



Introduction to Lean Six Sigma

*Presentation to the Institute of the Internal Auditors
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Agenda

1. Introduction – Process Improvement
2. What is Lean?
3. What is Six Sigma?
4. Questions



Introduction to Process Improvement

How long does it take to build a ship?



- World War II 'Liberty' ships
- 441ft long and 56ft wide
- 600,000 feet of welds
- Displacement of 7,000 tons
- 18 American shipyards built 2,751 Liberty ships between 1941 and 1945 – the largest number of ships built of the same design



Average lead time of 57 days

**Record time 4 days, 15 hours and 29 minutes,
Nov 8th-12th 1942**

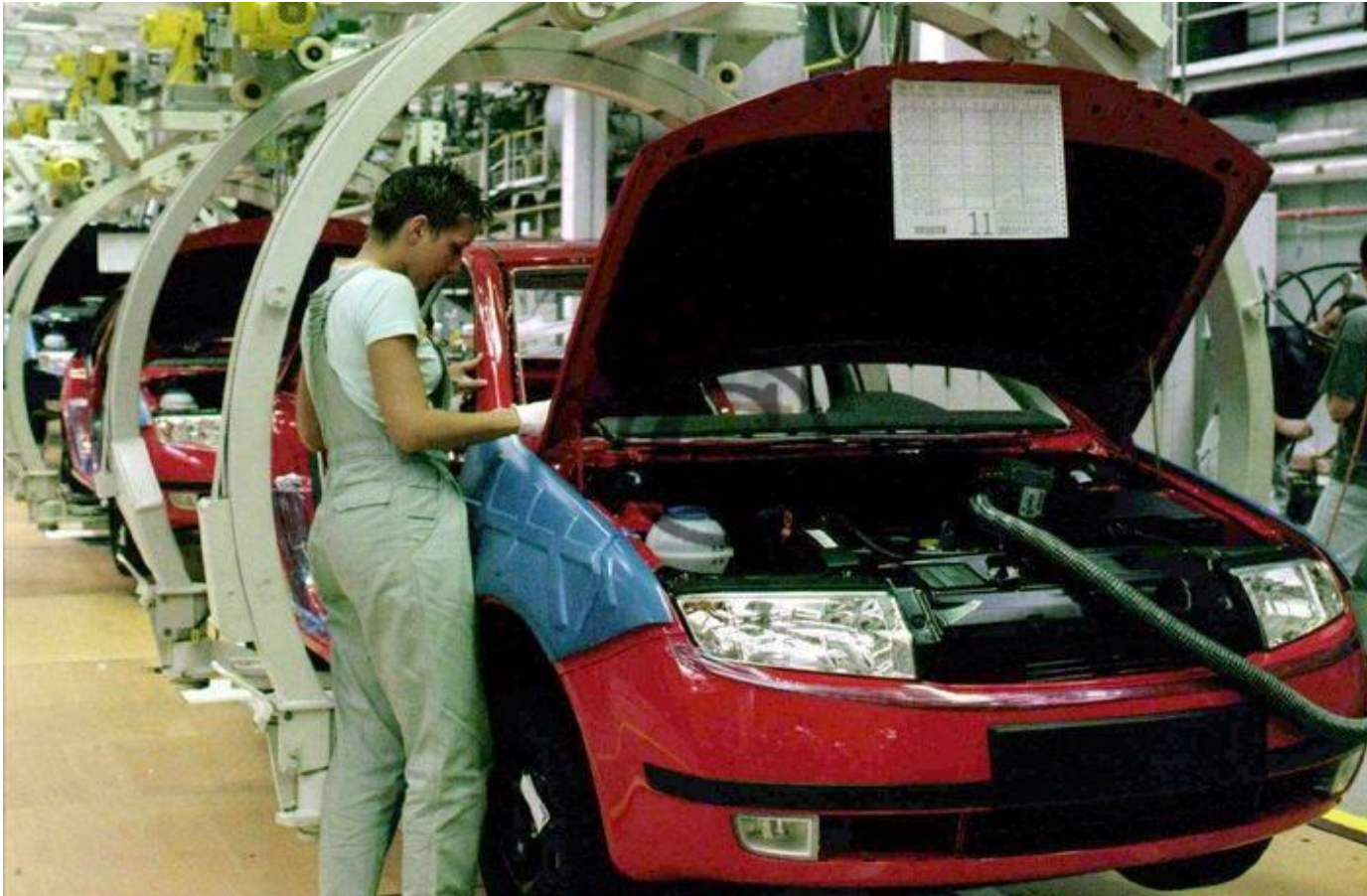
How long does it take for assemble the Boeing Dreamliner?

