Streamlining and Improving on Assembly Process

Department of Industrial Systems Engineering and Management
IE3100M Systems Design Project | Group 7

SDP Supervisor Assistant
Dr. Yap Chee Meng
Supervisor
Phua Boon Ween, Kevin Teo
Team Members
Cham Dao Hong | Chiang Wen Hsin | Darren Fong Guo Ren | Gao Xu Xin

TechnipFMC | NUS National University of Singapore

Company Background

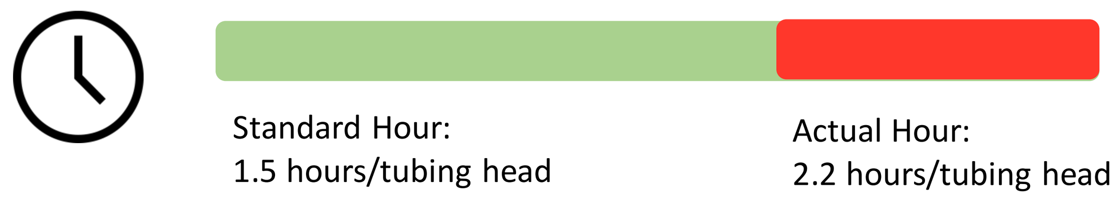
TechnipFMC is a global manufacturing leader in the oil and gas industries. TechnipFMC is organized in three business segments – Subsea Technologies, Surface Technologies, and Technip Energies. Currently, TechnipFMC has approximately 37,000 employees spreading across 48 countries.

Project Objective

The team was tasked to streamline the Assembly process under the Surface business segment which provides TechnipFMC customers with field-proven equipment The goal is to accurately map out the current state and propose a future state of the manufacturing supply chain where wastes are identified and reduced/removed to increase efficiency. Methodology shall be in-line with LEAN principles with tangible savings in cost and time.

Problem Overview

In order to maximize the impact of the project, tubing head was chosen as the focus of the project as it is currently the top selling project under the Surface business. Furthermore, it also has a significant mismatch between the standard assembly hours – an internal estimates of the number of man-hours the company should dedicate to a particular product type, and the actual work hours.



The final proposed solution aims to be **measurable, impactful and actionable**. Allowing TechnipFMC to strive towards lean operation through process cycle time reduction.

Methodology

Process Discovery with SIPOC → Detailed Process Mapping with Microsoft Visio → Identifying Values and Waste → Problem Identified → Design Considerations → Solutions and Recommendations

