



LEAN
SOLUTIONS
ACADEMY

Lean Six Sigma Training
Green Belt

brought to you by:



**PATRICK
ADAMS**
CONSULTING

Class Schedule

Day 1

- What is Lean Six Sigma ?
- 8 Wastes
- 5S
- Voice of the Customer (VOC) and CTQs Process
- Mapping, Value Stream Mapping

Day 2

- Pull, Kanban and Flow
- Visual Management
- Poka Yoke
- Standardized Work
- SMED
- Kaizen / Kaikaku
- **Define Phase**
- Problem and Project Selection and Definition
- Business Case Project Charter
- **YELLOW BELT EXAM (as Homework)**

Day 3

- **Measure Phase**
- **Introduction to SigmaXL**
- Fishbone Diagram, Pareto Charts
- FMEA
- Six Sigma Statistics
- Measurement System Analysis

Day 4

- Process Capability
- **Analyze Phase**
- Correlation and Regression Analysis
- Introduction to Design of Experiments (DOE)

Day 5


- Hypothesis Testing
- **Improve Phase**
- **Control Phase**
- Control Plans
- Statistical Process Control (SPC)
- Control Charts
- **Revision and Rework of Mock Exam Questions**
- **GREEN BELT EXAM (In own time)**

Flow and Pull

Remember the 6 fundamentals of Lean ?

1. Value

2. Value Stream

3. Flow 

4. Pull

5. Perfection

Flow

*(Keeping the value
stream moving)*

Flow

- Flow is sometimes referred to as **'Continuous Flow Production'**

Flow Production

Upstream (Suppliers)



"The ideal arrangement for Flow production should resemble a watershed: the river being the main assembly track, fed by tributaries in the shape of sub-assembly lines which, in turn, would be supplied by streams representing the machine lines fed by brooks typifying the material conveyors. Each part should flow continuously forward ... ultimately to the sea - the customers."

Downstream (Customers)

Flow and Pull

Enablers for Flow

1. Use Single Piece Flow or Smaller Batches
2. Total Productive Maintenance (TPM)
3. Line Balancing (Cycle Times and Takt Times)
4. Theory of Constraints
5. Mistake Proofing (Poka Yoke)
6. Jidoka
7. SMED (Quick Change Over)

One Piece Flow vs Batch

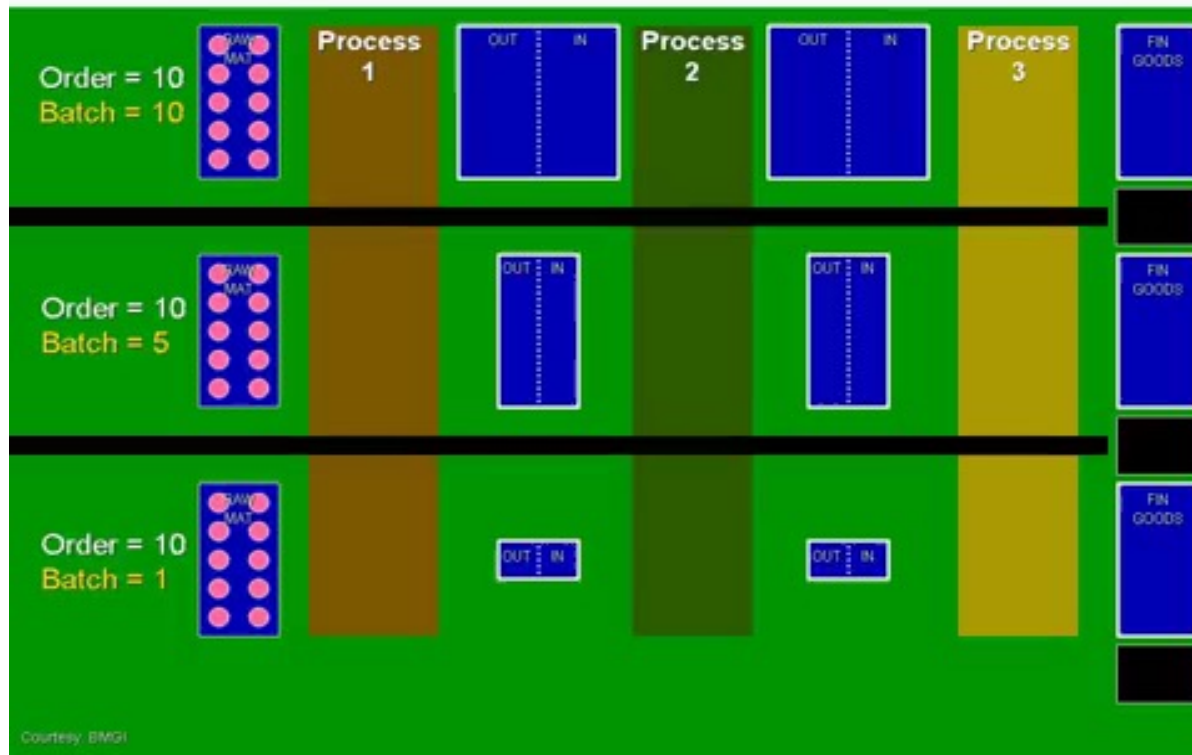
One Piece Flow



Batch



Flow – One piece flow versus Batch Production



Batch vs Single Piece Flow



TPM

Meaning of TPM

T-TOTAL

- Total efficiency
- Total life cycle of production system
- Total manpower coverage

P-PRODUCTIVE

- Productivity maximization by:
 - Zero accident
 - Zero defect
 - Zero break down

M-MAINTENANCE

- Maintenance covers life cycle of production system:
 - Individual processes
 - Plants
 - Prod. Mgt. System

“**TPM** is a new way of thinking about equipment maintenance to prevent accidents, defects, breakdowns or stoppages. **TPM** engages the operators and workers to improve equipment effectiveness with an emphasis on proactive and preventative maintenance.”

Six Big Losses

TPM Six Losses

- There are six equipment losses identified within TPM that are used to calculate your OEE (**OVERALL EQUIPMENT EFFECTIVENESS**).
 - Availability
 - **1. Breakdowns**
 - **2. Changeovers**
 - Performance
 - **3. Minor Stoppages**
 - **4. Reduced Speed**
 - Quality
 - **5. Defects**
 - **6. Setup Scrap**

Line Balancing

- Understand the TAKT TIME and CYCLE TIMES of the operations in your process and BALANCE your line. The goal is :

CYCLE TIMES = TAKT TIME

Definitions:

- TAKT TIME = Demand Time = Time needed to produce each unit of product or service in order to keep up with customer demand
 - CYCLE TIME = Actual time taken for production of each unit or service

Note: Always be aware for the specific definition of Cycle Time in your work or business because there can be subtle differences between companies

Line Balancing example

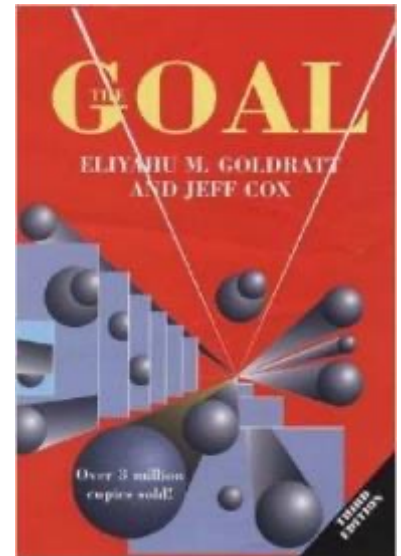
- Demand is 4,800 units per month. Assuming 30 days per month and 8 hours per day.
- Therefore TAKT TIME in minutes is :
Total time period in minutes ÷ total number units demanded
 $(30 \times 8 \times 60) \div 4800 = 3 \text{ minutes}$

Theory of Constraints

Theory of Constraints (TOC)

Focusing on any operation in a process that is not the constraint will not improve the overall Flow of the process.

1. Identify the constraint
2. Optimize the constraint
3. If necessary reallocate resources from other operations in the process to the constraint
4. If necessary bring in more resources from outside the process
5. Once the constraint is 'fixed', look for the New constraint in the process



Poka Yoke ***&*** ***Jidoka***

Poka Yoke and Jidoka prevent Defects

- **Create no defects / errors**
- **Accept no defects / errors**
- **Pass no defects / errors**



Jidoka

- **Work** stops immediately when a problem first is detected.
- The **Root Cause** of the defect is discovered and corrected before work continues
- This prevents defects being passed on downstream
- This short term disruption to FLOW will improve both FLOW and QUALITY in the long term

Poka Yoke

Originally called Baka Yoke (Idiot Proofing) it was changed to Poka Yoke (mistake proofing) by Toyota in 1963's so as not to dishonor anyone to be labeled as an "Idiot".

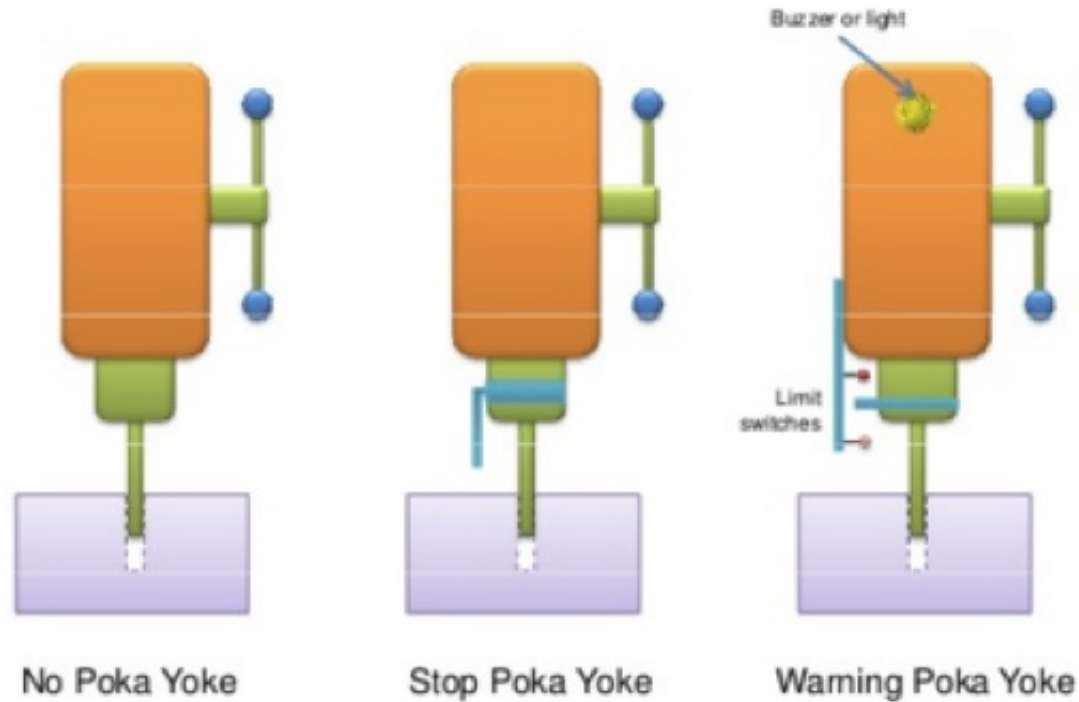
Poka Yoke = Mistake Proofing

- *Prevent mistakes rather than correct mistakes*
- *Prevent defects rather than correct defects*

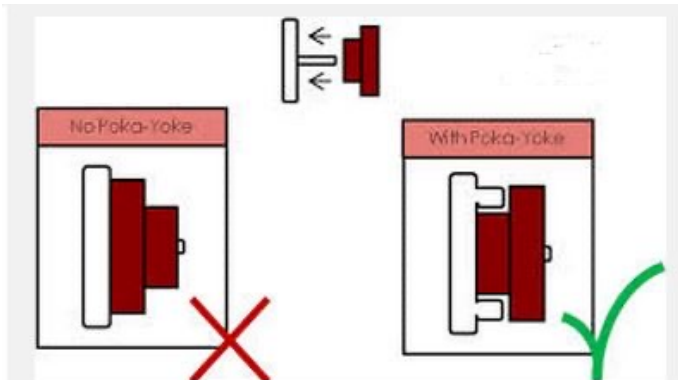
Poka Yoke example

Example:

Drill Poka Yoke



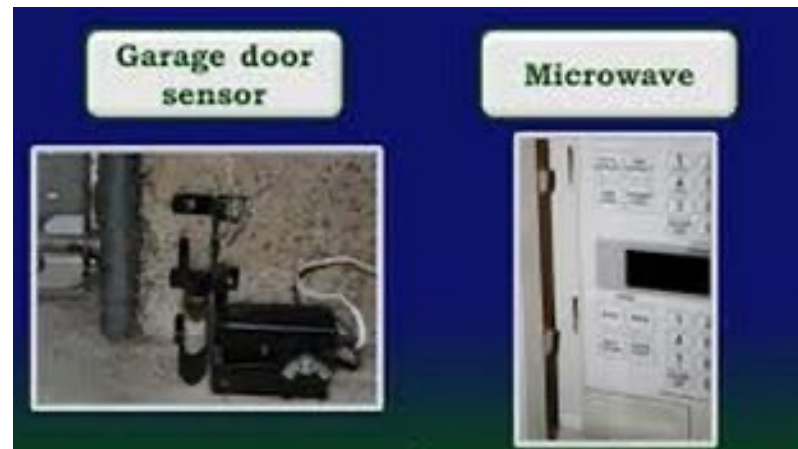
Poka Yoke Examples



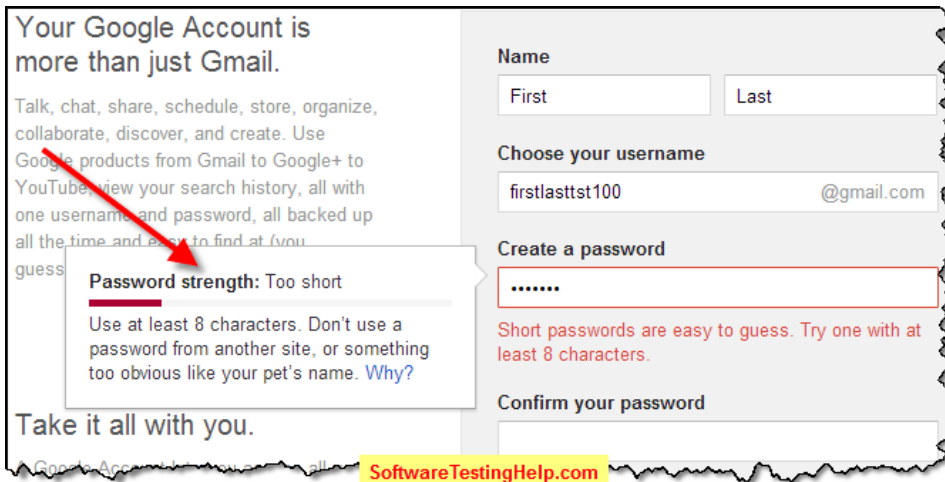
Andon

info@smirtandon.com

Andon Boards (Screens)



Poka Yoke Examples in the Office



Your Google Account is more than just Gmail.

