have any knowledge of Lean Manufacturing



- After the activity

92%

Consider themselves able to implement Lean Manufacturing in a real situation



- Most of the students feel that the activity is entertaining and engaging
- Most of the students consider that the activity positively contributes to their future professional career
- The activity promotes the acquisition of soft skills such as problem-solving and collaboration

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