

8th

Reinventing Maintenance

Lean Maintenance

April 27, 2011

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KCB

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Agenda

- Lean: What it is and what it is not
- The case for Lean in Maintenance
- The 8 forms of waste
- Lean Principles
- The Lean Improvement Cycle: 3 Key Behaviours
- Lean Tools & Techniques
- Lean Roadmap
- Conclusion

What Lean Is

- A process that drives increased value to the customer
- Lean simplifies work, eliminates waste, reduces costs & improves asset utilization
- A way of holding ourselves accountable to the goals we have set out to achieve

PUT SIMPLY:

*Lean is about focusing your efforts on what adds **value** to the customer, by focusing your attention on eliminating what does not.*

What Lean is NOT

- It's NOT about reducing headcount.
- It's NOT a flavour of the month or fad
- It's NOT an initiative or project
- It's NOT a short term fix

If you're going to adopt Lean as your operating philosophy, you need to provide AMNESTY to your people

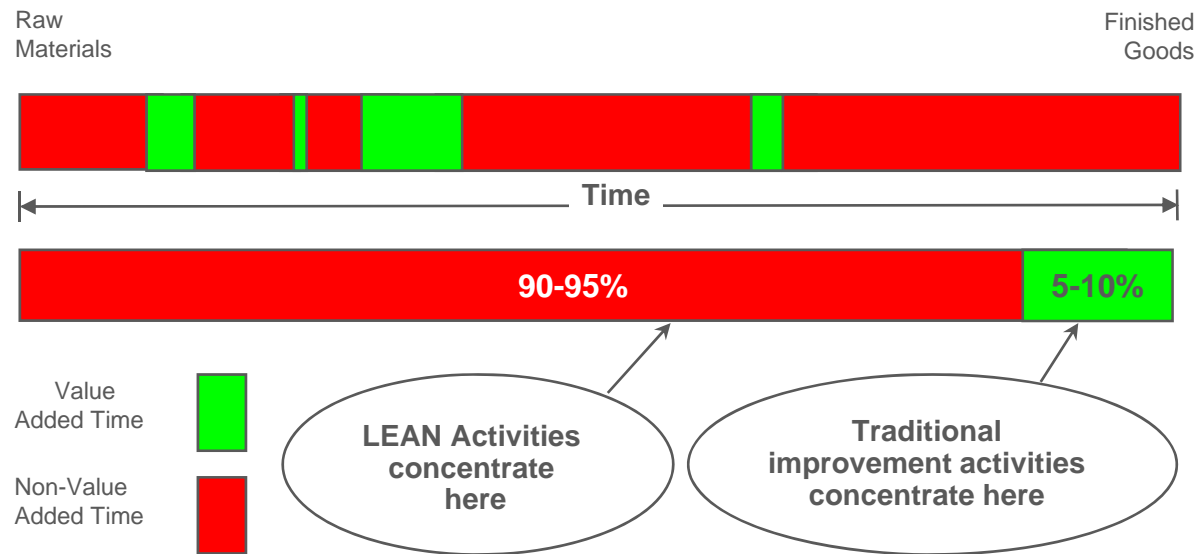
The case for Lean in Maintenance

- Capacity Assurance: Maintenance Excellence as a core competency
- Competitive Advantage:
 - Increased throughput
 - Improved yields
 - Increased savings
 - Improved labor productivity
 - Reduced working capital
 - Improved safety

Build the Business Case, Merchandise it, and
MANAGE to it

Lean Objectives

In most processes, a small percentage of total time spent is actually on what is perceived as value by a customer.



Typically, companies concentrate on decreasing the 5-10% of “value added activity” by **working harder**, rather than attacking the 90% of “non-value added” (NVA) activity and **working smarter**.

Lean focuses on reducing/eliminating NVA

8 FORMS OF WASTE: TIMWOOD

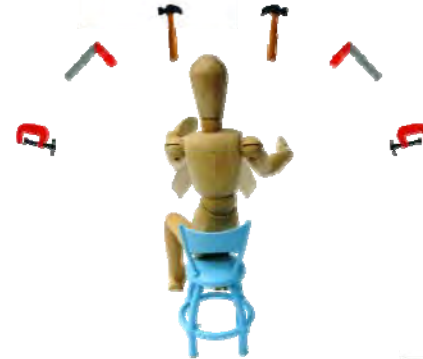
Transport



Inventory



Motion



Waiting



Overproduction



Over Processing



Defects



8. Waste of Intellect

Is there waste in your backyard?