Talk, chat, share, schedule, store, organize, collaborate, discover, and create. Use Google's products from Gmail to Google+ to YouTube, view your search history, all with one username and password, all backed up all the time and easy to find at /you/guess

Password strength: Too short

Use at least 8 characters. Don't use a password from another site, or something too obvious like your pet's name. [Why?](#)

Take it all with you.

Name: First Last

Choose your username: firstlastst100@gmail.com

Create a password:

Short passwords are easy to guess. Try one with at least 8 characters.

Confirm your password

SoftwareTestingHelp.com



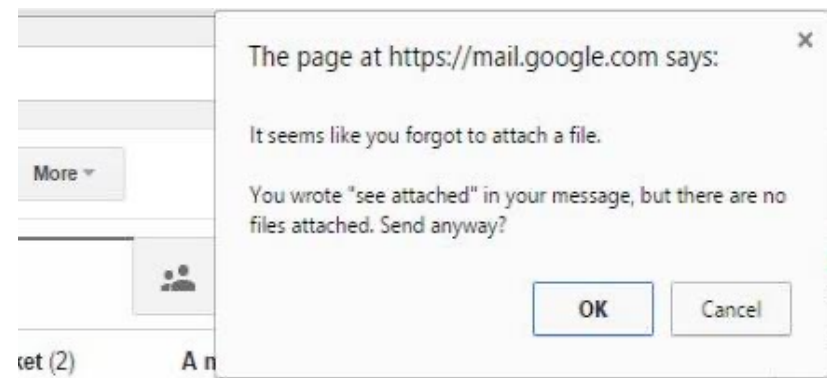
Google

software testing

- software testing
- software testing certification
- software testing life cycle
- software testing jobs

Showing results for [software testing](#)

Search instead for [softwar testing](#)



The page at <https://mail.google.com> says:

It seems like you forgot to attach a file.

You wrote "see attached" in your message, but there are no files attached. Send anyway?

More ▾

OK Cancel

**How many Poka Yoke devices can
you see in the following video ?**

LEAN SOLUTIONS

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Quality at Source (upstream Quality)

- Quality means meeting requirements of the customer (or next step in the process) and not creating defects.
- We can use tools such as **poka yoke** (mistake-proofing) and **visual control** to prevent errors

Poka Yoke in your work

- List some examples of Poka Yoke (Mistake Proofing) that you use in your company.

- Can you think of some new areas of your work that could use a Poka Yoke ?

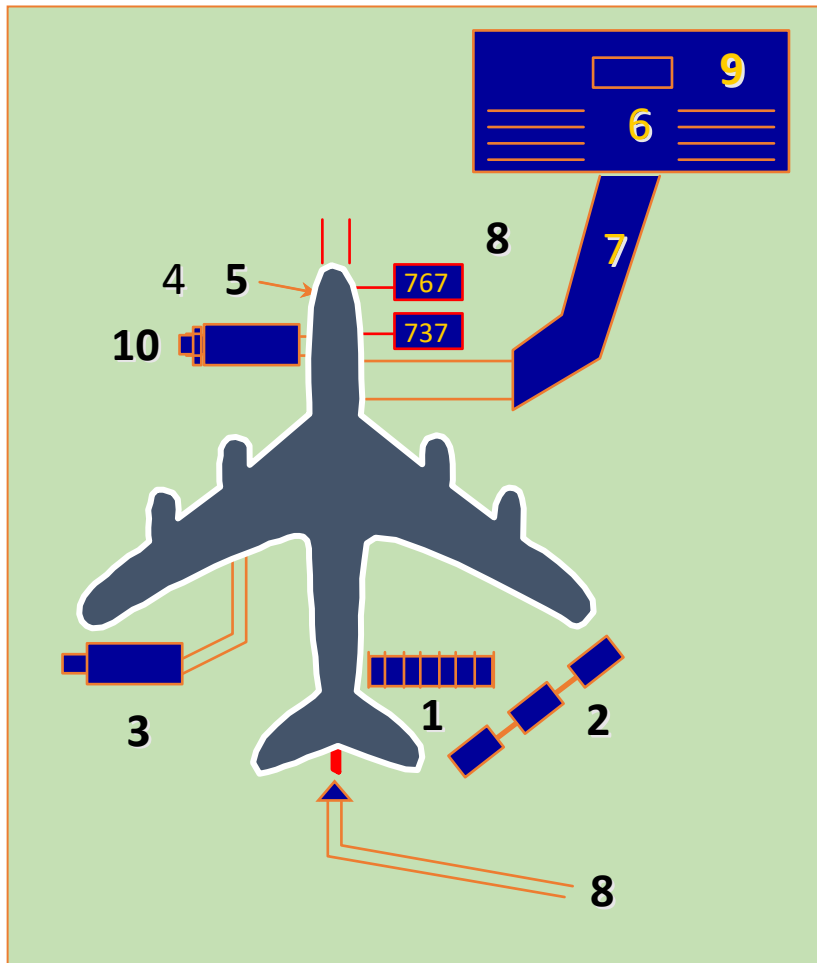
Quick Change Over

(SMED)

Quick Changeover / SMED

- Quick changeover and new setup. The faster the changeover times, the less downtime of equipment.
- Quick changeover principles can be used and applied in almost any operation or process.
- It was originally developed to improve die and machine tool setups.
- **SMED = Single Minute Exchange of Dies**
- **Change over of an Auto Body Panel Die (mould) in less than 10 minutes.**

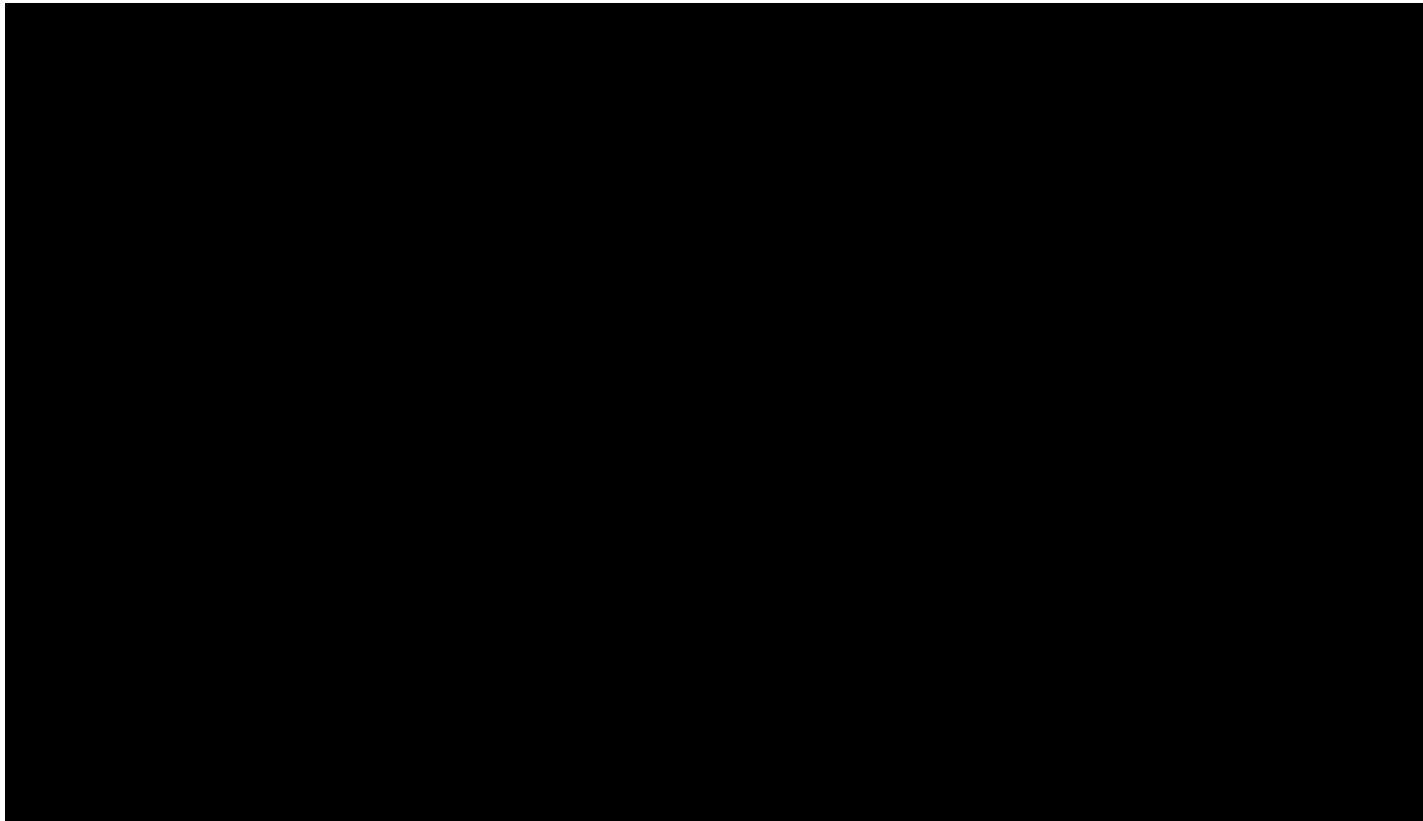
Classic Quick Changeover: Airport Arrival/Departure



Goal: Fast turnaround of aircraft with minimum delay to departing and arriving passengers

1. Unload/load baggage on roller conveyer with bar-coded baggage tracking
2. Preposition full and empty baggage carts
3. Preposition fuel truck for high-speed fuel dump
4. Prebrief pilots
5. Precook, package, and load meals
6. Perform computer-assisted plane preflight check
7. Use flexible ramp jet way
8. Use marked taxi and park lines
9. Precheck passengers and position close to gate
10. Use 2nd service door to enable parallel food and passenger loading

QUICK CHANGE OVER / SMED VIDEO



F1 Pit Stops 1950 vs 2013: Quick Changeover / SMED

<https://www.youtube.com/watch?v=UllGI3laGAo>

Stage 1: Observe & Measure Total Changeover Time

What is the correct method of measuring changeover time?

Changeover time should be recorded as the interval between the stopping and full-speed restart of operations - normally between the last good part produced in a production run and the *first good part* produced in the next production run

Actual shop floor measures and recording of changeover times often provides the only picture of the current conditions on the floor.

0 minutes

CHANGEOVER TIME

60 minutes

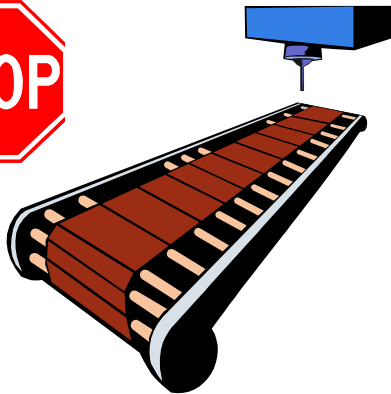
Value Added
Work Stops

Value Added
Work Starts

Stage 2: Separate Internal & External Steps

Internal steps

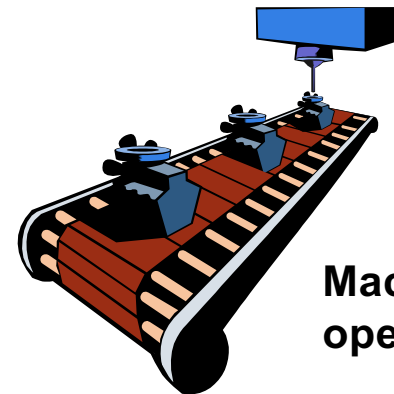
Activities occurring during the changeover that *can only be performed when production is shut down*



- Changing Screens
- Change Miner Picks
- Loosening/tightening critical bolts

External steps

Activities that *could be performed during a production run*



Machine is operating

- Cleanup
- Tool preparation and retrieval
- Assemble subcomponents
- Paperwork

Stage 3: Convert Internal steps to External steps



Stage tools in the area before the changeover so time will not be spent retrieving them during the changeover process



Wait until the changeover is complete to fill out paperwork or data entry into computer.



Examples: Eliminate Waste from Internal Steps

Current method

Improved method

Fastening

- Loosen attachment bolts
- Use manual tools (wrench, screwdriver, etc.)
- Use bolts and nuts

- Use fewer or shorter bolts
- Use air tools
- Use quick (1-turn) fasteners

Positioning

- Adjust to center manually
- Adjust front-to-back position manually

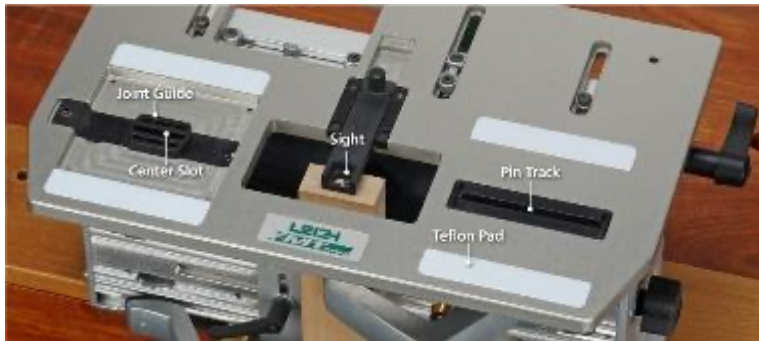
- Use center pins and guides
- Use stop-blocks to ensure proper position

Adjustments

- Manually adjust temperature and speed (using trial and error)
- Manually set programs for automated equipment

- Set temperature and speed at pre-determined standard
- Pre-load programs

Examples: Eliminate Waste from Internal Steps



Use locator pins and guides



Use Quick Release Mechanisms



Use Snap-On connections

Quiz 5:

- What is the standard symbol used to indicate a decision point in a Process Map ?
- **DIAMOND**
- There are 2 types of Value Stream Map. Once is a 'Current State' (as-is) map and The other is a _____ (_____) map.
- **FUTURE STATE MAP (To-Be)**
- Name one measurement that you would see on a **Value Stream Map** that you would not see on a Process Map ?
- **TIME, REWORK, WASTE, OPERATOR NUMBERS, INVENTORY**
- What is the Japanese name used for 'Mistake Proofing' of a process step ?
- **POKA YOKE**
- FLOW is critical to any process? What needs to Flow in an Airport or Hospital ?
PEOPLE flow in Airports and Hospitals
- **SMED** is an acronym used in Lean Manufacturing. What is a good name this same principle when used in Service Organizations ?
- **QUICK CHANGE OVER**
- A fundamental concept of any Lean Process is that it has no delays, constraints, Waiting or Queues. This Lean concept is call _____
- **FLOW**

Case Study

Case Study of improved FLOW PRODUCTION

Purever Industrial Solutions (Nelas-Portugal)