- New Boeing 787 aircraft
- 50% composites
- 20% Aluminum
- 15% Titanium
- 1,500 aluminum sheets
- Up to 50,000 fasteners
- 101 tonnes
- 56m long
- 60m wingspan
- Up to 330 passengers

**Estimated assembly
time of 3 days**



How long does it take make a new Toyota Prius?



- Each car has around 20,000 parts
- Each car is unique – colour, trim, fit out,
- Different cars (coupe vs sedan vs wagons) follow each other in a mixed production line

It takes just 24hours from stamping to rolling off the line

Tsutsumi, just one of Toyota's 12 Japanese plants makes two cars every minute

So why do processes take so long?

- If you can:
 - Build a ship in four days ...
 - Assemble an aircraft in three days ...
 - Make a car in one ...

... then why does it take up to 5 days to get a credit card?

Some common lead times for processes

- 3-5 days for a credit card from paper application to card receipt
- 1-2 weeks for life insurance if a medical is required with extremes of up to 2 months
- 24 hours to get a loan approved (longer if outside of common criteria)
- 4-8 weeks to hire someone
- ? Weeks to get an insurance claim approved

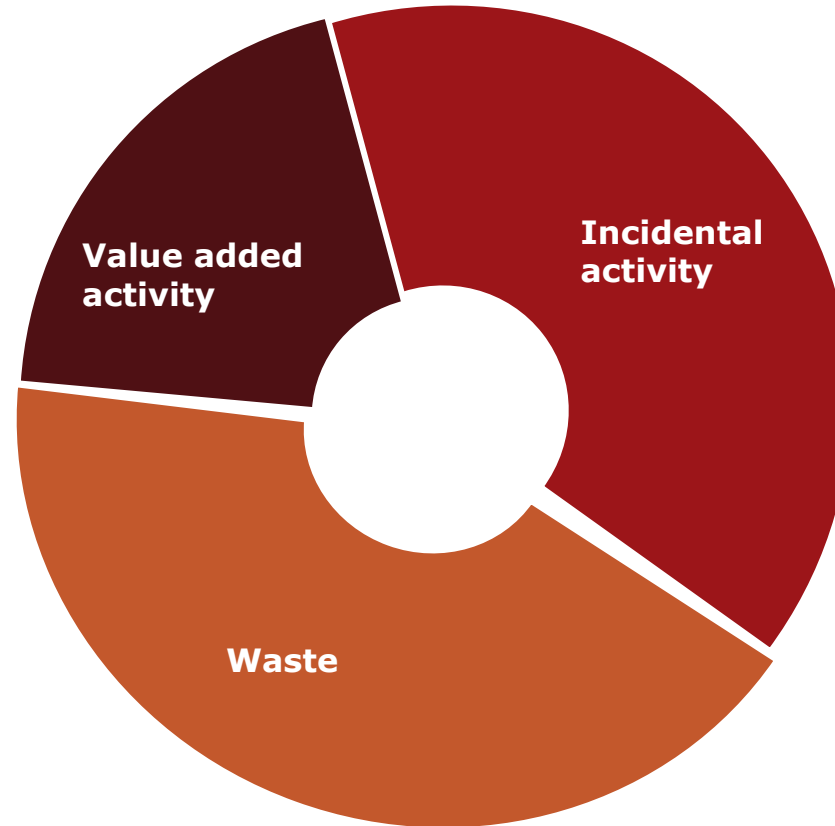
Why should a service that produces little tangible or physical output take so long?