Is there waste in your backyard? – Metallurgical plant



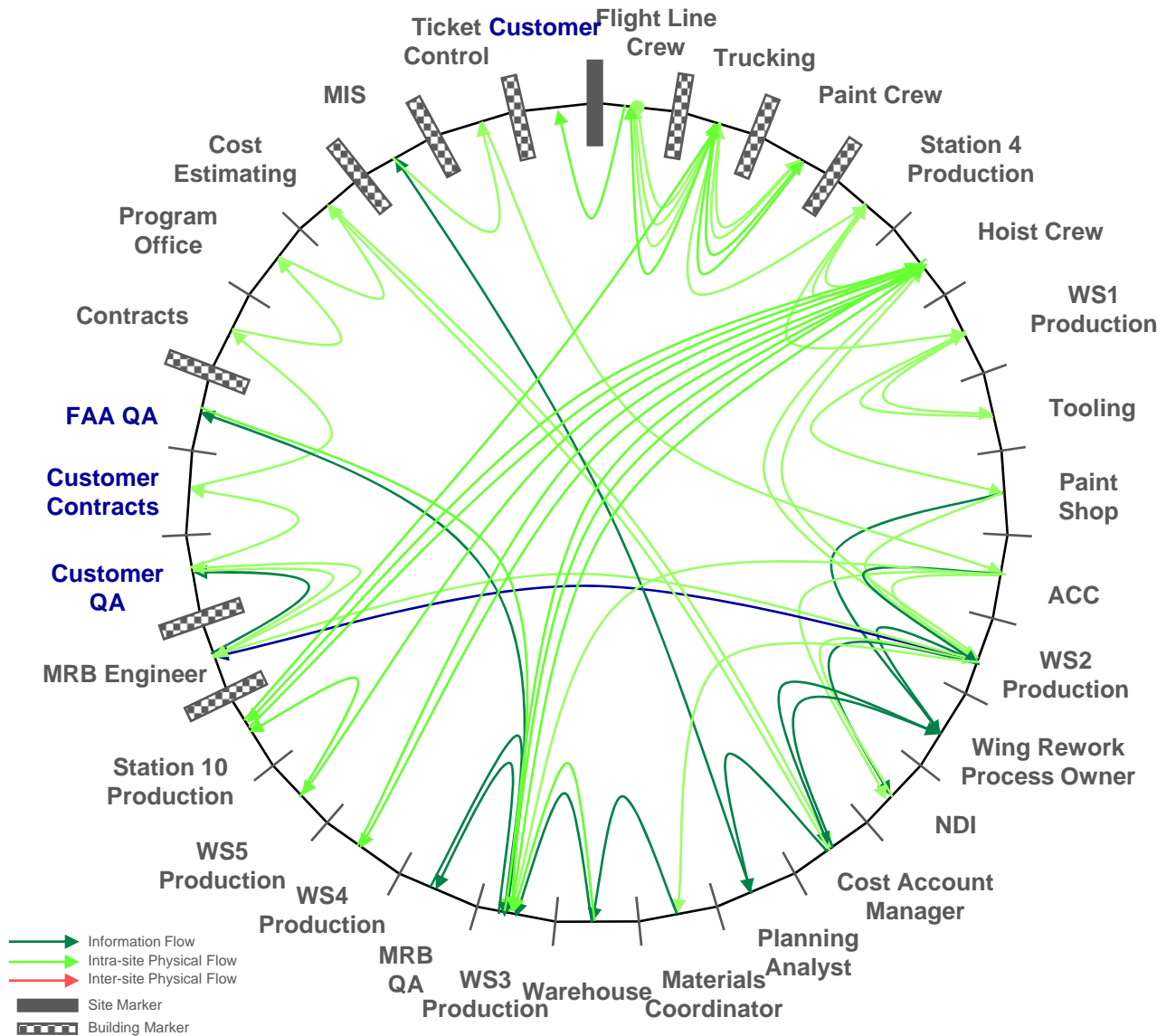
Is There Waste in Your Backyard? A mine storehouse



Is There Waste in Your Backyard?