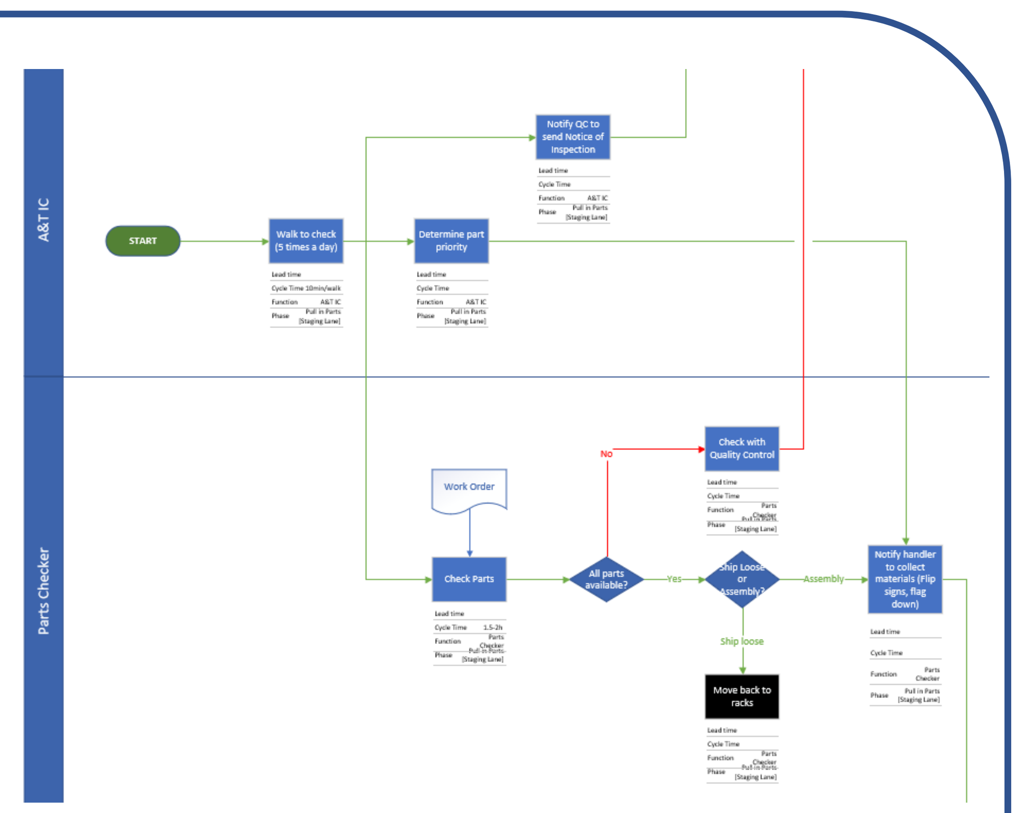
SIPOC

- SIPOC stands for suppliers, inputs, process outputs and customers which form the columns of the table.
- SIPOC draws clear boundaries to the entire assembly process which appear to flow seamlessly at the first glance.
- Established the level of detail needed for the value stream mapping

Supplier: Description	Supplier: Type	Input: Description	Input: Type	Process	Output: Description	Output: Type	Customer: Description	Customer: Type	Voice of the Customer (What does the customer require)
Material handler	Internal	Tubing head (low level) delivered to staging lane Secondary parts delivered to warehouse staging lane Forklift Production order	Material Material Resource Documentation	Pulling of parts into Assembly Area	Tubing head (low level) in Assembly zone Secondary parts in Assembly zone	Material Material	Assembly Technicians	Internal	Tubing head (low level) and secondary parts are sepearted into pallets according to their part number
Assembly Technicians	Internal	Tubing head (low level) Secondary parts Production order (for part numbers) ZPP	Material Material Documentation Documentation	Parts Checking (ensure all materials required are obtained)	All required parts ready for assembly Parts that are missing	Material Information	Assembly Technicians Third-party Inspector	Internal External	All parts required for the tubing head (low level) should be presented No missing parts and process should go as smoothly as possible
Assembly Technicians	Internal	Tubing head (low level) moved to assembly zone Crane Craning tool Cleaning tools Mechanical lifting plan	Material Resource Resource Resource Documentation	Cleaning & Inspection	Tubing head (low level) on the rubber matt Parts that are non-conforming (rust or defect) Cleaned anti-rust from tubing head (low level)	Material Material Material	Assembly Technicians Third-party Inspector	Internal External	Tubing head (low level) should be free from anti-rust and should not be rusty or defected before stenciling Process should go on as smoothly as possible
Assembly Technicians	Internal	Tubing head (low level) on the rubber matt Cleaned tubing head Stenciling machine Production order for part numbers	Material Material Resource Documentation	Stenciling	Stenciled tubing head (low level) with respective part number	Material	Assembly Technicians Third-party Inspector	Internal External	Tubing heads(low level) are stenciled with their respective part number Process should go on as smoothly as possible
Assembly Technicians	Internal	Tubing head (low level) Secondary parts ZPP	Material Material Documentation	Part Matching (marking secondary parts to match tubing heads)	Matched secondary part to tubing head body (low level) Marked secondary parts in assembly staging lanes	Information Material	Assembly Technicians Third-party Inspector	Internal External	All parts are marked with number to match the tubing head(low level) Process should go on as smoothly as possible

Detailed Process Map

- The detailed process map is an extension of the SIPOC.
- The horizontal axis is the overarching process, and the vertical axis is the functional group involved.
- Each rectangular block represents a step in the process, while each diamond block represents a decision-making process.
- Green arrows signify the correct flow of processes while red arrows signify failure cases.
- Process time details are captured, including small steps such as form filling and the document that is being filled.
- Estimated cycle times are recorded over blocks of several processes.