Longer lead times are because some activities in our processes do not add any value

Value added activity:

- Work that directly adds value in the face of the customer i.e. the work the customer is physically paying for

e.g. getting the card ready to use



Incidental activity:

- Work that does not directly add customer value but is necessary and difficult to design out of the system

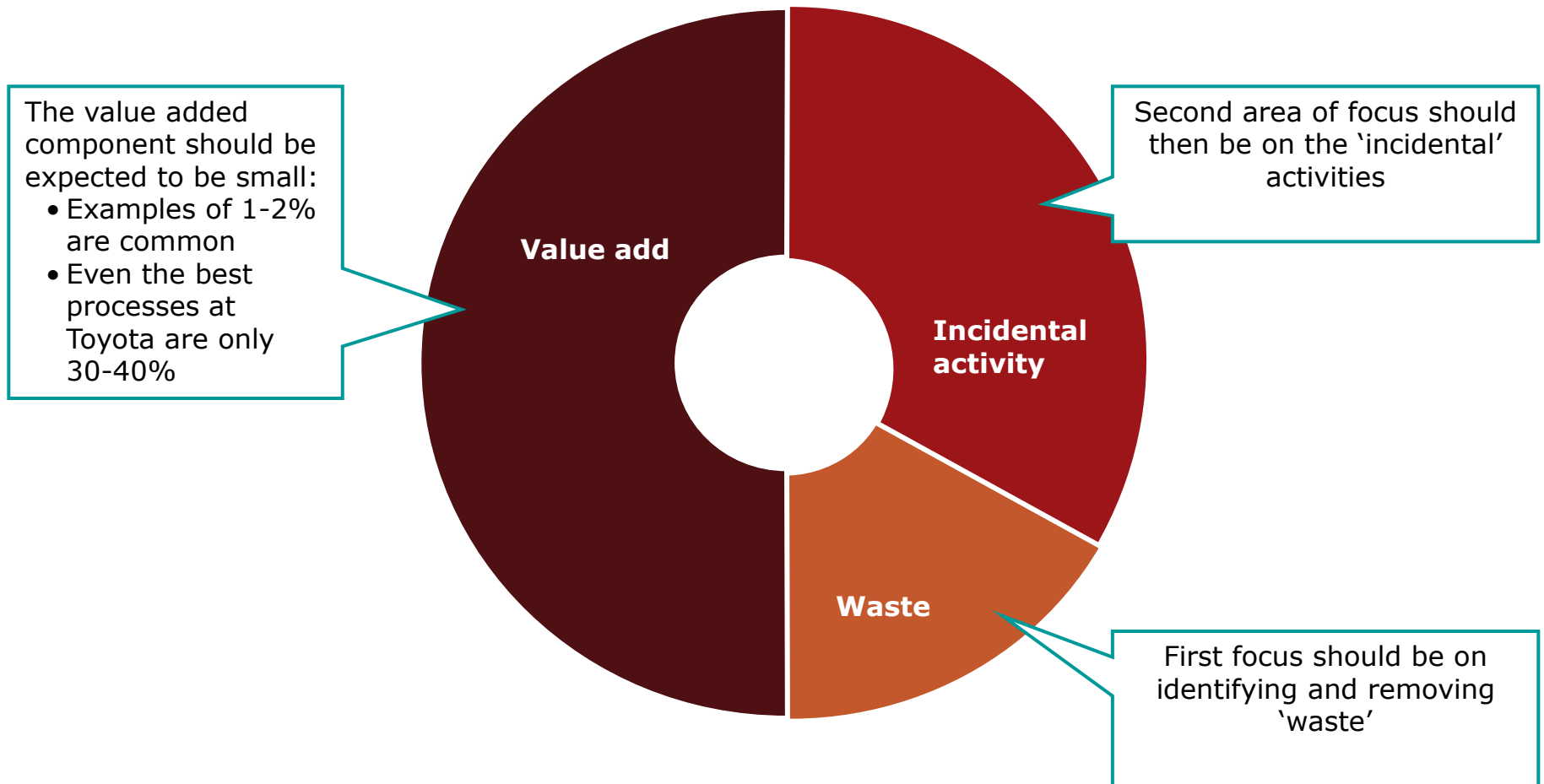
e.g. NZ Post deliver time

Waste:

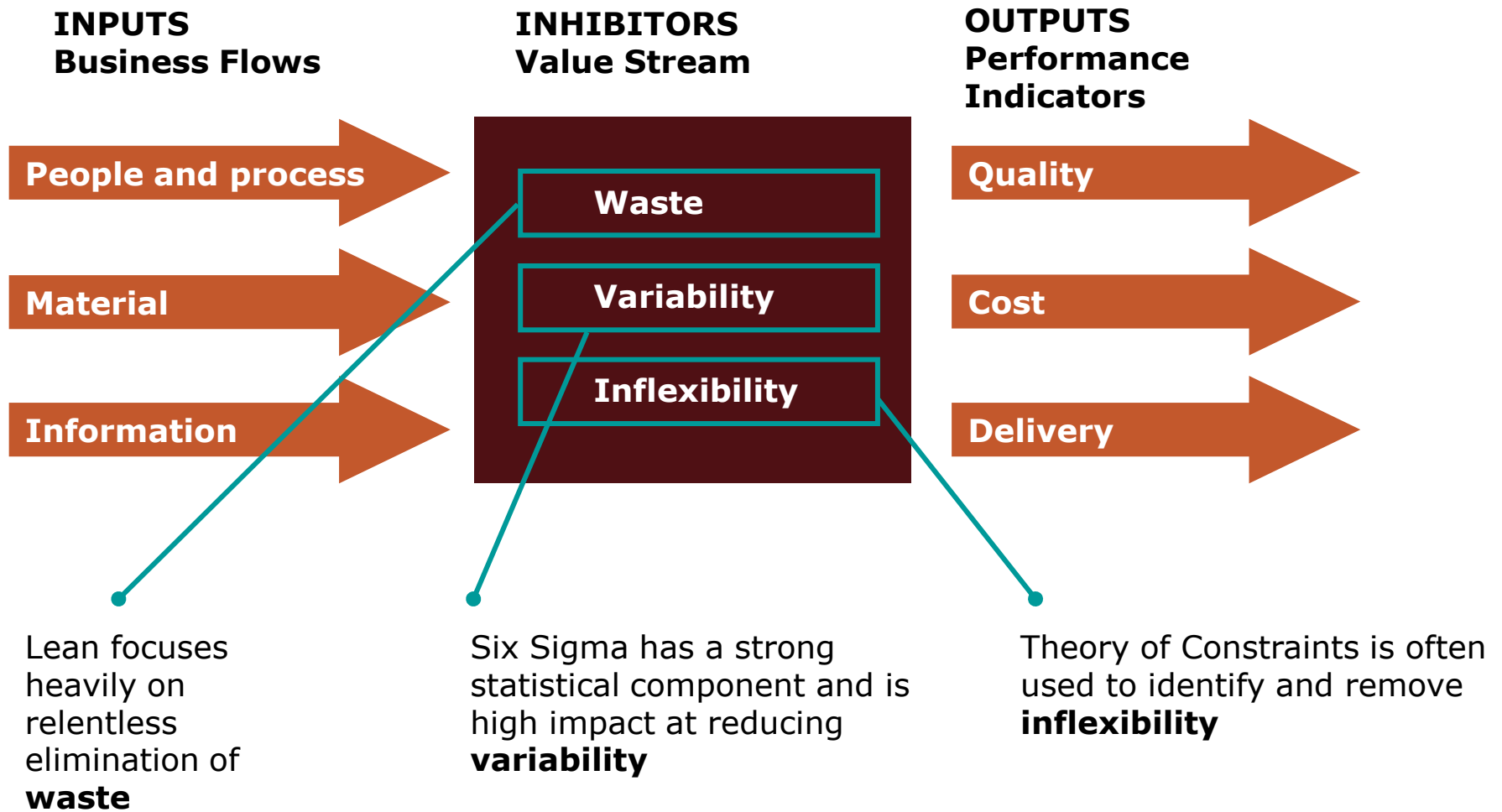
- Work that does not add any value to the product
- The Japanese word for waste is Muda

e.g. the embossed card waiting for the next courier pick up time

The objective process improvement is to increase the proportion of value adding time by tackling waste and incidental activity



Waste is one of three 'system' inhibitors that impact our quality, cost and delivery





What is Lean?