Value Stream in Organizational Space (As-Is) Aircraft Wing repair

Wing Rework



Hand-off Statistics

Total Handoffs	62
Total Nodes / Orgs	31
Hand-offs to:	
Production	25
Program Support	23
Field Support	9
Customer/FAA	5
Suppliers	0
Inside Miami	62
Outside Miami	0

- Eight organizational nodes and 14 handoffs are introduced (beyond those required for core work) when a conditional kit is exercised due to Customer / FAA oversight and contract approval requirements
- In a conditional environment, hand-offs involving administrative organizations are approximately 112% of those involving value-adding organizations

Lean Principles, Tools & Techniques

PULL

Everything produced at the rate of production of the final product -- "pull" production control

- Just-In-Time production and delivery
- Linked production at Takt time
- Kanbans
- Level scheduling
- Machines available on demand

LEAN WORK METHODS

Tactical shop-floor policies used to implement Lean

- Product-oriented production
- Standard work
- Visual control
- Good housekeeping/5S
- Set-up time reduction
- Total preventive maintenance
- U-shaped lines
- Autonomation
- Line stops and andons
- Error proofing

FLOW

Maximizing value by producing only what is desired in the shortest time possible with the least resources

- Single piece flow
- Physically and visually linked operations
- Consolidated operations
- Simplified and standardized processes

ORGANIZATION & CULTURE

Progressive employee relations and change leadership

- Workplace safety
- Multi-skilled, flexible workforce
- Worker job security
- Improvement incentives
- Education and development
- Flat organizations
- Decentralized management

SOURCING & SUPPLIER INTEGRATION

Partnership between supplier and producer

- Fewer, better managed suppliers
- Quality at the source
- Shared destiny relationships
- Supplier development

PURSUING PERFECTION

Continuous improvement attitude and empowerment

- Kaizen events and continuous improvement
- Self-inspected quality, not inspected in quality
- Process ownership and responsibility
- Advanced quality concepts and measures
 - Hardware Variability Control (HVC)
 - Statistical Process Control (SPC)

3 KEY LEAN BEHAVIOURS

- We can often dive into solution mode when we want to improve a process, yet there are 3 key behaviours in Lean that challenge this approach:

- **GO SEE**

- Go to the process and look

- **SHOW RESPECT**

- Don't assume you know better than the people working the process every day

- **ASK WHY?**

- Respectfully ask the right people “why” to understand the process and unearth true, not assumed, **process waste**



3 MAIN TYPES OF WASTE OBSERVATION



Ohno Circle

Observe the process from a set position
Done in silence over an undefined period (depends on process)
No immediate interaction with the process performers



Waste Walk/Go To The Workplace

Study the process at the Workplace
Done over a few hours
Interacting with the process performers



DILO (Day In the Life Of)

Close study of work activity carried out by an individual or small team
At least a full day of observation

GO TO GEMBA (Waste Walks)