PRODUCTS



Shelves for Food Sector



Modular Cold Rooms

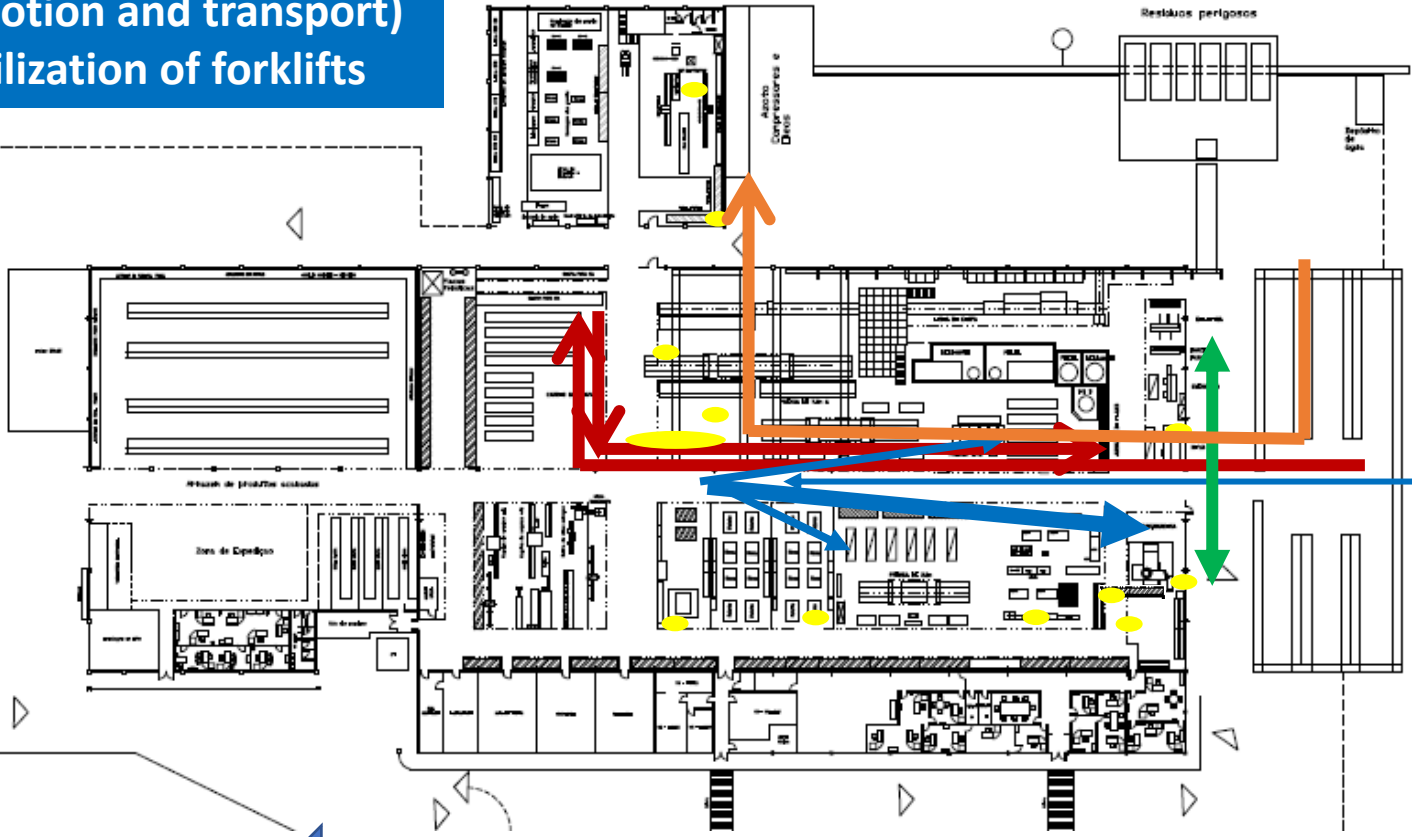
The Plant



Analysis of Flows in Jan-2017

Flow Analysis
Long distances
Waste (motion and transport)
High utilization of forklifts

WIP



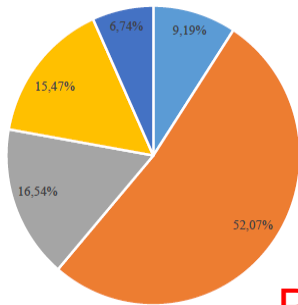
- ➔ Heavy, distant, forklift
- ➔ NVA movements
- ➔ Long distance
- ➔ Forward and backward

OUTPUTS INPUTS

Data Analysis in Jan-2017

Collection of times and distances

Materials transported by Operator from:

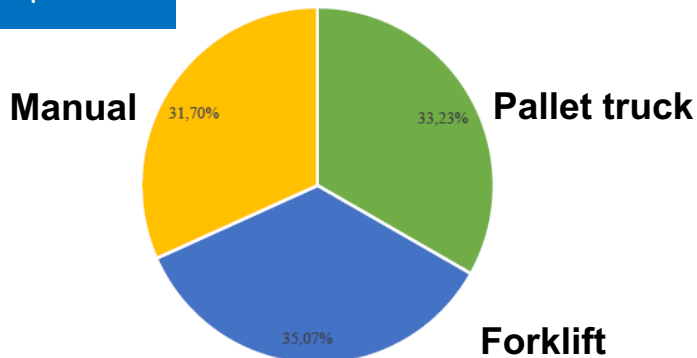


Logistics: 26%

Production!! 52%

Not adding value

How is transported:







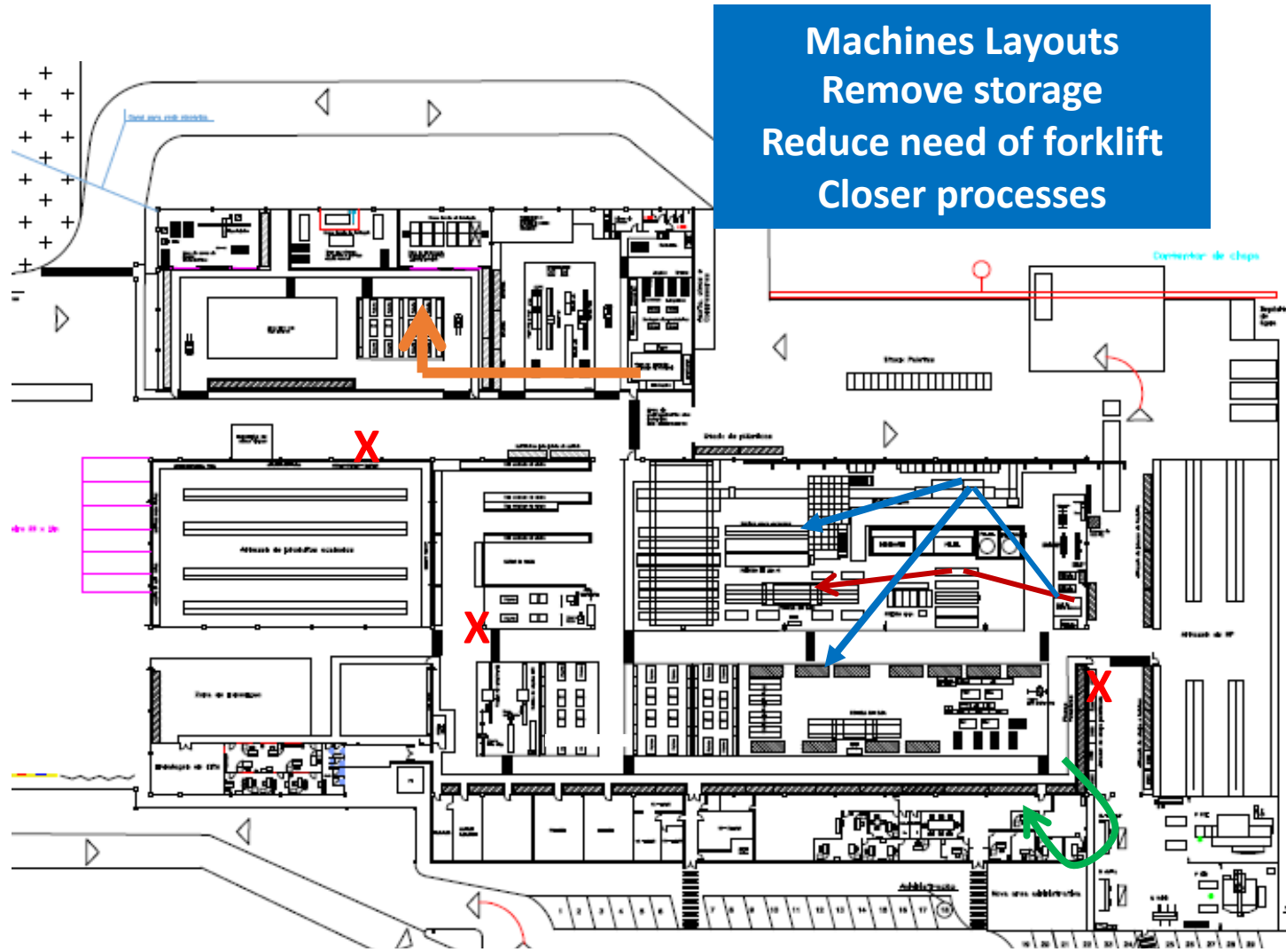
To \ From	Armazém	Linha Chapa	Armazém Chapa	Puncionadora	Máquinas Tradicionais	Preparação da prensa de 3.2m	Prensa 3.2m	Prensa 5.2m	Prensa 6m	Prensa 12m	Ferragem Pivotantes	Ferragem Deslizantes	Corte PVC	Ângulos	Máq. Madeiras	Alumínios	Salas Limpas	Coolblok	Estabilização	Expedição	Rua	
Armazém																						
Linha Chapa																						
Armazém Chapa																						
Puncionadora																						
Máquinas Tradicionais																						
Preparação da prensa de 3.2m																						
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Alumínios																						
Salas Limpas																						
Coolblok																						
Estabilização																						
Expedição																						
Rua																						

Matrix of all production flows and their frequency

Data for layout changes, milk-run and raw-material storage

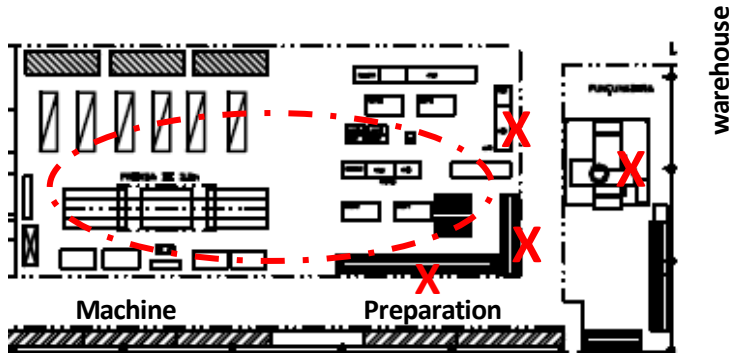
Improvement of Flows in 2018

-  Aluminium profiles
-  Steel plates
-  Wood pannels
-  Plastic and rubber profiles

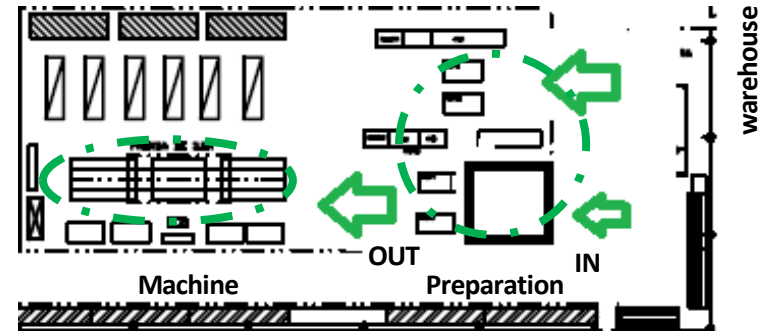


Creating Flow – Door Injection Press

Before



After



- No material Flow
- Machine stopped due to lack of prepared parts.
- Preparation stopped due to lack of components.
- Push production. No balance.
- Use of forklifts. Rack storage.
- 4 shifts (7 days / week) – total of 14

- Material Flow
- Machine is **pulling** production from Prep
- Preparation with Kanban system from warehouse.
- Reduced use of forklifts. Materials in conveyors or pallets.
- 3 shifts (5 days / week) – total of 13
- Tools: 5S, Kanban, Create Flow, Kaizen⁴³

Make space for Flow

- CLEAR AISLES



5S & Organization also played an important role in reducing waste

- No Need for Forklifts



From “we need more forklifts trucks!” to “we need more wheels and trolleys”

Layout Changes: more flow – less waste

- Change Layouts (team work)



Changed machine position so that material could flow directly to warehouse or next process

- Reduce stock / increase flow



Remove pallet racking storage => material needs to flow + less use of forklifts

Remove WIP – more flow, more space

Before

- Production Area Shelves /WIP



Removing this racks was one of the first actions. Benefits helped to reduce resistance to change!

After

- Flow, space and less WIP



The next step was changing machines and giving a fresh look to the shopfloor!

Reducing the need of forklift trucks

- Milk-run for long profiles



Long aluminium profiles (6m / 20ft) were now simple to deliver to cutting machine

- Materials moved in trolleys



Build trolleys to materials that are difficult to transport, assuring no damages or scratches

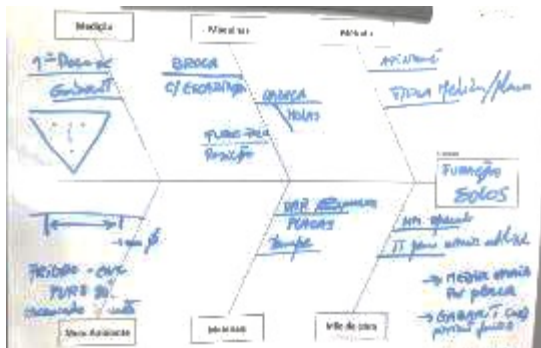
Quality Actions

- PROBLEM SOLVING TRAINING


Train and Practice



Basic
Quality
Tools!!



- QUALITY ALERTS



ALERTA QUALIDADE

MCO.DQ.060 / 6.1

Data: 14/08/2017

O que aconteceu?

- Buracos na mousse de PUR dos painéis;
- Painéis por limpar;
- Etiquetas sem Nº de Autocontrolo
- Reparações deficientes

Onde? Artigo / Cliente?

Stock Intermediário - Logística

Causas



- falta de controlo dos colaboradores
- não cumprimento das tarefas de verificação e reparação dos painéis
- manutenção e estado dos moldes


Ações tomadas

Identificação com etiqueta amarela – Aguarda reparação.
Quando se limpa e prepara o painel, durante a verificação visual devem ser corrigidas todas as imperfeições.

Planear intervenção aos moldes.