"The relentless pursuit of eliminating activities that do not create value for customers."



1. Minimise cycle times
2. Optimise touch times
3. Continuous flow

What is Lean?

- Lean is a set of principles, often associated with manufacturing, that accelerates the speed of all processes across an entire business
- Lean is the relentless pursuit of eliminating activities that do not create value for customers
- Focus on each product's **value stream** rather than the organisation, titles, roles or process
- The Service industry can apply Lean principles if it views the internal operations as processing a tangible "service product"

"All we are doing is looking at the timeline from the moment the customer gives us an order to the point we collect cash. And we are reducing that timeline by removing the non value added wastes."

Taiichi Ohno
Inventor of Lean

'Lean' has its roots in the Toyota Production system and has been evolving for more than 50 years

Toyota founded

1933

1946

1950

1960

1970

1980

1990

2000

2006

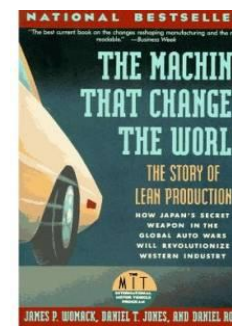
- Toyota nearly bankrupt
- Limited access to capital with post war depression in Japan
- Productivity one ninth of US automakers
- Annual volume = 11,000 cars vs. 3.6 million at GM

- Labour strikes and layoffs at Toyota
- Taiichi Ohno (TPS founder) leads plant turnarounds

- Toyota becomes #1 Japan exporter

- Toyota launches overseas production

- "The Machine That Changed The World" is published
- 'Lean' is coined



- Toyota number 1 in car production, 9.1m cars pa.
- General Motors second (8.9m)
- Ford third (6.3m)

Toyota and Lean

Ranking by Sales (Million Units Sold)

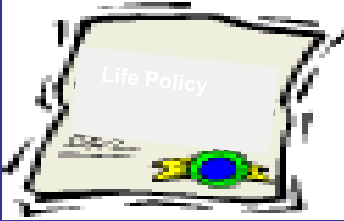
Rank	1950	1970	2001	2009
1	GM	GM	GM	Toyota
2	Ford	Ford	Ford	GM
3	Chrysler	Chrysler	Toyota	VW
4	Studebaker	VW	VW	Ford
5	Nash	Fiat	Renault	Hyundai
6	Kaiser – Fra	Toyota	Daimler	PSA
7	Morris	Nissan	Honda	Honda
8	Hudson	Renault	Hyundai	Nissan
9	Austin	BL	Fiat	Fiat
10	Renault	Peugeot	Mitsubishi	Suzuki