THINK OF TIMWOOD



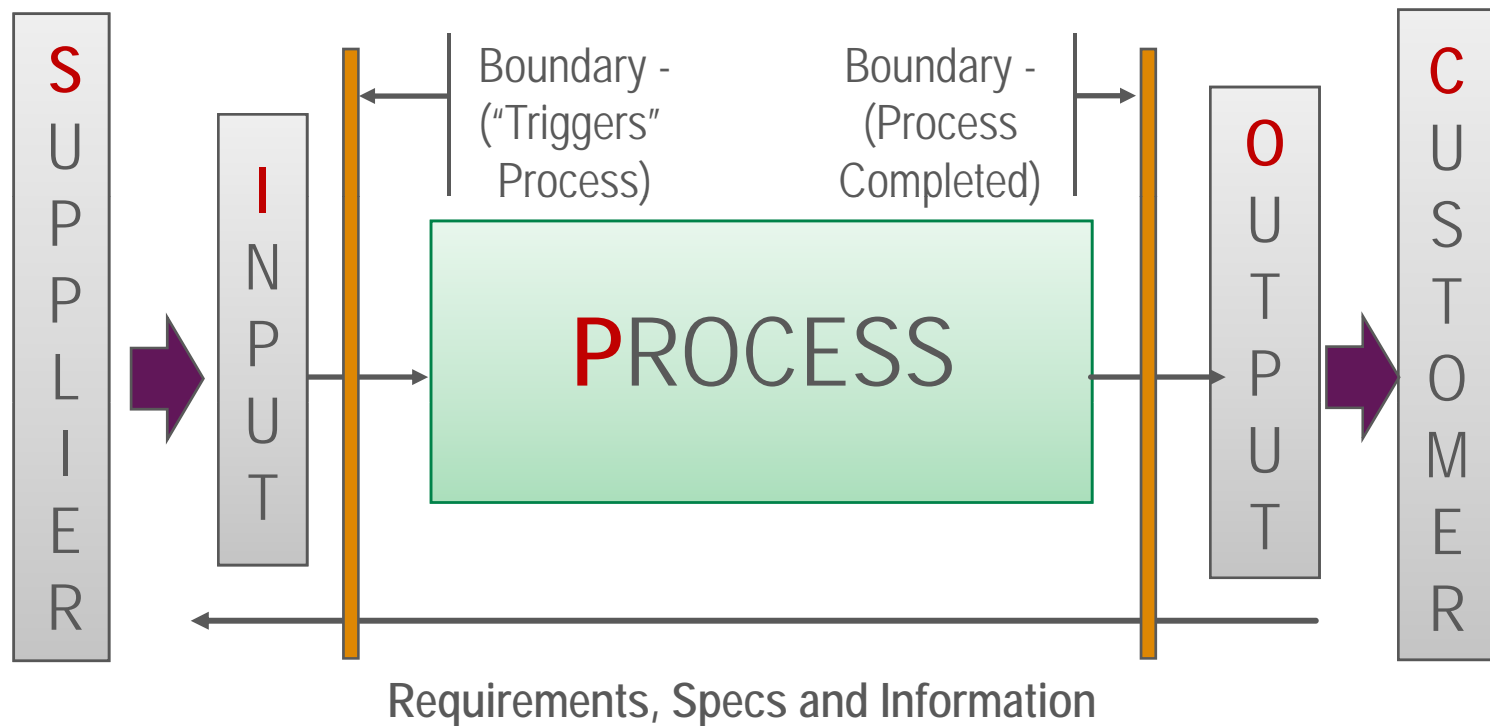
7 Waste		Observer's Name _____	Process / Activity _____
		Area Department _____	Date _____
Type of waste - TIMWOOD Transportation Examples: Movement of incorrect amount quantities, incorrect placement of goods within site, shipping full loaded containers, excessive transportation of supplies.	Type of waste identified	Ideas to eliminate waste	
	Transportation	Transportation	
Inventory Examples: excess or excessive of materials, just-in-case parts, incorrect storage of materials, excessive work-in-progress.	Inventory	Inventory	
Motion Examples: lack of proper storage for materials, tools, gauges, excessive material handling, poor ergonomics / manual handling.	Motion	Motion	
Waiting Examples: Waiting for inspection, for arrival of materials, tools, crane operator, for repair work, approach, change over information, confirmation on final use for material. Delay required.	Waiting	Waiting	
Over Production Examples: Excessing inventory, poor management of inventory, excessive production, multiple changeovers during set up work, creation of scrap, that are never used.	Over Production	Over Production	
Over Processing Examples: Duplication of work, lack of information and work instructions, excessive checking, inspection, testing, rework, producing non-conforming specifications.	Over Processing	Over Processing	
Defects / Rework Examples: All work is subject to the 8 wastes/7 wastes but as a customer-related to the customer.	Defects / Rework	Defects / Rework	

Forget the conference room, gather around Gemba. If the issue is core plug permeability, gather around the core! If the issue is waiting for computer time to run IPSP model, go to the computer! If the issue is on the Platform, go to the Platform!

- The employees that are closest to the issue are at Gemba. Use their experience and wisdom. The Team **MUST** Be involved in business problem solving – and – Continuous Improvement.
- By seeing for yourself at Gemba, you will better understand the process, arrive at the root cause and formulate a solution.

WASTE IDENTIFICATION: SIPOC

SIPOC is ONLY a tool used to document agreements made between the process customers and suppliers.



SIPOCs are often used as a pre-cursor to the creation of a Value Stream Map

VALUE STREAM MAPPING

- A series of steps and processes **including people, materials, information and equipment** designed to bring a product or service to the customer.
- In a **Lean Organisation**:
 - The process steps are interconnected and not separated, all elements focus their part in the end-to-end process.
 - Performance focus is on the end to end process.
 - The customer creates the demand (pull).
 - Improvement activity is looked at “end-to-end”.