Imagens



Visually displayed in all areas

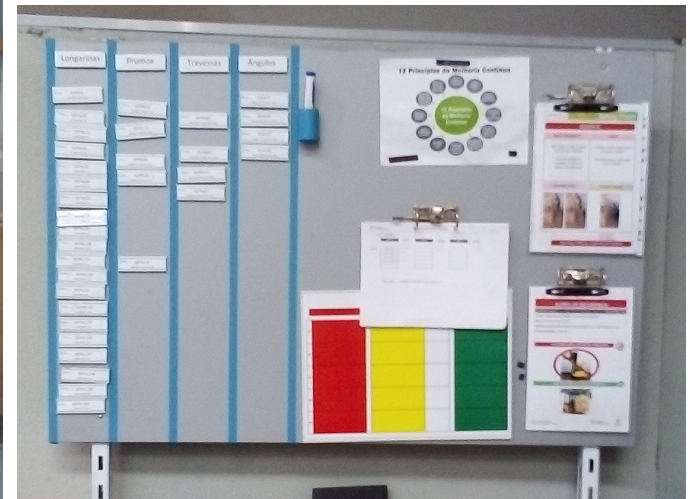
More Improvements Examples



Ergonomic
No pallet.
No Forklift.
No damages.



Kanban Board
near operator

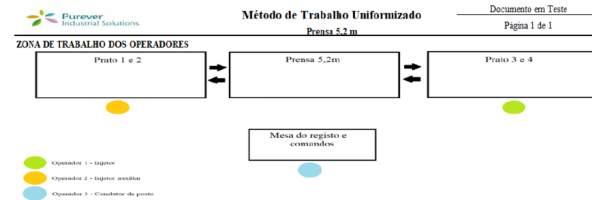


Colour code to
prevent mistakes

SMED (Rapid Change Over)



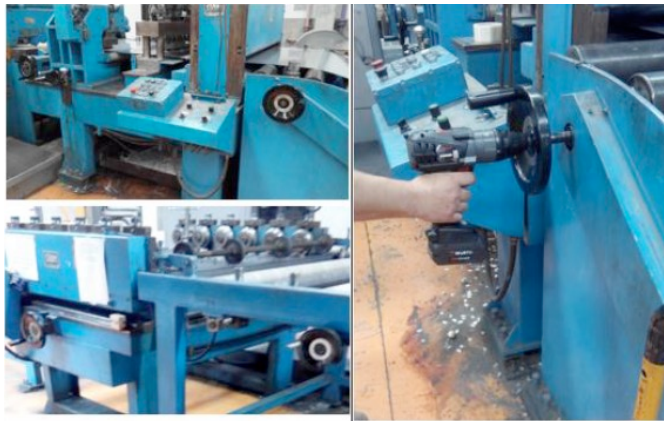
Organization and Visual Management



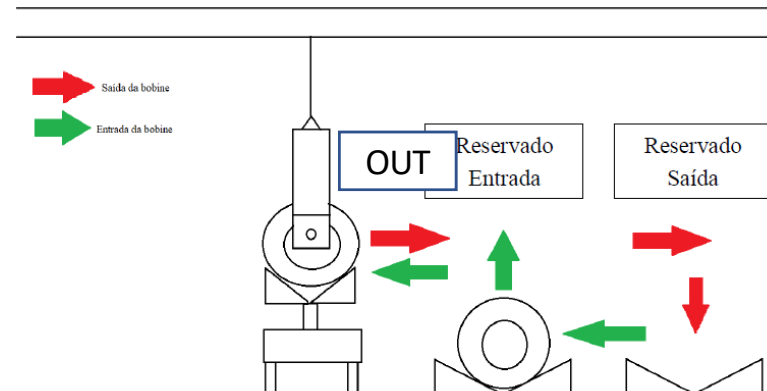
DISTRIBUIÇÃO DE TAREFAS NA PREPARAÇÃO DOS PRATOS

	Tarefa	Ferramenta	Tempo (min)	Tarefa	Ferramenta	Tempo (min)	Tarefa	Ferramenta	Tempo (min)
Se mudar medidas	Tirar painéis do prato (colocar os painéis de uma forma plana no painel anterior)		1,5	Tirar painéis do prato (colocar os painéis de uma forma plana no painel anterior)		1,5	Ajustar a tirar os painéis em cada um dos pratos		1,5
	Retirar moldes e espaçadores		2,0	Retirar moldes e espaçadores		2,0	Ajustar o operador que efetuar troca de moldes		4,0
	Colocar novos moldes e espaçadores		2,0	Colocar novos moldes e espaçadores		2,0			
	Limpar moldes	espátula, bichoquim e mandro	2,0	Limpar moldes	espátula, bichoquim e mandro	2,0	Regato da pressada anterior		2,0
	Limpar prato	pinçeta	1,0	Limpar prato	pinçeta	1,0	Identificação de painéis		
	Aplicar desmoldante		1,0	Aplicar desmoldante		1,0	(ajudar operadores com a chapa caso seja de grandes dimensões)		3,0
	Colocar chapas exteriores no prato		1,5	Colocar chapas exteriores no prato		1,5			

Standards and Team Work



Reduce time



Preparation – External activities

Results 2017 vs 2018

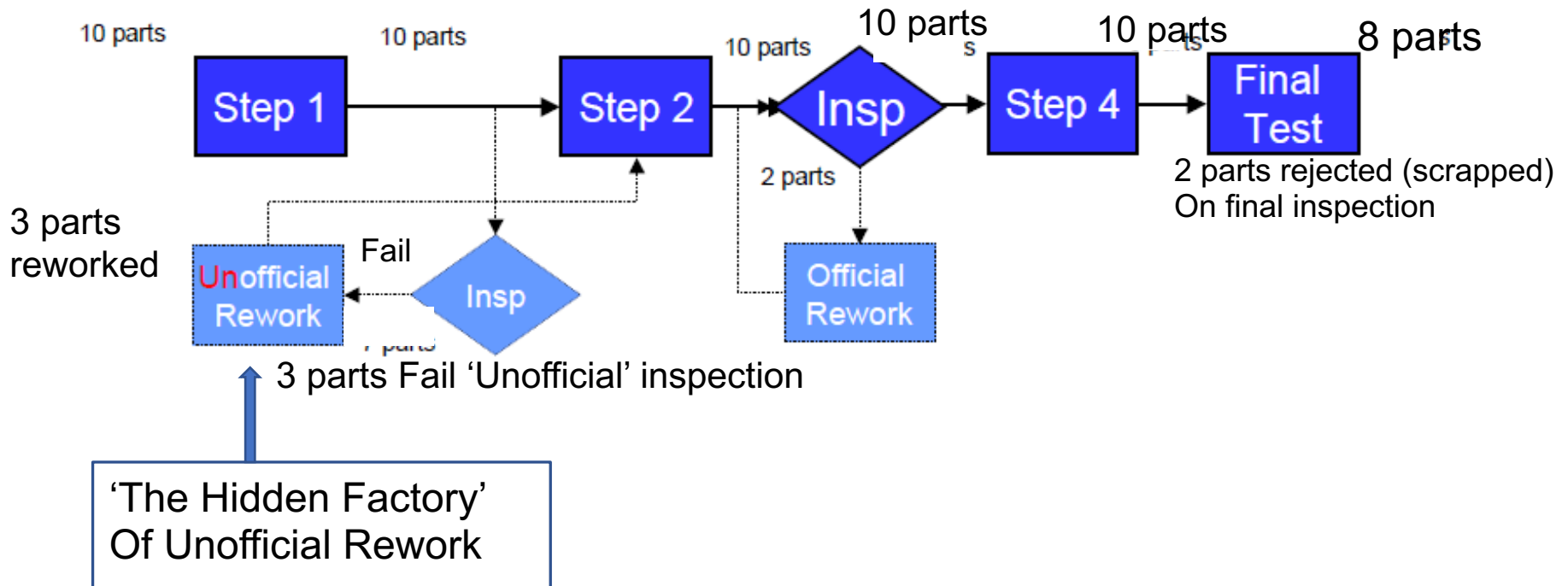
Weekly Results

RESULTS	Jun-17	Nov-18
OUTPUT (m2/week)	500	1500
OEE	41.7 %	78.9 %
Defects	1.5%	0.2%
Average WIP	50 Units	25 Units

Rolled Throughput Yield (RTY)

Rolled Throughput Yield (RTY)

RTY is the best measure of YIELD and is a true LEAN METRIC because it accounts for all WASTE (rework and scrap).



3 parts Unofficially Reworked + 2 parts Officially reworked + 2 parts scrapped
 10 parts started but only 3 good parts required no rework at all.

RTY = 30%

Flow and Pull

Remember the 6 fundamentals of Lean ?

1. Value

2. Value Stream

3. Flow

4. Pull 

5. Perfection

Pull

**(Downstream demand
driven production)**

Pull

Pull is sometimes referred to as
‘Just-in-time Production’

Just in Time

“PULL” and “KANBAN” are fundamental for...

...a JUST-IN-TIME process

- WHAT is needed
- HOW MUCH is needed
- WHERE it is needed
- (WHEN it is needed)

Note: ‘WHEN is usually not necessary because it assumed it is needed ASAP

Kanban

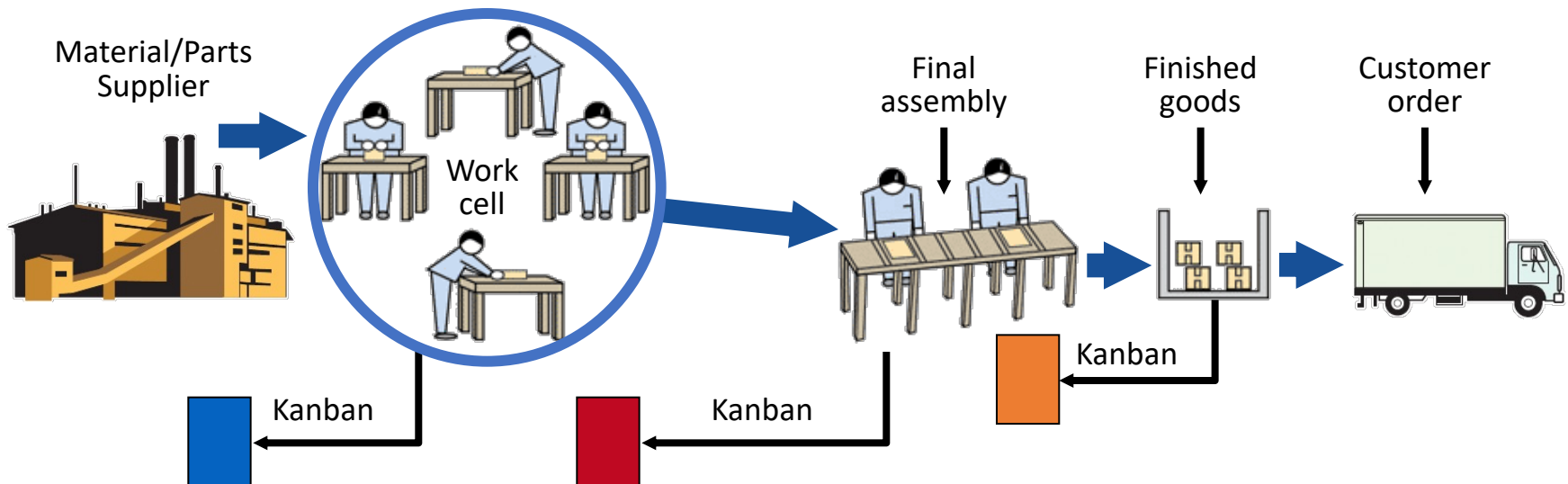
- **Kanban** is the Japanese word for ‘card’ or ‘ticket’
- The Kanban card was an authorization for materials to be moved from an Upstream location to a Downstream location. The card had printed on it What was needed How much was needed and Where it is needed.
- A sequence of Kanbans pulls material through the process
- Electronic signals are generally used today, but the system is still called a Kanban

Kanban Card EXAMPLE

Supplier: PU1 Description: Production Unit 1 Kanbans: 9	Customer: PU2 Location: Loc02 Container: Box 1 Qty: 100
created: 10/12/2013 22:33:00 printed: 11/12/2013 12:10:11	Description: Item 012345
 iks INTEGRATED KANBAN SYSTEM	Kanban ID:  1090
Item ID: 012345	

Kanban

Good Kanban Systems help to minimize inventory and WIP



Kanban Boards

Tool to track the **FLOW** of work on a project.

Use white-board and Post-it notes or software such as LeanKit.com



Kanban Boards

Visual Management

The Big Picture



Kanban Boards


See how KANBAN is improving time, cost and quality across new vehicle development projects at Jaguar Land Rover (Software and Hardware).

See Video at: <https://vimeo.com/172780037>



Flow and Pull

Remember the 6 fundamentals of Lean ?

1. Value
2. Value Stream
3. Flow
4. Pull
5. Perfection 
6. Involve and Respect Workers

LEAN
SOLUTIONS

brought to you by:



Kaizen

Small Steps

to Perfection

Kaizen



Kaizen : The Key to Japan’s Competitive Success : 1986. Masaaki Imai

Kaizen and Kaikaku

Definition of Kaizen:

Kaizen

“Change for the Better”

The philosophy of continual improvement, that every process can and should be continually evaluated and improved in terms of time required, resources used, resultant quality and other aspects relevant to the process. Step by step leads to BREAKTHROUGH Improvement.

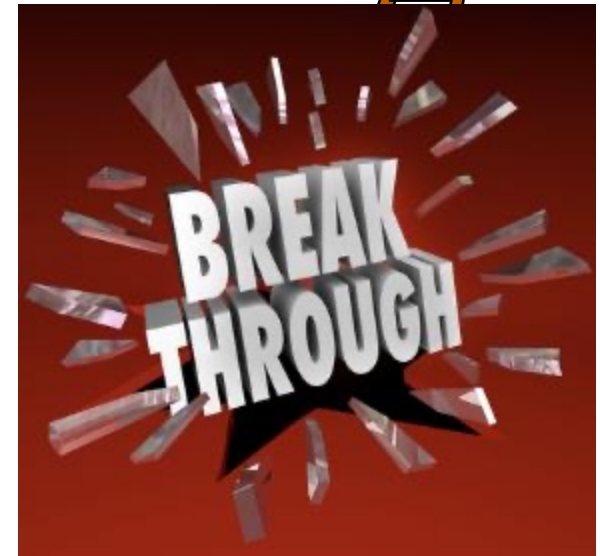


“BreakThrough” Improvement

Definition of Kaikaku:

Kaikaku

A **RADICAL, BREAKTHROUGH** project that is needed when a Radical redesign of our business model or processes is needed



What is the difference between Lean Kaizen, Kaikaku en Kakushin?