LEAN IN ALL INDUSTRIES

Oil platforms

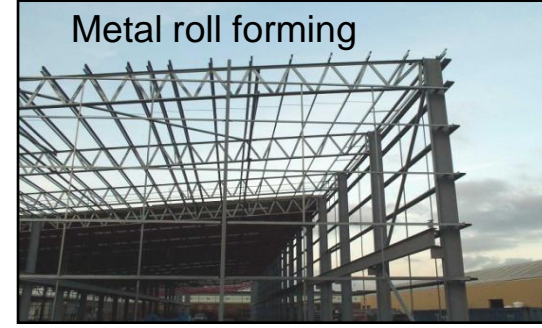


Aerospace ducting



Life Insurance

Metal roll forming



Aircraft components



Kitchen units



Pharmaceuticals



Military headsets



Commercial Lighting



Shock absorbers



Banks



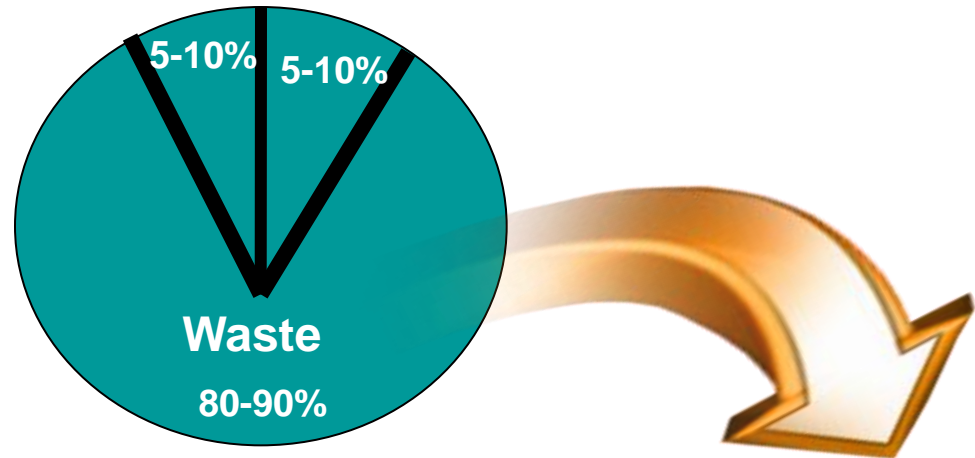
Why Lean?

“The relentless pursuit of eliminating activities that do not create value for customers.”

Value Add activities

Necessary activities

Mortgage Application	
Total Cycle time	76 days
Value Added time	6.5 hrs
602 hrs	
Claims processing	
Total Cycle time	2 days
Value Added time	1.0 hr
15 hrs	
Statement processing	
Total Cycle time	3 days
Value Added time	2.5 mins
23.96 hrs	



Incredible opportunities

Why so much waste?

SUBOPTIMISATION

- Focus on individual components does not improve overall performance
- Errors accumulate and cause downstream impacts
- What proportion of our process is done right first time

Information collection

Application Input

Application approval

Documentation preparation

Disbursement

Documentation receipt

Customer

3.0%

9.0%

5.0%

6.0%

RTY = 78%

Why so much waste?

Information collection

Application Input

Application Approval

Documentation preparation

Disbursement

Documentation receipt

Customer

Hidden Complexity – lack of visibility

- Why do things take so long
- Where are things held up
- How often do we rework activities

Why so much waste?

Lack of VOC

- Are we delivering what the market wants
- What levels of performance do our customer need
- How do we know we are delivering?



Information collection

The diagram shows a series of seven overlapping, light blue rounded rectangular boxes arranged in a descending staircase pattern from top-left to bottom-right. Each box contains a background image of architectural blueprints with a blue pen and a compass. The boxes are labeled with the following steps: Information collection, Application Input, Application Approval, Documentation preparation, Disbursement, and Documentation receipt. A large, 3D-style orange arrow starts from the bottom of the 'Documentation receipt' box and points towards a final box on the right labeled 'Customer'. This 'Customer' box contains an image of hands holding a blue credit card.

Application Input

Application Approval

Documentation preparation

Disbursement

Documentation receipt

Customer

Lean can be difficult.....

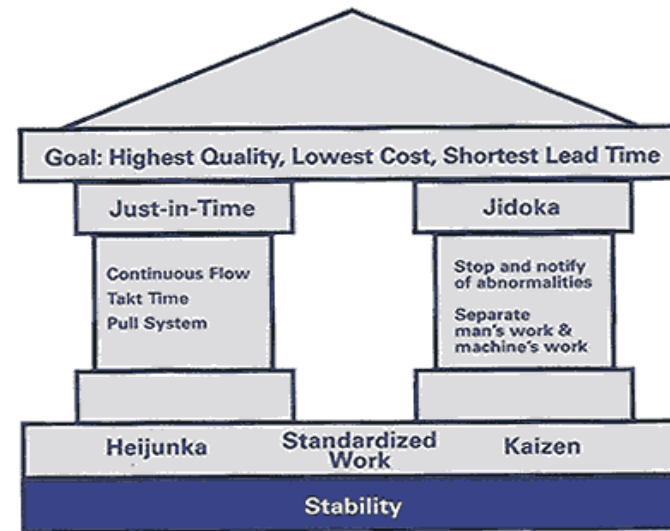
- It is designed to surface problems and make it necessary to fix them
- There should be no avoiding problems in Lean
- We should constantly find problems, identify their root causes, and solve them to order to improve
- But we have to change people's behaviour and..
 - People tend to avoid and cover problems
 - People tend to avoid difficulty
 - People become complacent
 - People tend to stop at the first workable solution