5 WHYS

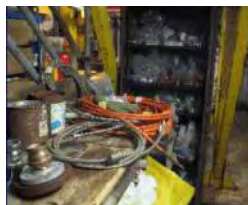
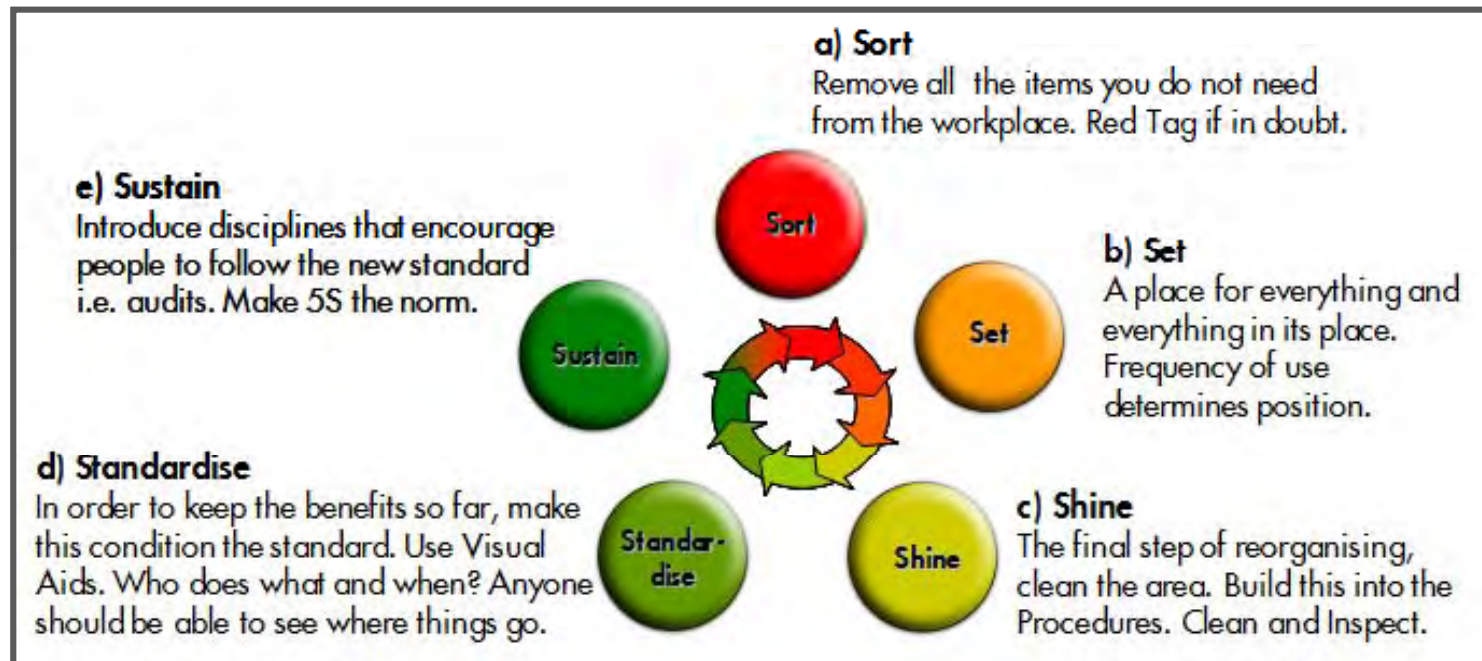
5 Whys is a progressive set of questions (whys) that help to identify the root cause of a problem. Essentially you write down a problem statement and then ask WHY - the first answer is the most important as this sets the scene for the subsequent questions

- We use this tool because:
 - It doesn't require deep expertise to apply
 - Quick and simple to use
 - No-one needs to be an expert in anything to do a 5 Whys investigation.
 - Using 5 Whys will not drown the team in paper work.
 - Identifies easy root cause issues.
 - Requires minimal data.



5S

Is a process for creating and maintaining an organized, clean, safe and high performance workplace, that exposes waste and is the foundation for Continuous Improvement.