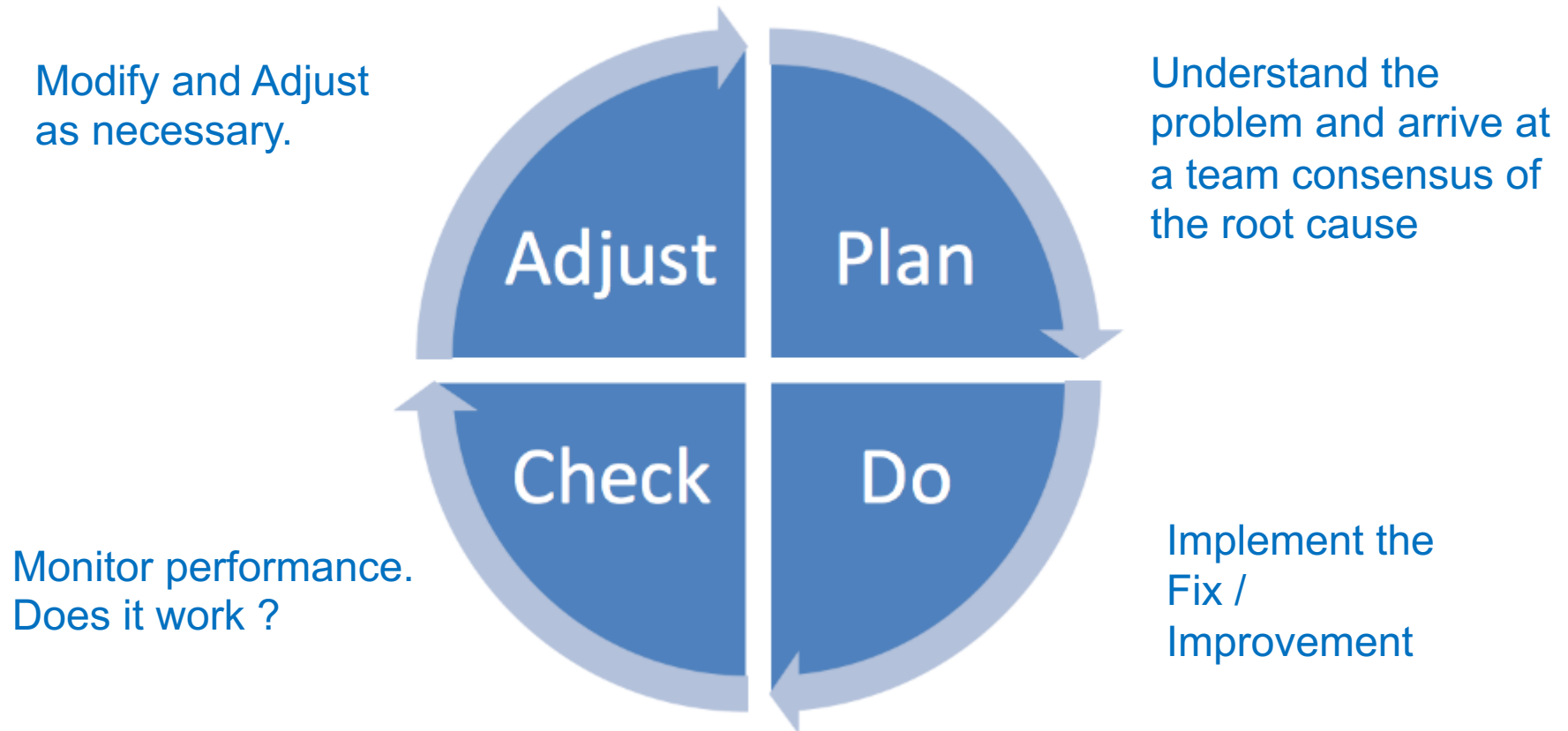
Kaizen	Kaikaku	Kakushin
Improvement for the better	Radical change	Change through innovation
Operational	Strategic	Strategic
<p>This forms the basis of lean organization.</p> <p>Continuously improve the existing way of working in small steps.</p>	<p>New product, service or service within existing organization.</p> <p>Reform of existing business model. These changes cannot be achieved with smaller incremental steps (from Kaizen).</p>	<p>Transform through the advent of new innovation.</p> <p>used terms: out-of-the-box thinking; design thinking. game changers</p>

Kaizen Events

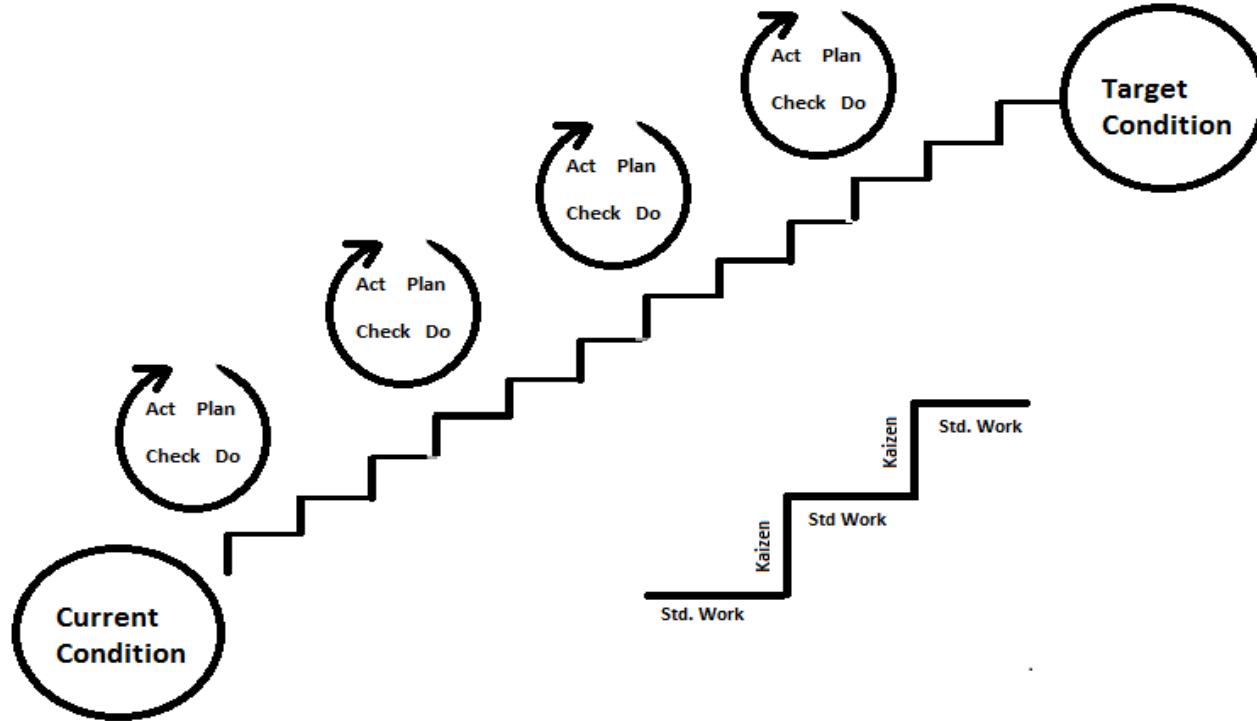
Kaizen Events

- *Simple and Low Risk Improvements that can be done in less than 1 week.*
- *Less “overhead” in project management needed.*
- *Can be done regularly and low cost.*
- *A “Kaizen Board” keeps track of Kaizen Events*
- *Team performing the Kaizen can be organized by a Green Belt or Black Belt.*
- *Pre-Kaizen Event Planning meeting (Plan)*
- *Kaizen Event (Do)*
- *Post Kaizen Control / Monitor period (Check and Adjust)*

PDCA for Kaizen Events



Continuous Improvement (Kaizen)



Kaizen Event Boards



ID	Event Name	Leader	Facilitator
K0105	Assigning Student Employee		
K0093	mtg Rptg Tech Area SS	Thomas H.	Wardman Lorenz
K0106	Ellen Hirsch office SS	Carl Posen	Mark Reid
K0125	Holiday Luncheon vsm +	Ellen Hirsch	Ward Reid Wardman Lorenz
K0126	Office Supplies Inventory	Edwin Erickson	Megan R.
K0107	Amita Quinn office SS	Darke Gunde	
K0109	Dining Table daylight project	Sandy K.	Ward Reid
K0119	Cap + Gown Process Mapping	Becky B.	Megan R.
K0124	Formal Security Requirements VSM	Brian H.	
K0115	Ripley Signage Management	Chris Mason	Carl Posen Wardman Lorenz
K0120	Facilities Property VSM	Nancy L.	Megan R.
K0121	Lean Library VSM	Laura Hargis	Carl Posen
K0113	Pub Drive SS		
K0118	Ticket Office Desk SS	Eric Posa	Wardman Lorenz
K0018	Closing Sponsored Folds	Gracie May	Steve Martin
K0117	Termination Process	TCH	



Quiz 6:

- If you are part of a Kaizen Event team, what is the approximate number of days you would expect to work on it ?
- **BETWEEN 1 and 5 days**
- What does PDCA mean ?
- **PLAN**
- **DO**
- **CHECK**
- **ADJUST / ACT**
- TRUE or FALSE ?
We re-standardise Operating procedures every time we find a new and better way to operate.
- **TRUE**

Flow and Pull

Remember the 6 fundamentals of Lean ?

1. Value
2. Value Stream
3. Flow
4. Pull
5. Perfection
6. Involve and Respect Workers



Involve the Worker

Respect the Worker

Gemba

GEMBA = Where the Real Work is Done

- Japanese translation “The Place where Value is Created”
- GEMBA describes the physical places at work where workers ADD VALUE for the CUSTOMER.
 - **ANSWERING CUSTOMER PHONE CALL**
 - **PACKING**
 - **WELDING**
 - **ASSEMBLING**
 - **PAINTING**
 - **CLEANING etc**
- RESPECT of the GEMBA and the Workers is fundamental to Lean

Gemba Walks

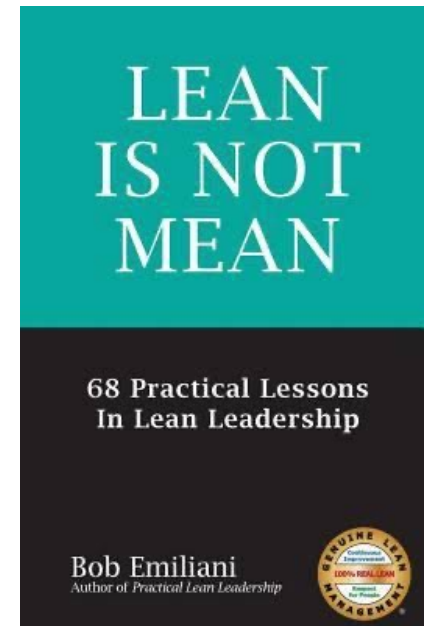
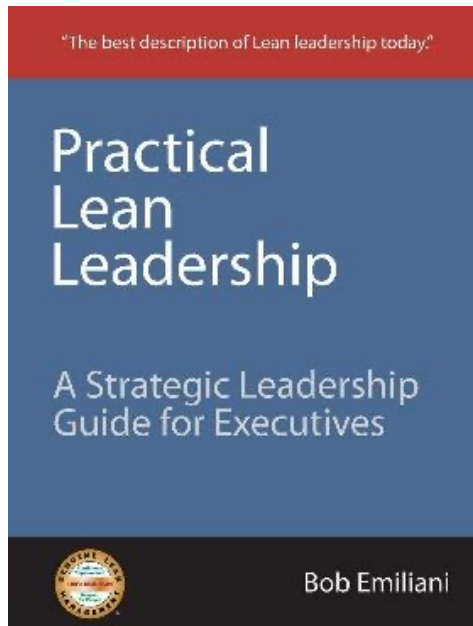
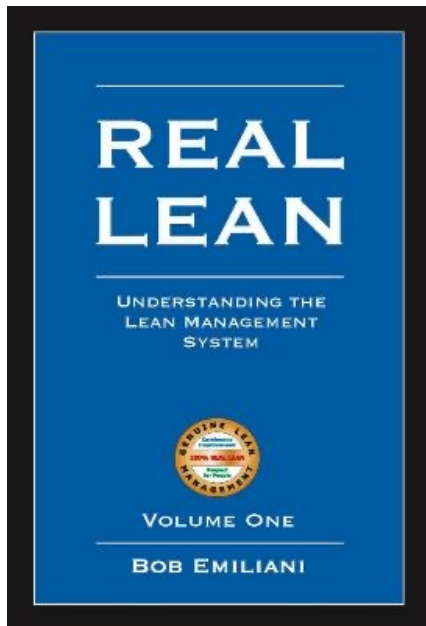
Genchi Genbutsu



- 1. Go See it for yourself at the Gemba**
- 2. Ask the right questions to workers**
- 3. Show Respect to the workers**

Gemba Walks are opportunities to coach and teach your workers.

‘ Lean Management ’ Behaviour



Professor Bob Emiliani

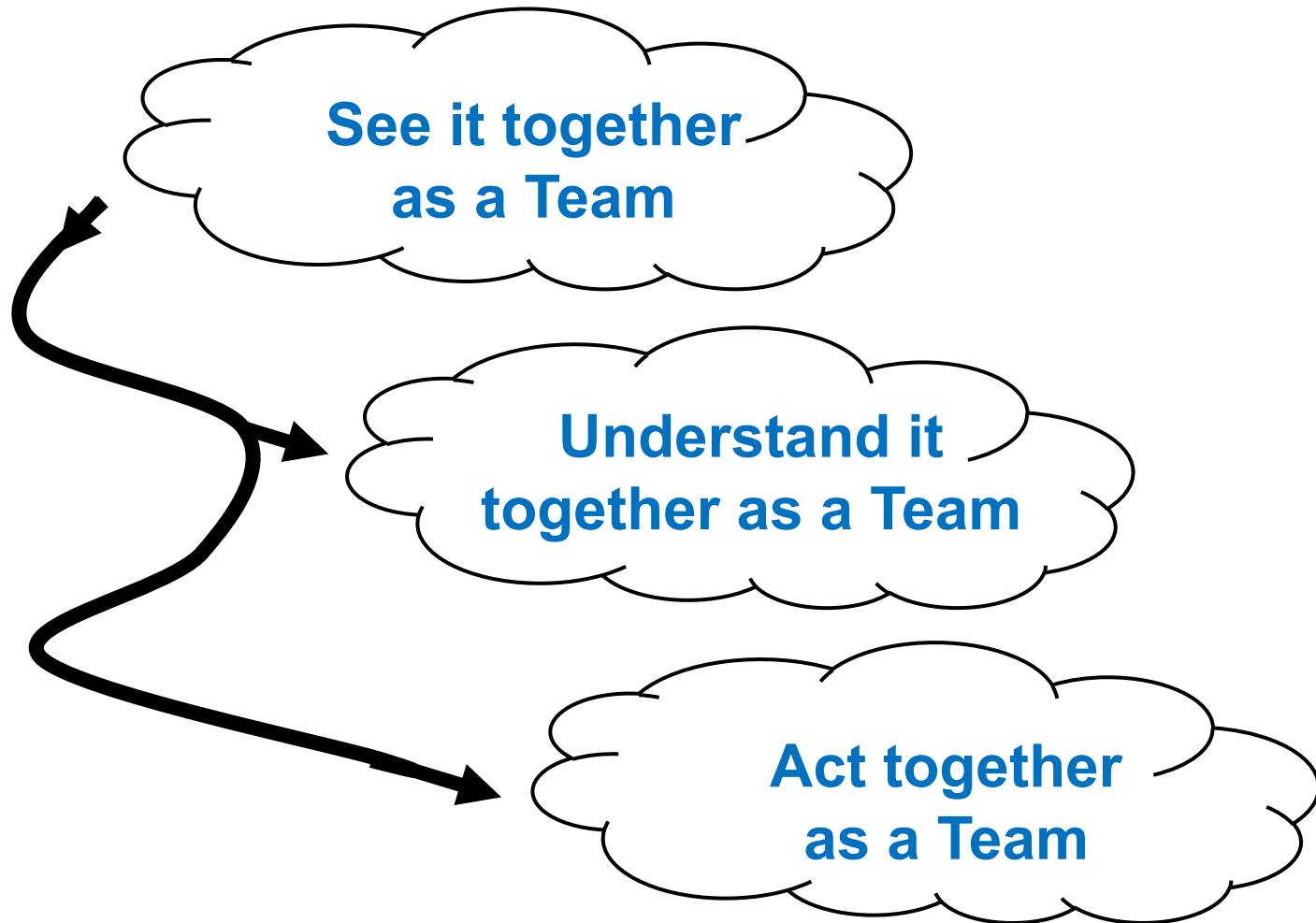
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brought to you by:



Visual WorkPlace

The Visual Factory / Visual Management



The Visual **Workplace** / Visual Management

A Visual Workplace (Visual Management) enables a team to effectively manage its processes with clear **VISUAL COMMUNICATIONS** that **ALL TEAM MEMBERS** can clearly see!