Identifying Values & Waste

- Lean wastes are being identified at every step in the detailed process map
- Tubing head is a **build-to-order product**; hence overproduction waste does not exist.
- The main waste is **waiting** which can further worsen the **underutilization of talent**
- A solution is proposed for every identifiable issue and discussed with the technicians for **effort and impact analysis**
- Eventually **drawing test plug and critical materials** are identified as the biggest problem as it is a single point of failure

Process	Function	Phase	Defects	Waiting	Non-utilised Talent	Transportati	Inventory	Motion	Overprocessin	Overproductic
			8 wastes of Lean Manufacturing							
Walk 5 times daily to check	Cell IC	Pull in Parts	NA	Waste	NA	Waste	NA	Waste	NA	NA
Determine and arrange part priority	Overall IC	Pull in Parts	NA	Waste	Waste	NA	NA	NA	NA	NA
Notify QC to send notice for inspection	Cell IC	Pull in Parts	NA	Waste	NA	NA	NA	NA	NA	NA
Check Parts	Parts Checker	Pull in Parts	NA	NA	NA	NA	NA	NA	Waste	NA
(If parts missing) Check with quality control	Parts Checker	Pull in Parts	Waste	Waste	NA	NA	Waste	NA	NA	NA
Move back to racks	Parts Checker	Pull in Parts	NA	NA	NA	Waste	Waste	Waste	NA	NA
Notify handler to collect materials	Parts Checker	Pull in Parts	NA	Waste	NA	NA	Waste	NA	NA	NA
Check with cell IC for part priority and location	Material hande	Pull in Parts	NA	Waste	NA	NA	NA	NA	NA	NA
Draw isolation plug	Material hande	Pull in Parts	NA	Waste	NA	NA	NA	NA	NA	NA

Process	Phase	Issues	Solution	90 Day	Category	Impact	Effort	Proposed Benefit
Draw isolation plug	Pull in Parts	- Only Mr. low knows the exact location of isolation plug, hence,this is a single failure point. - Other technicians takes about 1 hour to locate the plug due to: 1.Incomplete labelling when moving from previous facility to new facility 2. Disorganized shelving of equipment upon returning (no specific order, no specific location)	1. Relabel and optimize the storage layout the pallets in order to help technicians locate the necessary tool easily 2. Software to record the inventory and the location of where the materials are stored in the warehouse	Yes	Delivery	High	High	1. Removes the single point of failure (Mr. Low absent) 2. Reduces time wasted to search and find each isolation plug 3. Future-proofing for new technicians
Draw critical materials	Pull in Parts	Even though more people have knowledge on where the critical materials are compared to isolation plug, most of the critical material are unlabeled. Hence, time spend on locating can be further redueced.		Yes	Delivery	High	High	

Problem Identified

- Tubing heads come in **different configurations and dimensions**.
- Test plugs, test flange and critical materials needs to be drawn from the warehouse and attach to the tubing head before testing.
- Only **one material handler** is managing the testing tools.
- Material handler finds right tools in 5-30min, depending on his memory of the location.
- In his absence, other technicians can spend up to 1.5h to locate the right tools on the rack/pallet.
- **There are 2 major problems:**
  1. Pallets are unlabelled or poorly labelled with part information
  2. Pallets are arranged on racks randomly
- The **poor labelling system and over-dependence on the material handler** results in a **single point of failure** for this process.