Before



After

Technicians Area



Before

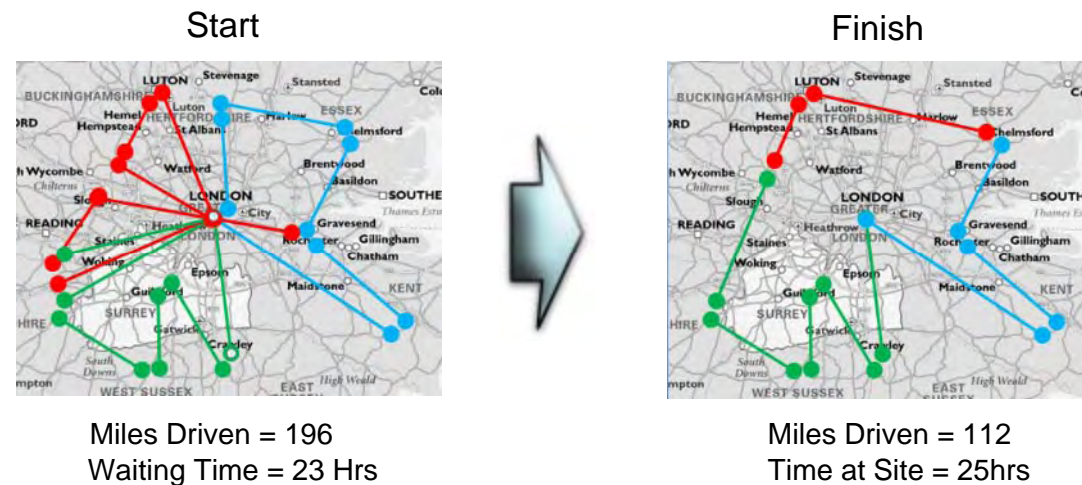
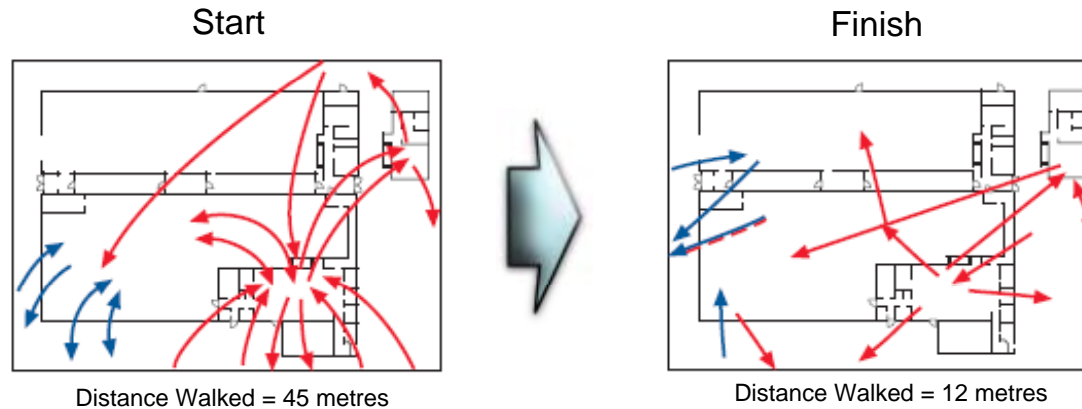


After

Office

SPAGHETTI DIAGRAM

A simple visual tool to optimise layouts and steps within a process: Used widely to identify two types of wastes: Transport and Motion.



Spaghetti Diagrams can be used anywhere, in an office, workshop or worksite.

SOME LEAN MAINTENANCE CASE STUDIES: WHAT IS AN SOP...AND WHAT MAKES A GOOD ONE?

Changeover - Loader System PPM-FSL011

Special Reminders

- GMP guidelines apply
- Wear gloves or very clean hands
- Hearing protection
- Eye protection
- Lock & tag
- If this is not done correctly, severe problems will occur
- Use table on reverse of this form to determine correct position
- Additional person(s) required
- Picture on front side
- Enlarged picture on reverse side
- Obtain all tools & materials listed on reverse side
- Related SOPs, documents, etc.
- PPM-FL-9001
- PPM-FL-9002
- PPM-FL-9010
- PPM-FL-9012

Procedure Overview

- Determine settings for desired product
- Set Vacuum Valve Positions
- Set Aligner Pin Position
- Enter Recipe for desired product
- Home Robots
- Start system when all systems ready