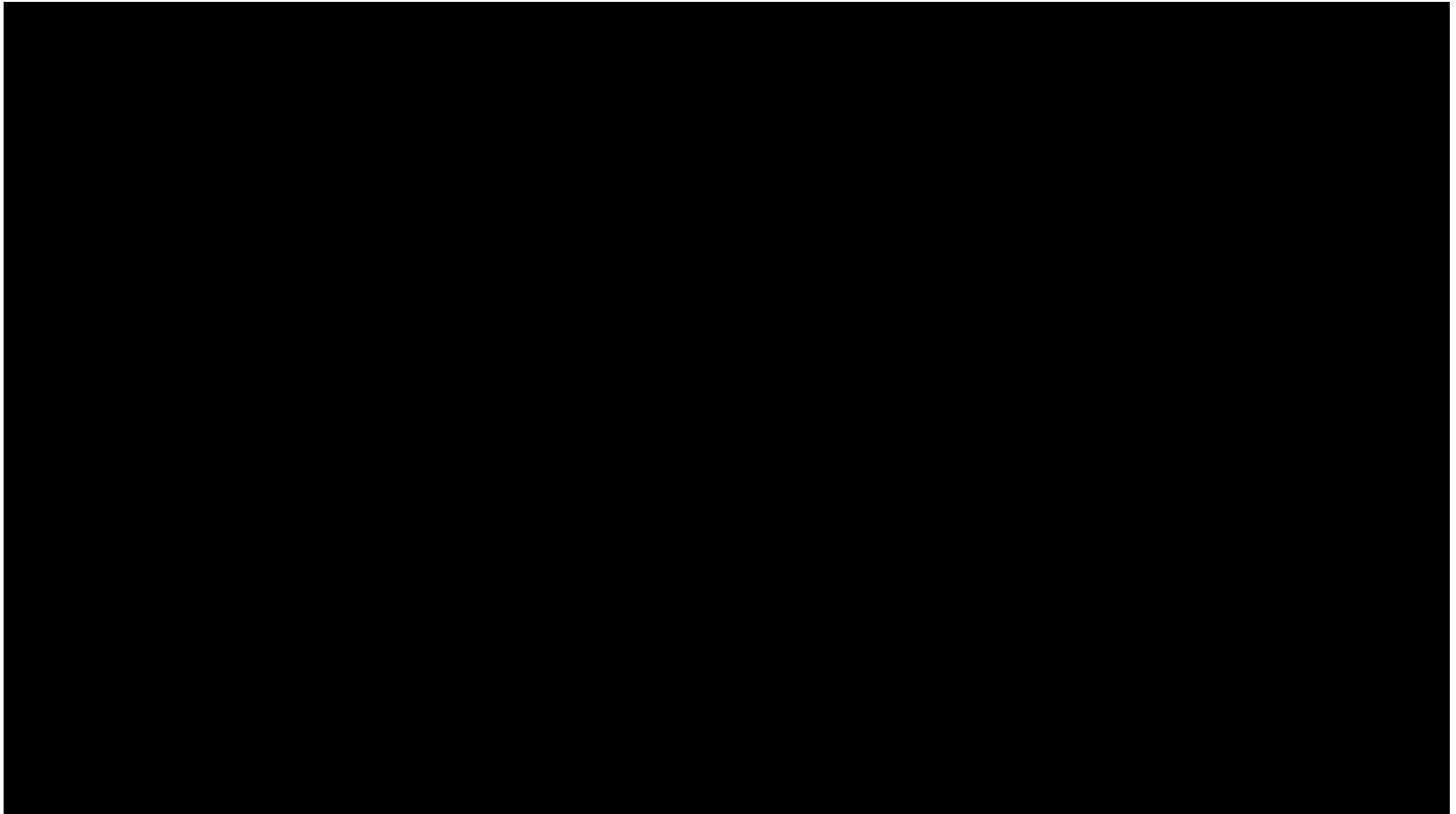
- Can we all clearly see when we have Downtime Issues?
- Can we all clearly see when there is an accident?
- Can we all clearly see what our team performance is ?
- Can we all clearly see our Tools & Supplies?

LINE PRODUCTION INFORMATION BOARD			
PANEL NO:	EFF.(TAR)	940 %	DATE
057611	EFF.(ACT)	100 %	2303
GSPH	TAR.	0464	CYCLE TIME (SEC.)
	ACT.	0520	TAR.
TOTAL STROKE	AVE.	4304	A D C (MIN.)
	TAR.	0240	ACT.
	ACT.	0178	L.STOP (MIN.)
			CUR.
			TOT.

PLAN	ACTUAL	EFFICIENCY								
0005	0004	080								
LINE 5 - CENTRELESS FORGE			CLOCK							
HOURLY OUTPUT			05595.1							
1	2	3	4	5	6	7	8			
000	000	000	000	000	000	000	004			

Visual Management

<https://www.youtube.com/watch?v=2NrNq9cHTBA>

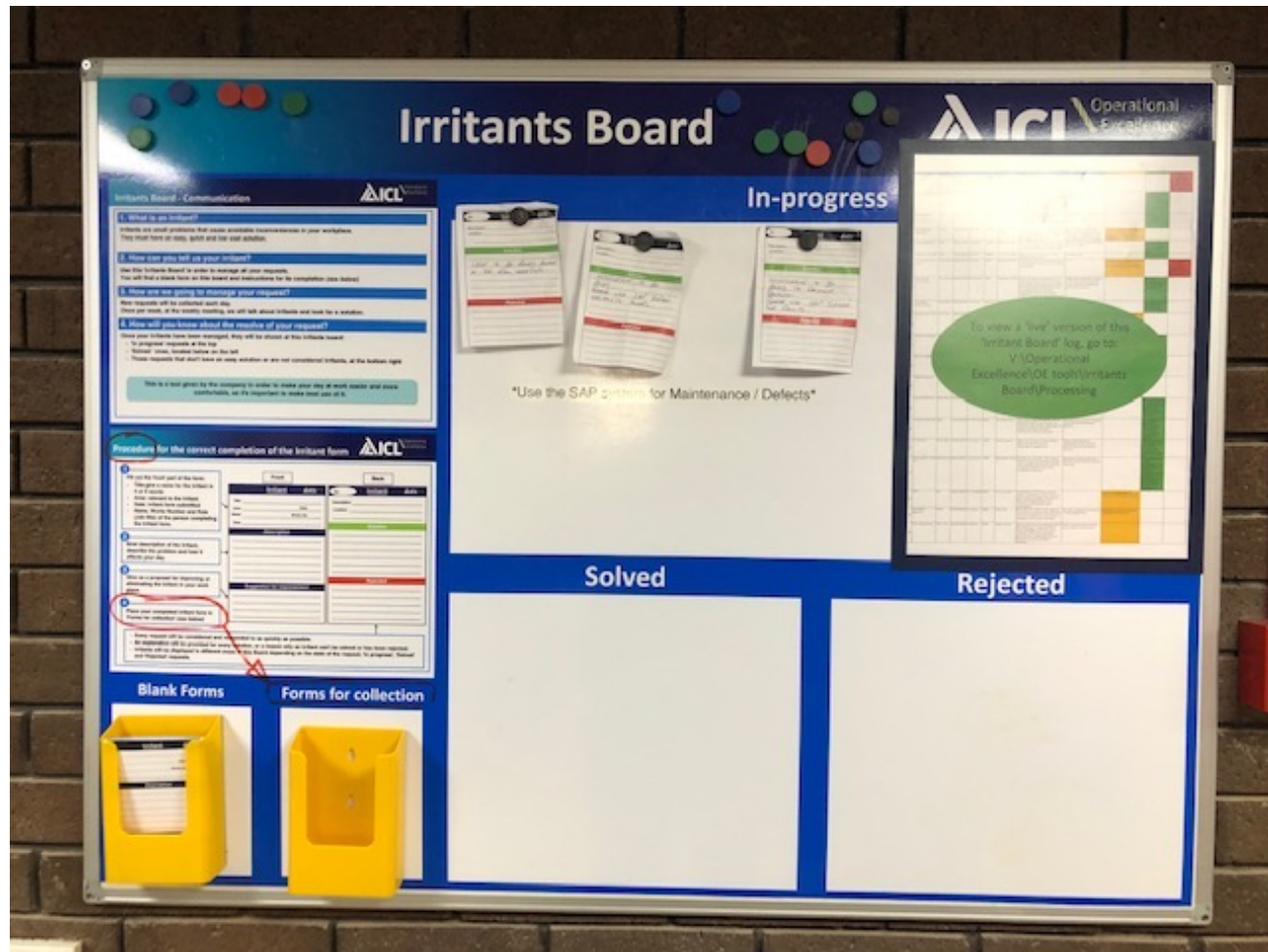


Visual Factory

<https://www.youtube.com/watch?v=jiJSvNu87EE>

no
INTELLIGENT SIMPLICITY

Examples of Visual Workplace



A Visual Work Place



Labeling of disposal bins



E-stop



Requirements



Lock out procedure

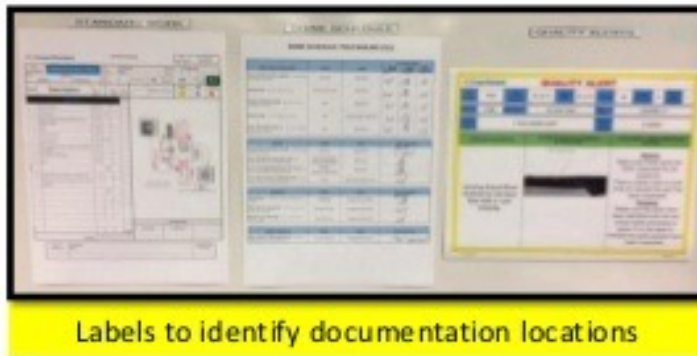


Stop before proceeding



Shadow Board

A Visual Work Place



Visual Management Tools

Kamishibai Board : Cards are red on one side and green on other side.



Visual Management in your work

- What areas of your work could do with Visual Management ?

- What ideas do you have for Visual Management in your work?

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Standardized Work

What is Standardized Work?

- **Standardized (Standard) work is an agreed-upon set of work procedures that establish the best and most reliable methods and sequences for each process and each staff**
- Standard work aims to maximize performance while minimizing waste in each person's operation and workload
- Standard work helps people and equipment each day to meet customer demand

Standard Operating Procedures (SOPs)

Recipe (SOP)

1. Heat the oven to 180C/350F/Gas 4.
2. Line two 18cm/7in **cake** tins with **baking** parchment.
3. Cream the butter and the sugar together until pale. ...
4. Beat in the eggs.
5. Sift over the flour and fold in using a large metal spoon.
6. The mixture should be of a dropping consistency; if it is not, add a little milk.



Team Work for Developing SOPs

Making good SOPs is a Team Activity , Not 1 person !



- 1. Arrange a workshop to collect input and ideas from all workers that will be using the SOPs**
- 2. Review the final SOPs with all the team and get sign-off**
- 3. Conduct Training with the new SOPs before they are used in production**

3 key elements to good SOPs

Good Standardised Operational Procedures (SOPs)
should have 4 key elements

1. Important Steps

The Logical Order in which to do the Operation

What ?

2. Key Points

Anything in the Step important to avoid Injury or to make the job safer and easier

How ?

3. Reasons Why we need to do it this way

Why ?

4. Visual example of it done correctly

Show me

Example : SOP for Folding a T-Shirt

Important Step (What) A logical segment of the operation when something happens to advance the work	Key Points (How) Anything in a step that might: <ol style="list-style-type: none"> 1. Make or break the job 2. Injure the worker 3. Make the work easier 	Reasons (Why) Reasons for the key points
1. Lay flat	<ul style="list-style-type: none"> • facing up, top to the right 	<ul style="list-style-type: none"> • consistent starting point
2. Pinch top	<ul style="list-style-type: none"> • right hand, halfway between collar and seam • through both layers • left hand, create vertical crease 	<ul style="list-style-type: none"> • proper alignment • holds shirt together • visual aid
3. Pinch middle	<ul style="list-style-type: none"> • left hand, halfway down vertical crease 	<ul style="list-style-type: none"> • proper alignment
4. Pinch bottom	<ul style="list-style-type: none"> • right hand over left hand, bottom of vertical crease 	<ul style="list-style-type: none"> • proper alignment
5. Uncross hands	<ul style="list-style-type: none"> • holding pinches, shake out 	<ul style="list-style-type: none"> • removes wrinkles
6. Flop and fold	<ul style="list-style-type: none"> • face down • over exposed sleeve 	<ul style="list-style-type: none"> • exposes final fold • completes fold

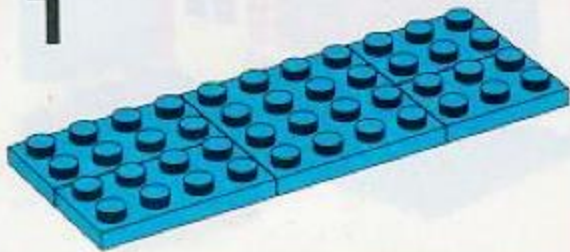
Folding a T-Shirt



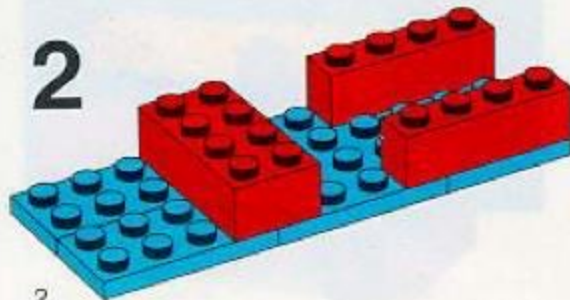
<https://www.youtube.com/watch?v=dNV4mOK5gW4>