There is more to Lean than just waste elimination - *It is a business "philosophy"*

Lean aims for the absolute elimination of waste, overburden and unevenness to allow smooth and efficient work

Lean has three desired outcomes:

- 1** To provide customers with the highest quality products, at lowest possible cost, in a timely manner with the shortest possible lead time
- 2** To provide workers with job satisfaction, security and fair treatment
- 3** To give the company flexibility to respond to the market, achieve profit through cost reduction activities and long-term prosperity



Standardised work Common work methods to ensure safety and quality

Jidoka The principle of stopping a process immediately an abnormality occurs
Just in time Linking production rate to customer demand

Flexible Manning Maintaining productivity despite demand fluctuations



What is Six Sigma?

Six Sigma has been made famous by GE

1985



Motorola Engineer, Bill Smith first coined the phrase. A measure of defects. 16 Billion in savings to date.



1996



GE launch Six Sigma: USD \$250m invested, savings returned of just under USD \$200m; 3000 projects, ~\$67,000 of benefits per project
Bank of America – 2B over 3 yrs
AMEX – 1B over 4 years



2011

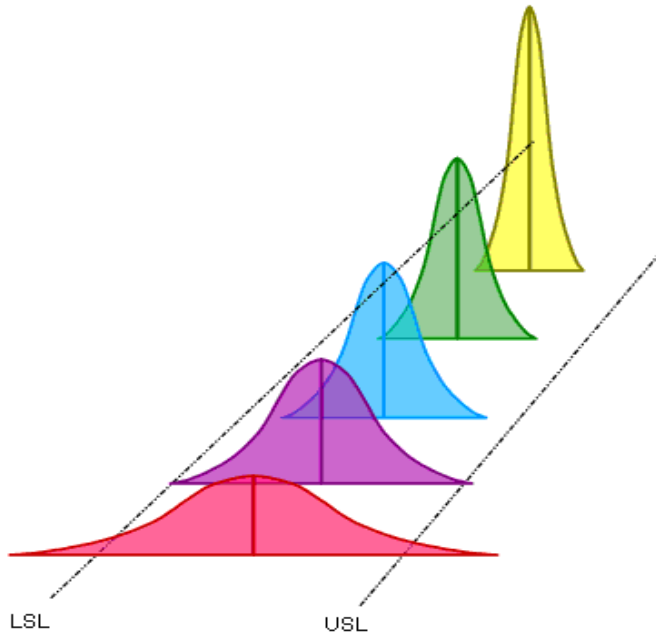


Six Sigma can be seen as: a vision; a philosophy; a symbol; a metric; a goal; a methodology



Spread to numerous industries
Continuously evolving DSS and VOC methods

Six Sigma means process optimisation with a target of 3.4 defects per million



Sigma capability	Defects Per Million Opportunities
6	3.4
5	233
4	6,210
3	66,807
2	308,537

99% Good (3.8 Sigma)

- 20,000 lost articles of mail per hour
- 5,000 incorrect surgical operations per week
- 2 short or long landings at most major airports each day
- 200,000 wrong drug prescriptions each year

99.99966% Good (6 Sigma)

- 7 articles lost per hour
- 1.7 incorrect operations per week
- 1 short or long landing every 5 years
- 68 wrong prescriptions per year

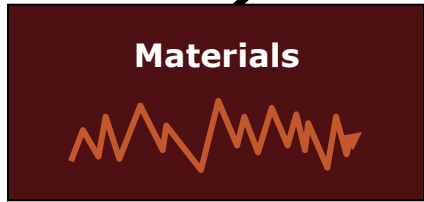
Six Sigma focuses on reducing variability which may come from five difference sources