Instructions & Explanations

Target 22 min

- Complete pre-checks opposite
- Determine vertical & horizontal positions of Vacuum Valves for the product to be run
- Lock & Tag before proceeding
- Do the following for each side of each Robot:
 - Start with "handle" side of Robot. Loosen nut, move the locking bar out of position
 - Place Vacuum Valve in correct vertical position
 - Move locking bar back & tighten lock nut.
 - Repeat for both Vacuum Valves on "handle side" of this bay.
 - On "brush side" of Robot arm, Loosen nut & move locking bar out of position
 - Place Vacuum Valve into correct vertical & horizontal position
 - Move locking bar back into position & tighten lock nut.
 - Repeat for both Vacuum Valves on "brush side" of this bay
 - Repeat for each bay of each Line
- For each Robot do the following:
 - Confirm required Aligner Pin
 - Pull Pin out
 - Loosen both knobs
 - Place Pin in correct position & move plate until knob moves all the way down
 - Tighten the knobs
- Identify correct recipe for product to be run
- Go to a Control Screen
- From Operation Screen, touch Tool screen, On Tool screen touch Recipe area & scroll until required recipe is shown
- Touch Select Table Entry & enter your password
- Enter value for Recipe & confirm
- On Control Screen Operation screen, touch Home Robots
- Watch the Robots to ensure they "Home" correctly
- Clear any faults
- Notify operators of other systems. Press green Start button

2.1. Loosen nut, move locking bar

2.5 Place in correct vertical & horizontal position

3.2 Pull Pin out

4.2 Control Screen & 6.1

Changeover - Loader System PPM-FSL011

Pre-Checks (Things to check before starting this process)

- Ensure that all product from previous run has been removed from the area & documentation for line clearances completed
- Ensure that the Former & Sealer areas of the machine are ready & have sufficient raw materials available
- Ensure that new product in filled trays is available & ready to load
- Stack each bay of each line with filled trays of the new product to be run
- Ensure your hands are very clean or wear gloves when performing this procedure as you will be touching parts that will come in direct contact with tooth brushes.

Tools & Materials Required

Item Description & Quantity required

Item Description & Quantity required	Step
No special tools are required for this procedure	

People (Who is required or needs to be notified)

- Notify the people who will be operating the other parts of the machine & coordinate your activities with theirs
- Notify any other personnel who may need to be aware of this changeover

Key Learning/Performance Points

ITEM	C	Step
Using the table below, specify the Vacuum Valve and Aligner pin position for any given product.		1.2
Demonstrate how to lock and tag the machine.		1.3
For any given product, demonstrate how to find and select the appropriate Recipe		4.3
Perform a Loader System Changeover as per this PPM.		all

Step 2.2 Vacuum valves positions

Vertical Positions

- Position 1
- Position 2
- Position 3

Outside position

Inside position

Position vertically & horizontally

Vertical alignment (shown here for position 2, inside)

Recipe Table

Recipe No.	Toothbrush Type	Blister Type	Vacuum Valve Position Horizontal (Brush Side)	Vacuum Valve Position Vertical (Brush Side/Handle Side)	Aligner Pin Position
1	Brush-type1 Left	Brush-type1	Inside	Position 1 / Position 2	4
2	Brush-type1 Free	Brush-type1	Outside	Position 1 / Position 2	4
3	Brush-type2 Single Compact	Brush-type2	Outside	Position 1 / Position 1	5
4	Brush-type2 Single Full	Brush-type2	Outside	Position 1 / Position 1	4
5	Brush-type2 Dual Compact	Brush-type2	Outside	Position 1 / Position 1	5
6	Brush-type2 Dual Full	Brush-type2	Outside	Position 1 / Position 1	4

5S Lean Projects: Before & After



Disorganized maintenance areas with large inventory of parts/equipment



External yards strewn with old parts and equipment – no known owner or history



Maintenance areas cleaned, tools organized, and parts/equipment moved to warehouse or scrapped



External yards turned to marshalling zones with signs designating areas

Case Study: Pump Replacements (Cycle time reduction)

Optimizing globally by mapping and measuring the end-to-end process (Oil Company)

Objectives:

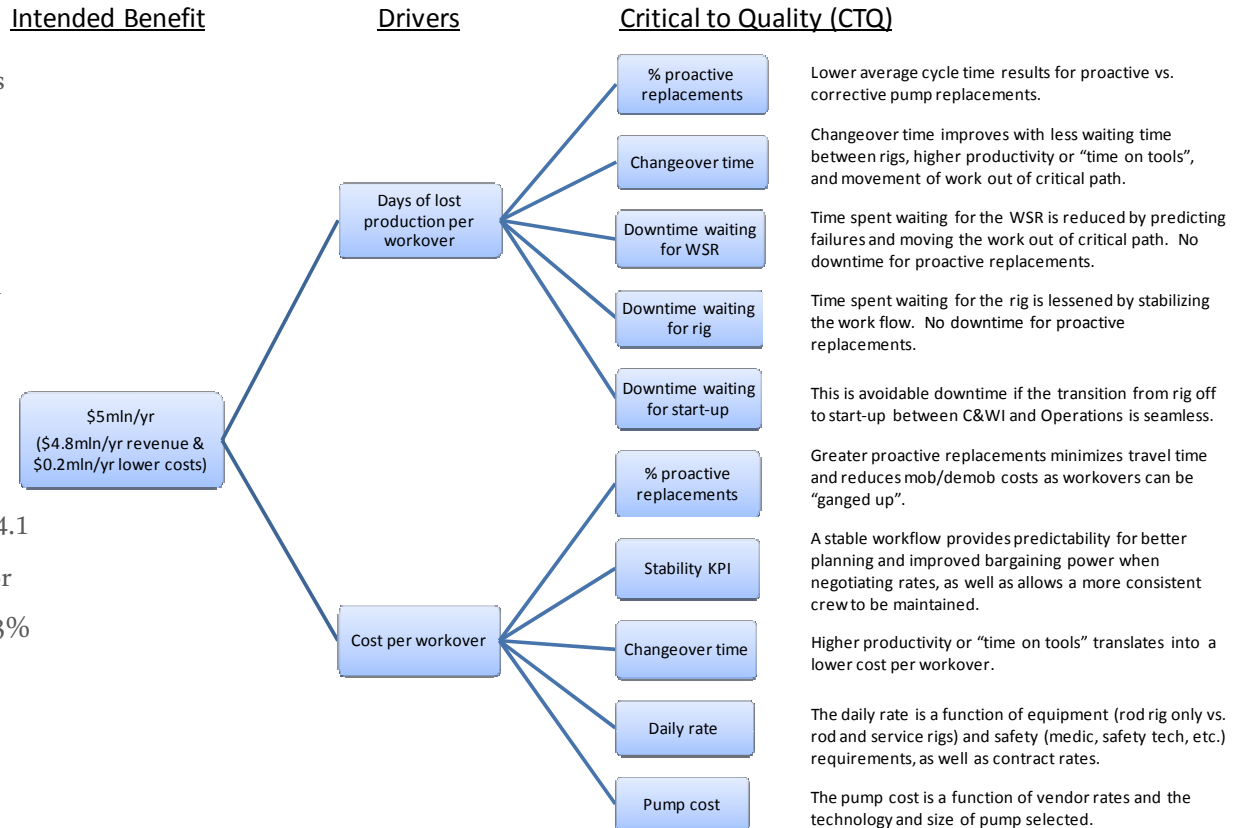
- Reduce cycle time for pump replacements in cold operations
- Decrease well workover costs

Case for Change:

- 11.3 day cycle time resulting in 375bpd of deferred production (\$8.2mln/yr in revenue)

Highlights:

- Proactive replacements have a 4.1 day cycle time (vs. 11.3 days for corrective replacements) and 13% lower workover costs.



Lean Maintenance Roadmap: Managing the Change Effort (a.k.a “The Soft stuff is the Hard stuff”)

1. Reducing complacency, fear, and anger to the point that the change has a chance of starting.
2. Putting together the right groups of people to drive the change effort who will take the time to develop a deep understanding of the what, the why and how of the change as well as act as role models and hold others accountable because they are committed, enthusiastic and focused on achieving the change.
3. Creating a vision which is clear, achievable and inspiring allows leadership to see the behavioural implications and develop performance metrics.
4. Consistently sending concise, candid, heartfelt, messages about the direction of change.
5. Getting people to act on the vision by removing disabling barriers (e.g. managing resistance; addressing resourcing challenges etc).
6. Get clear, meaningful and visible wins to quickly demonstrate that the change is on the right course.
7. Addressing the more difficult parts of the transformation by persisting, monitoring and measuring progress.
8. Making sure that new behaviour through modelling, rewarding and recognizing the new behaviours



Conclusion

- Maintenance isn't sexy. But for capital-intensive organizations, transforming the traditional function of maintenance into an integrated, strategic and fully-supported process can spell the difference between a company that attracts new business and provides a competitive advantage, versus one doesn't.
- Without question, adopting Lean as your Maintenance Operating Philosophy will deliver significant benefits:
 - Increased throughput (revenue)
 - Improvements in equipment availability & on-line time
 - Significantly lower operating costs
 - Reduced working capital
 - Fewer safety incidents

..... ***and your people will have fun doing it!***