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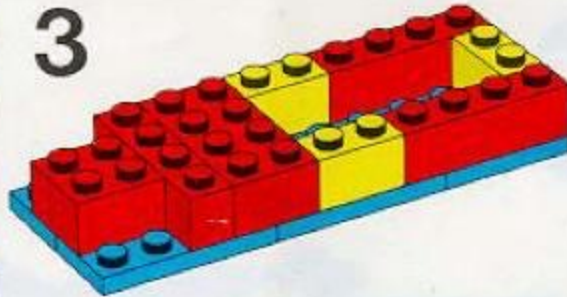


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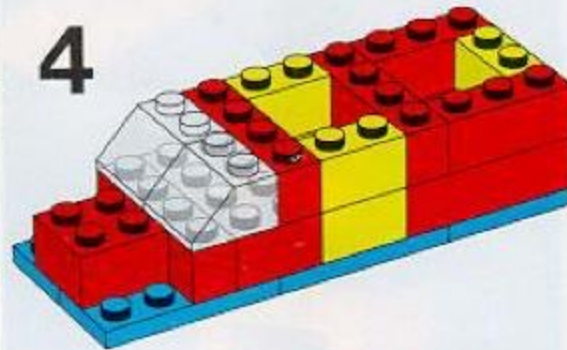


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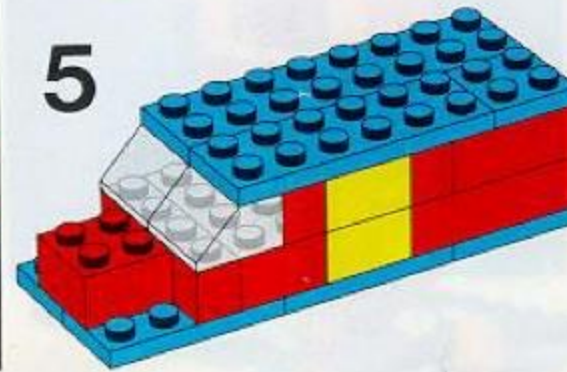
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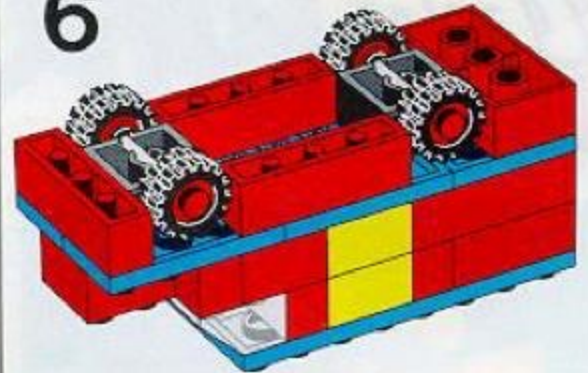
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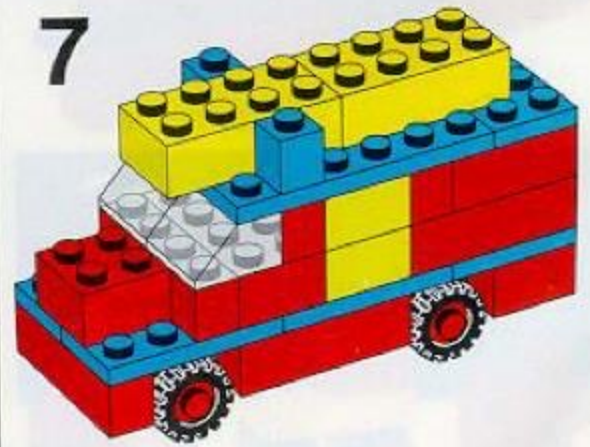
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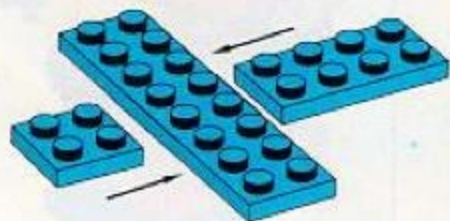


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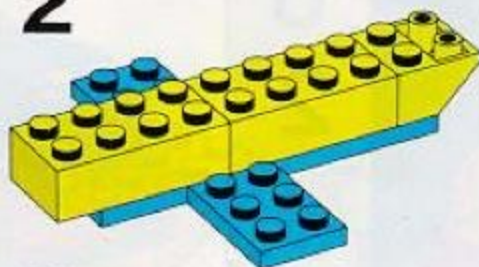




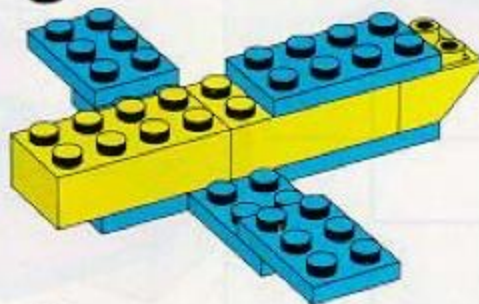
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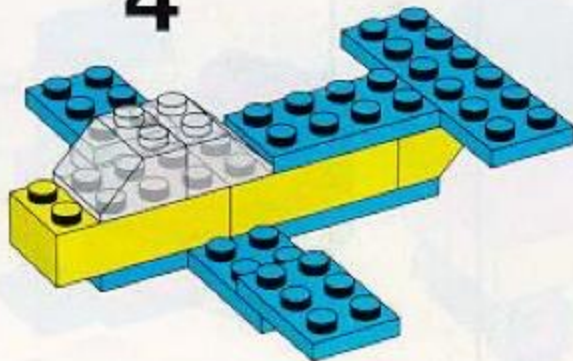
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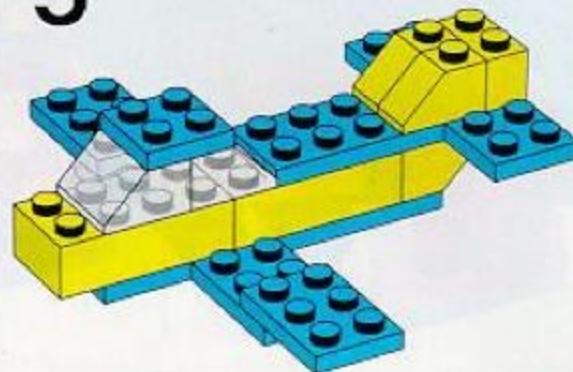
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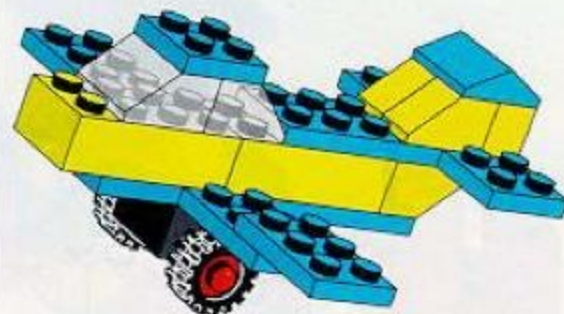
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5



6



SOP for 3-Star Manufacturing Inc

Construct a 6 to 8 Step SOP for 3-Star Manufacturing Inc



SOP for 3-Star Manufacturing

	Important Step (What)	Key Points (How)	Reason (Why)
1			
2			
3			
4			
5			
6			

Quiz 7:

- What is a 'Gemba Walk' ?
- **Going to see for yourself what is happening where the real work is done**
- What is the benefit of having a Visual Work Place ?
- **All team members can see the status of work and operations easily and at the same time.**
- Give one example of a Visual Management tool or technique ?
- **Colour Coding, Notice Boards, Graphs and Charts, Good Labelling**
- What are the key components to a good SOP (Standard Operating Procedure)?
 - **What**
 - **How**
 - **Why**
 - **Use a picture or video**
- A fundamental concept of any Lean Process is that it has well defined and repeatable actions by workers. This concept is call _____work
- **STANDARDISED**

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brought to you by:

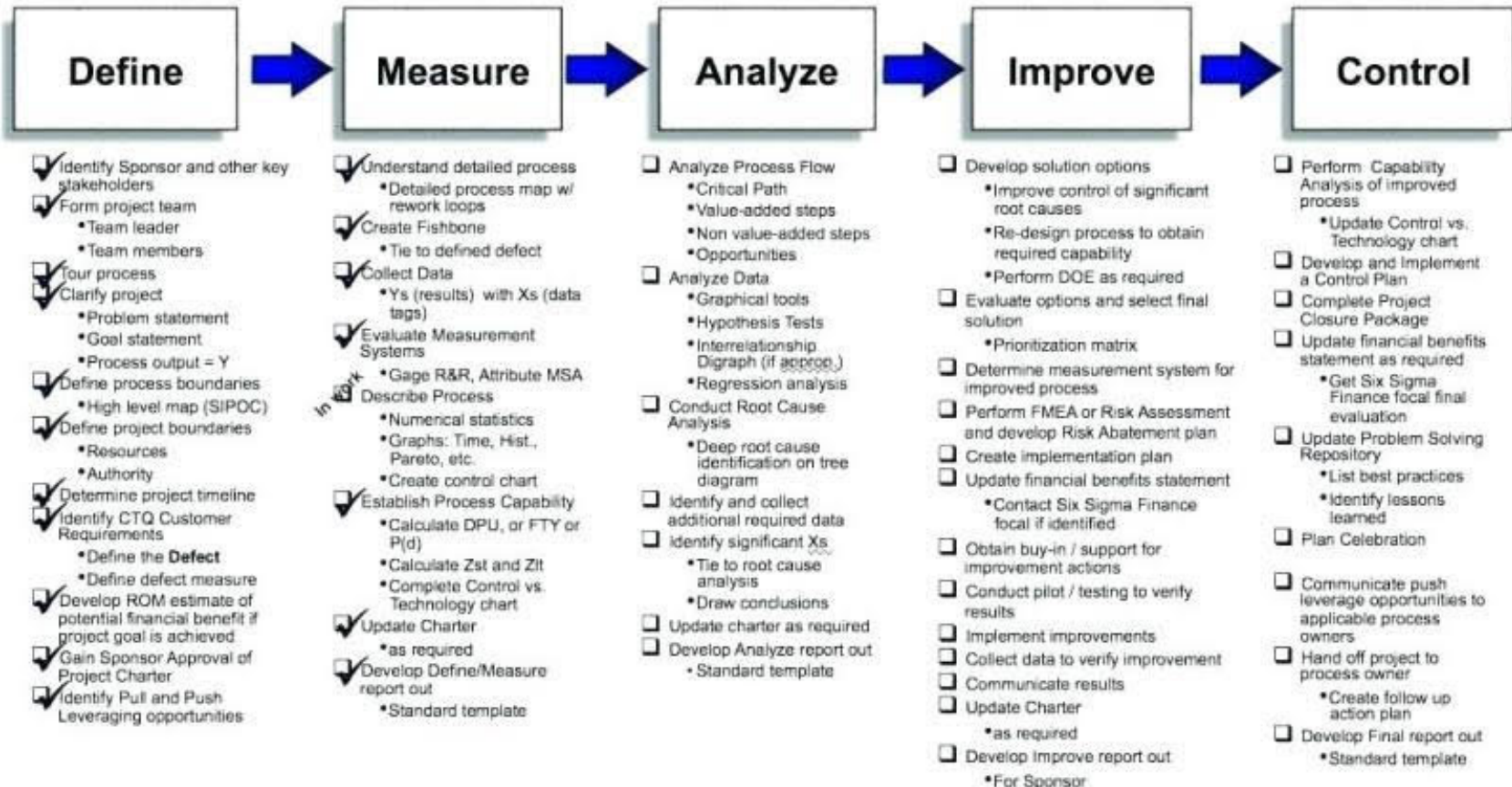


DMAIC

The Six Sigma Framework for Problem Solving

- **D**efine - the business problem (or opportunity), Team and Scope
- **M**easure - the process current state (as-is) of the problem area
- **A**nalyze - determine Root Cause of the problem
- **I**mprove - Identify and Choose Best Solution then implement the solution
- **C**ontrol – Ensure your solution is working. Monitor and Control.

Project – DMAIC Roadmap



Scientific Method (1620)	DMAIC (1986)	PDCA (1939)	8D (1987)
Define Problem	<u>D</u> efine	<u>P</u> lan	1. Establish the Team
Formulate Hypothesis	<u>M</u> easure		2. Describe the Problem
Gather Appropriate Data	<u>A</u> nalyze		3. Develop Interim Containment Actions (ICA)
Test Data			4. Define/Verify Root Causes
Develop Conclusions	<u>I</u> mprove	<u>D</u> o	5. Choose/Verify Permanent Corrective Action (PCA)
	<u>C</u> ontrol	<u>C</u> heck	6. Implement/Validate PCA
		<u>A</u> ct	7. Implement/Validate Preventive Action
			8. Recognize the Team

Source: KAVON International, Inc. and JMP Consulting

Figure 1: Roadmap Comparisons to the Scientific Method

We do NOT need to use all the possible tools on every project.

Be 'Lean' in selecting correct tools according

- a) **The type of problem**
- b) **The scale/size of problem**
- c) **How much money and time you have**
- d) **The skills /experience of your project team**

Define Phase

-Defining the PROBLEM

»

-Defining the PROJECT

DMAIC - (D-e-e-m-a-k-e)

- **Define** - the business problem (or opportunity)
- **Measure** - the process current state (as-is) of the problem area
- **Analyze** - determine Root Cause of the problem
- **Improve** - Identify and Choose Best Solution then implement the solution
- **Control** - Ensure your solution is working. Monitor and Control.

DEFINE : Problem and Project Definition

Define

- The most important Phase of any DMAIC Project
- Choose the right problem to tackle
- Define the PROBLEM
- Identify the key TEAM members and STAKEHOLDERS
- Understand the SCOPE
- Present a good BUSINESS CASE
- Develop a PROJECT CHARTER

3 Document Outputs of Define

1. Business Case (including Problem Statement)
2. Project Charter
3. High Level Process Map or SIPOC

Project Selection – Core Components

Business Case – The Business Case defines the Problem and the Business motivation for considering the project.

The Problem is defined with a ‘Problem Statement’.

Project Charter – The Project Charter is a more detailed version of the Business Case. This document further focuses the improvement effort. It can be characterized by two primary sections; one, basic project information and two, simple project performance metrics.

High Level Process Map – Used to show a high level understanding of the scope of the process that is to be measured, analyzed, improved and controlled. The SIPOC tool can also be used.

What is a Business Case ?

A Business case has 3 main parts :

1. What is the problem that the business or the customer is experiencing?
This part is called the 'Problem Statement'
2. What is the target or goal we are trying to reach ?
3. What are the consequences for the business if the problem is not solved, or business benefits if it is solved ? In other words, what is the business motivation for a project to solve the problem ?

The Business Case is constructed with the help of the Process Owner / Manager or the Business Owner / Manager.

Business Case example

Problem Statement

- Customer complaints have increased by 50% in 2019. The 2017 average was 20 complaints per month with a total of 240 over the full year. 2018 average was 21 per month with a total of 252 over the year, The average for the first 5 months of 2019 is 30 complaints with a total of 150 in 5 months.