Solutioning

Design Considerations

Rating	Total Operation Cost (A)	Impact (B)	Execution (C)	Business Needs (D)	Duration (E)	Implementation (F)
1	> $10,000	Low impact	Little confidence	Company does not need this	More than a year	Extremely difficult
2	>$5,000	Medium impact	Medium confidence	Solution solves problem but does not align with needs	Less than 1 year	Difficult
3	>$1000	High impact	Good confidence	Solution aligns with business needs but can implement over time	Less than 6 months	Manageable
4	<$1000	Highest impact	Excellent confidence	Solution aligns with business needs and company needs this change urgently	Less than 1 months	Easy Implementation

- A 3M (Manpower, Method, Machine) Matrix is constructed to evaluate each solution approach with the consideration of the existing resources in the warehouse
- **Manpower:**
  One-time labelling – Perform extensive labelling in one time window
  Incremental labelling – Perform labelling over time as parts are drawn for use
- **Method:**
  Common pallet design – Pallet that temporarily contains a mixture of different parts used frequently for a specific period of production
  Pallets by dimension/size – Each pallet contains parts of a specified dimension
- **Machine:**
  Inventory software – Software solution for calibration tracking and tooling for business
  Low level inventory visualisation – Easy to implement clipboard inventory list visible at eye level

Improve efficiency in drawing critical materials

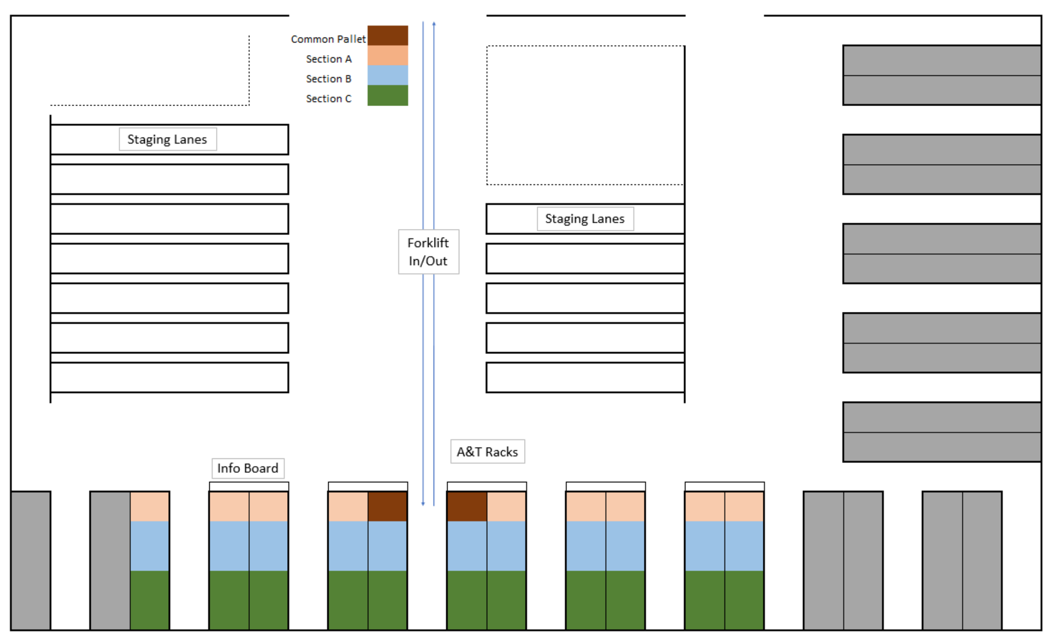
Category	Solution	A	B	C	D	E	F	Total
		Evaluation						
Manpower	One time labeling	2	4	4	3	4	2	19
Manpower	Incremental labeling	4	4	3	3	3	3	20
Method	Common Pallet Design	4	4	4	4	4	4	20
Method	Pallets by Dimension/Size	4	3	3	2	3	2	17
Machine	Implementing Software	1	4	2	3	1	2	13
Machine	Low-level inventory visualization	4	3	4	3	3	3	20