Target

- We need to reduce complaints back down to the 2017 level of an average of 20 per month.

Consequences

- We will see a drop in new customers and also customers leaving if we do not reduce the complaints and increase customer satisfaction.

What is a Project Charter?

The ***Project Charter*** expands on the Business Case, it clarifies the project's focus and the measures of project performance. The Project Charter completed by the Six Sigma Belt (Green or Black).

Lean Six Sigma Project Charter

Project Information

Project Name	
Department/Agency	
GB/BB Candidate	<i>Must be within the Executive Sponsor's and Champion's organization</i>
Champion	<i>Must be within the Executive Sponsor's organization</i>
Process Owner	<i>Ideally the same person as the Champion, if not then must be a direct report to the Champion</i>
MBB Coach	<i>You will be assigned an MBB Coach later.</i>
Executive Sponsor	<i>Oversees the organization within which the project is executed</i>

Project Overview

Problem Statement	<i>What is the issue that we are going to address with the project? What specifically is the negative impact of this problem on customers, employees, financials, etc. Give a very brief history and use historical data to quantify the problem.</i>	
Objective	<i>What are we trying to accomplish with this project? The objective should be stated in terms of the primary metric (below).</i>	
Scope	1. Project Scope (IS):	<i>On what process will the team will focus? What are the boundaries of the project such as agency, area, department, etc?</i>
	2. Out of project scope (IS NOT):	<i>What remains outside the area of project team work?</i>
Process Stakeholders	<i>Who will be impacted by this project? Include any customer(s) / Internal and external, downstream process owners, suppliers, upstream process owners, etc. who may be affected.</i>	

Metrics

	description	estimated baseline	goal
Primary Metric	<i>Give a precise definition of the metric on which we are basing our project (the metric we are focusing on improving).</i>	<i>estimate of current level of primary metric</i>	<i>Goal for the primary metric</i>
Secondary Metrics	<i>What are the metrics that we do not want to be negatively impacted as a result of our project?</i>		
Project Benefits	<i>What will be the benefits of a successful project? Who are the customers that will see better services or products? If the benefits are financial, what are the expected annual savings? (For financials, need to include the calculations behind the savings claims.)</i>		

Project Team

<u>Team Member</u>	<u>Role Within the Organization</u>

Project Schedule

Project Charter Tollgate	<i>expected completion date (This will be filled in later)</i>
Measure Phase Tollgate	<i>expected completion date (This will be filled in later)</i>
Analyze Phase Tollgate	<i>expected completion date (This will be filled in later)</i>
Improve Phase Tollgate	<i>expected completion date (This will be filled in later)</i>
Control Phase Tollgate	<i>expected completion date (This will be filled in later)</i>

Objective	What are the key objectives for this project? The objective should be stated in terms of the primary metric (below).	
Scope	1. Project Scope (IS):	On what process will the team will focus? What are the boundaries of the project such as agency, area, department, etc?
	2. Out of project scope (IS NOT):	What remains outside the area of project team work?
Process Stakeholders	Who will be impacted by this project? Include any customer(s) / Internal and external, downstream process owners, suppliers, upstream process owners, etc. who may be affected.	

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	description	estimated baseline	goal
Primary Metric	Give a precise definition of the metric on which we are basing our project (the metric we are focusing on improving).	estimate of current level of primary metric	Goal for the primary metric
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Project Team

<u>Team Member</u>	<u>Role Within the Organization</u>

Project Schedule


Project Charter Tollgate	expected completion date (This will be filled in later)
Measure Phase Tollgate	expected completion date (This will be filled in later)
Analyze Phase Tollgate	expected completion date (This will be filled in later)
Improve Phase Tollgate	expected completion date (This will be filled in later)
Final Report-Out and Certification	expected completion date (This will be filled in later)

Signoffs

role	name	date	signoff
Champion			<input type="checkbox"/>
Process Owner			<input type="checkbox"/>

SigmaXL Team/Project Charter

TEAM/PROJECT CHARTER

 Project Name:	
Date (Last Revision):	
Prepared By:	
Approved By:	

Business Case:				Opportunity Statement (High Level Problem Statement):		
				Defect Definition:		
Goal Statement:				Project Scope:		
Expected Savings/Benefits:				Process Start Point:		
				Process End Point:		
				In Scope:		
				Out of Scope:		
Project Plan:				Team:		
Task/Phase	Start Date	End Date	Actual End	Name:	Role:	Commitment (%):

Project Charter - Definitions

- **Problem Statement** - Articulates the pain of the defect or error in the process.
- **Objective Statement** – States how much of an improvement is desired from the project.
- **Project Scope** – Articulates the boundaries of the project. (Use SIPOC diagram)
- **Primary Metric** – The actual measure of the defect or error in the process.
- **Secondary Metric(s)** – Measures of potential consequences (+ / -) as a result of changes in the process.
- **Project Black Belt & Process Owner names**
- **Start date & desired End date**
- **Division or Business Unit name**
- **Team Members**
- **Stakeholder names**

A SMART METRIC

*When choosing the best **METRIC** to use as the main measure of success of your project, consider the **SMART** method of choosing metrics*

- **S = Specific** (*Is the metric well defined*)
- **M = Measurable** (*How will we measure it easily?*)
- **A = Attainable** (*Can we achieve the target ?*)
- **R = Relevant** (*Is the metric the related to the problem ?*)
- **T = Time Bound** (*When are we going to measure it ?*)

SIPOC for the Define Phase



Suppliers:

Inputs:

Process

Outputs:

Customers:

Suppliers

All internal and external suppliers to the process

Inputs

All inputs to the process i.e. material, forms, information, etc.

Process

One block representing the entire process with its name

Customers All internal and external customers to the process

Outputs

All outputs for both internal and external customers

SIPOC for the Define Phase

Class exercise: Complete this SIPOC for making a PARCEL delivery of a product that a customer has purchased through your company website.

Process name :

Suppliers

1. _____

2. _____

Inputs

1. _____

2. _____

Outputs

1. _____

2. _____

Customers

1. _____

2. _____

Other Activities for the Define Phase

- High Level Project Plan (Schedule)
- Start of Project Documentation
 - Issues Log
 - Communications Management Plan
 - Human Resources Plan
 - Stakeholder Management Plan (hint : use RACI to assist)
- Gate review involving Stakeholders before Measure Phase

Compare with Prince2 / PMP / G8D / PDCA

PMP / Prince 2 / G8D / PDCA / A3

Prince2	PMP	G8D	PDCA	Lean6Sigma
<ul style="list-style-type: none"> Starting up a project Initiating a project Directing a project Controlling a stage Managing stage boundaries Managing product delivery Closing a project 	<ul style="list-style-type: none"> Initiate Plan Execute Control Close 	<ul style="list-style-type: none"> Team Problem Contain Root Cause Correct Monitor Celebrate 	<ul style="list-style-type: none"> Plan Do Check Adjust 	<ul style="list-style-type: none"> Define Measure Analyze Improve Control

A3 reporting : Used by some Lean Organizations to compliment PDCA , G8D or DMAIC
(see your folder for example)

A3 report

A3 Problem Solving	
Title:	Owner / Date:
1. Background / Problem	5. Proposed Counter Measures
2. Current Condition	6. Plan
3. Goal / Target Condition	7. Follow-Up & Review
4. Root Cause Analysis	

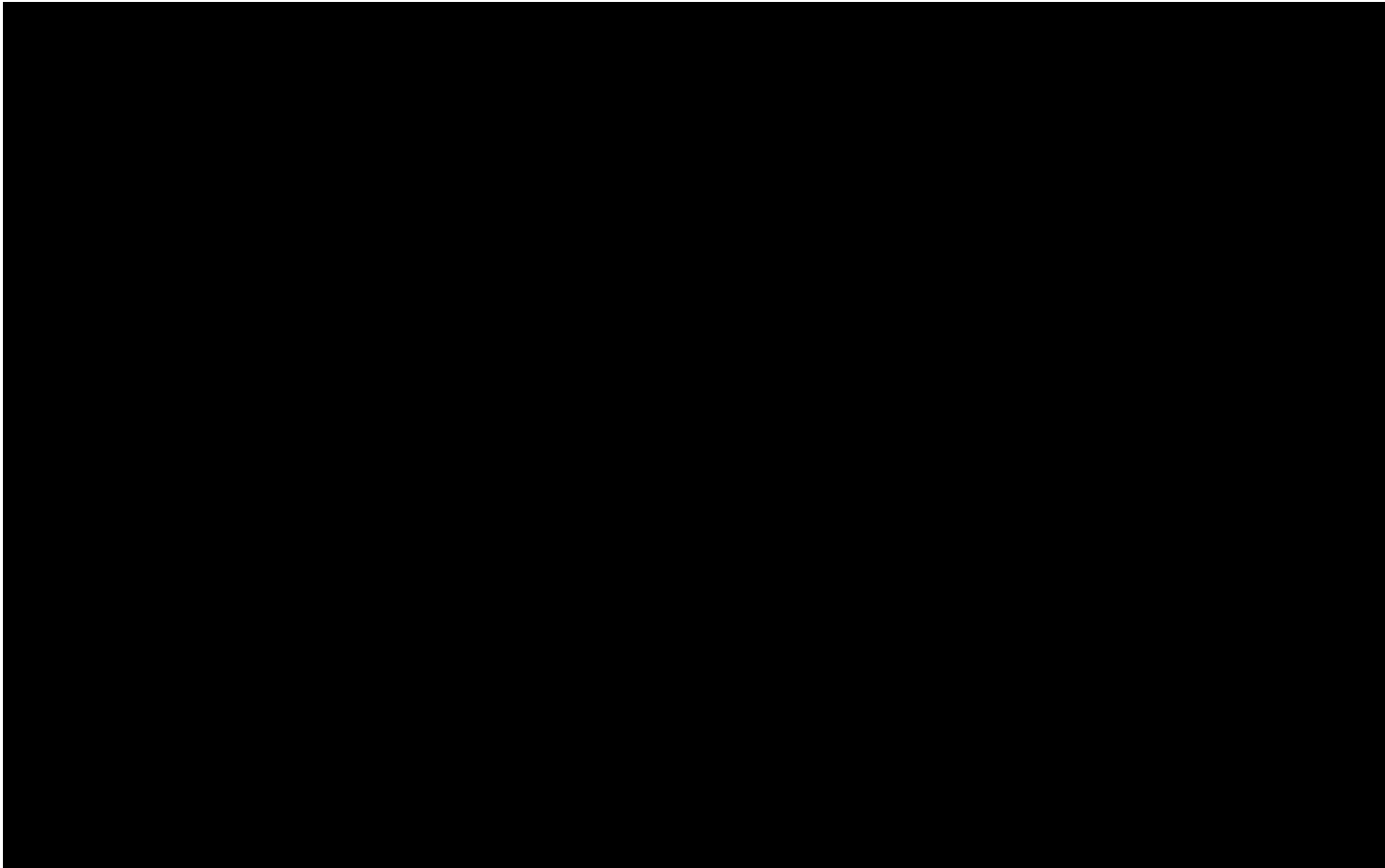
A3 report

The A3 Report

To: _____
By: _____
Date: _____

<p>○ Problem: "What problem are we trying to solve?"</p> <p>○ Background</p> <ul style="list-style-type: none"> • Background of the problem • Context required for full understanding • Business Importance of the problem <p>○ Current Condition</p> <ul style="list-style-type: none"> • Diagram of current situation (or process). • Highlight problem(s) with storm bursts. • What about the system is not IDEAL. • Extent of the problem(s), i.e., measures. <p>○ Cause Analysis</p> <ul style="list-style-type: none"> • List problem(s) • Most likely direct (or root) cause: <div style="text-align: center; margin-left: 100px;"> Why? Why? Why? Why? Why? Why? </div> 	<p>Target Condition</p> <ul style="list-style-type: none"> • Diagram of proposed new process • Countermeasures noted as fluffy clouds • Measurable targets (quantity, time) <p>Implementation Plan</p> <table border="1" style="width: 100%;"> <thead> <tr> <th style="width: 25%;">What?</th> <th style="width: 25%;">Who?</th> <th style="width: 25%;">When?</th> <th style="width: 25%;">Where?</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Actions to be taken</td> <td style="text-align: center;">Responsible person</td> <td style="text-align: center;">Times, Dates</td> <td></td> </tr> </tbody> </table> <p>Cost: _____</p> <p>Check / Monitor / Control</p> <table border="1" style="width: 100%;"> <thead> <tr> <th style="width: 50%;">Plan</th> <th style="width: 50%;">Actual Results</th> </tr> </thead> <tbody> <tr> <td> <ul style="list-style-type: none"> • How will you check the effects? • When will you check them? </td> <td> <ul style="list-style-type: none"> • Date check done. • Results, compare to predicted. </td> </tr> </tbody> </table>	What?	Who?	When?	Where?	Actions to be taken	Responsible person	Times, Dates		Plan	Actual Results	<ul style="list-style-type: none"> • How will you check the effects? • When will you check them? 	<ul style="list-style-type: none"> • Date check done. • Results, compare to predicted.
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Airport Improvement Case Study Video



Heathrow Airport Example

- Flight delays are being halved after the introduction of an air-traffic control system designed to eradicate gridlock in the skies.
- Rising numbers of aircraft will be able to land in strong headwinds — the biggest single cause of delays —
- The £13 million system, which is the first of its kind, allows air traffic controllers to land planes closer together by calculating the space between them based on time rather than distance.
- The change is likely to save £7.5 million per year in lost productivity and compensation claims as a result of reduced backlog on the approach to the airport
- It is hoped that 2,700 hours of delays in arrival flights will be cut in half

1. **State the business problem (Problem Statement)**
2. **Suggest a Business Case for the change?**
3. **What was the Primary Metric (KPI) being improved ?**
4. **What might be some Secondary Metrics considered ?**

Summary

At this point you should be able to:

- Understand the importance for the Define Phase.
- Understand the 3 main output documents of the Define Phase
 - Business Case
 - Project Charter
 - SIPOC of Level 1 Process Map
- Understand SMART Metrics
- Understand the Tuckman Model of Team building
- Understand other “**Initiate Project**” components of the Define Phase

Quiz 8:

- What is the framework used in Lean Six Sigma for running Lean Six Sigma projects where we are unsure of the root cause or solution ?
- **DMAIC Define – Measure – Analyse – Improve – Control**

- What are the names of the 3 document deliverables in the DEFINE Phase ?
- **Business Case (including Problem Statement)**
- **Project Charter**
- **Scope Statement or SIPOC**

- What does the acronym SIPOC mean ?
- **SUPPLIERS, INPUTS, PROCESS, OUTPUTS, CUSTOMERS**

- In the Define Phase we identify the Project Team Members and Stakeholders. Name some categories of STAKEHOLDERS to consider.
- **CUSTOMERS, SUPPLIERS, EXECUTIVES, PROCESS OWNERS**

- What do we call a 1-page summary document showing status of your whole project?
- **A3 Report**