Action Plan: Phase 1- Preparation

- **Full inventory audit** to identify problem pallets – Note part number, dimensions, quantity, weight, location and whether the part has been stencilled.
- Post-audit, **standardize a label design** and begin making for pallets which contents will not be changed.
- **Perform incremental labelling** for the pallets with no part changes as they are drawn for use.
- **Create a clipboard inventory list** of all the information gathered, to be placed at eye-level on each rack → intermediate solution to shorten the time spent on locating testing tools

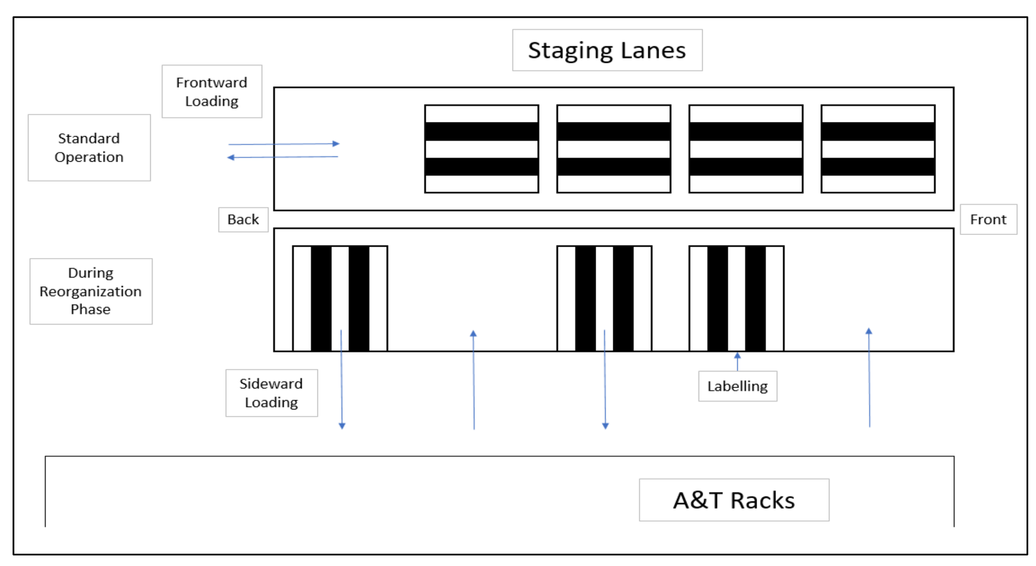
Phase 2: Planning

- A new layout for warehouse storage will be designed
- Follows the concept of 'ABC' sorting:
  Section A – High frequency of use
  Section B – Intermediate frequency of use
  Section C – Low/No frequency of use
  Common pallet – High frequency of use, especially during specific periods of time
- Planning part and pallet reorganisation:
  Part – Some parts will need to be regrouped, away from their original locations
  Pallet – With pallet content finalised, the final location of the pallet can be chosen subject to the new layout and rack weight limits



Phase 3: Execution

- Executing the plan must be carried out systematically to reduce disruption to standard operations.
- Buffer space is required during switching, to allow for rearrangement of parts, stencilling of parts and labelling of the pallets.
- At the end of this phase, all parts and pallets are in locations that are easy to access and easy to track.
- The clipboard inventory list is updated with the final information and a tweak to annotation is introduced to indicate that certain parts are currently in the common pallet, instead of their original ones.



Proposed Benefits

- Eliminate single point of failure
- Data collected facilitate future roll out of inventory software and predictive maintenance
- Based on an average 100 tubing heads orders, with 5 tubing heads per work order per month, the solution potentially save up to **360 man-hours** per year.
- Reducing actual hours per tubing head from **2.2 to 1.9 hour** → approximately **13.6% time saved**

Recommendations

Indysoft Implementation

- A software solution that can records all information, inventory and status of every testing tools.
- Allows technicians to locate the necessary tools quickly
- In a long run, the inbound and outbound data can be used to optimize the relocation of testing tools and pallets in the warehouse
- However, as material handler does not have extra bandwidth, it is recommended to have an extra manpower to manage the inventory and update Indysoft diligently.