- *Sickness / absenteeism*
- *Pace of work*

- *Machine reliability*
- *Time to complete task*



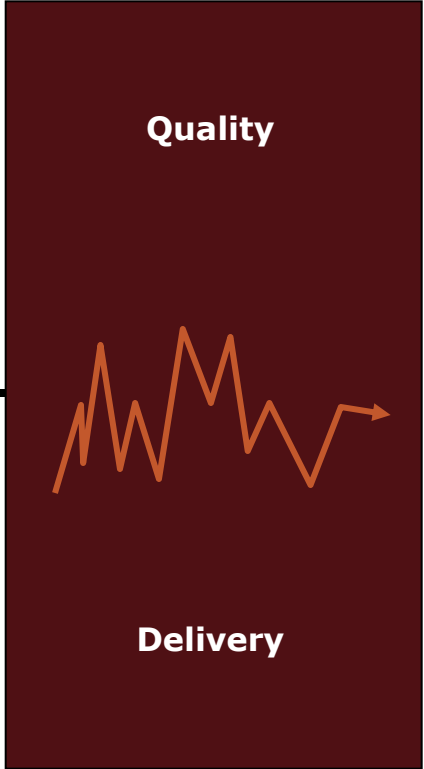
- *Weather*
- *Industry / business conditions*



- *Quality*
- *Lead time for re-supply*



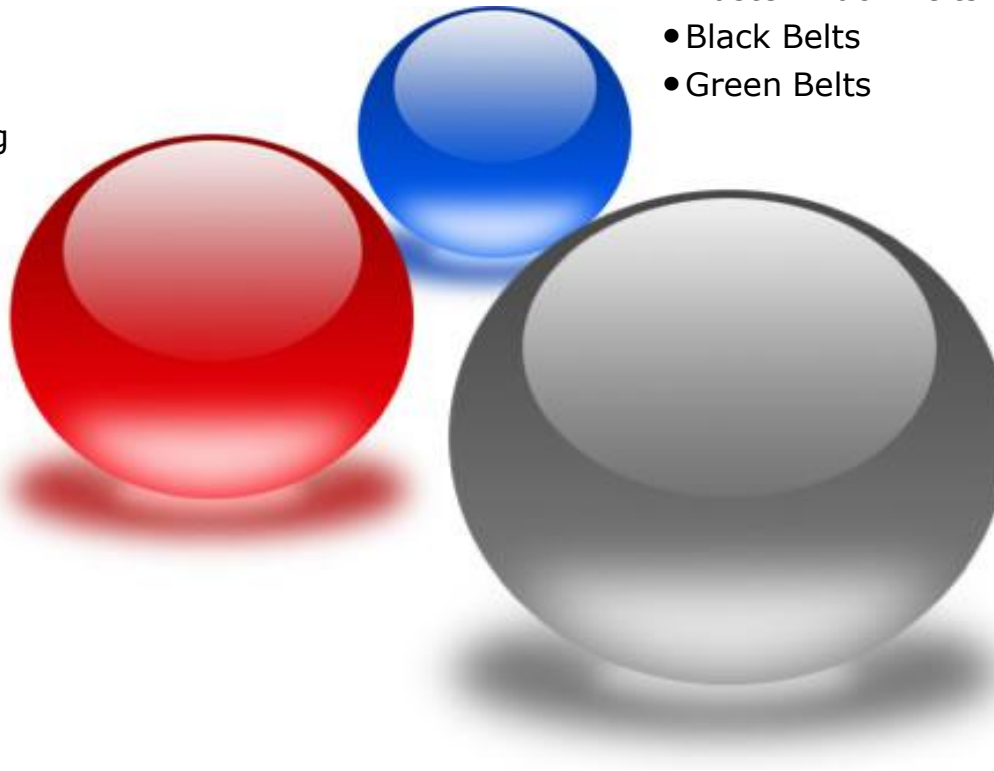
- *Accuracy of data*



There are 3 key components to Six Sigma methodology

A prescriptive problem solving approach using DMAIC

- Creates standardised, disciplined problem solving approach used across company
- Drives measurement and data-driven analysis of metrics that are critical to customers
- Focuses on reduction in variation of key metrics



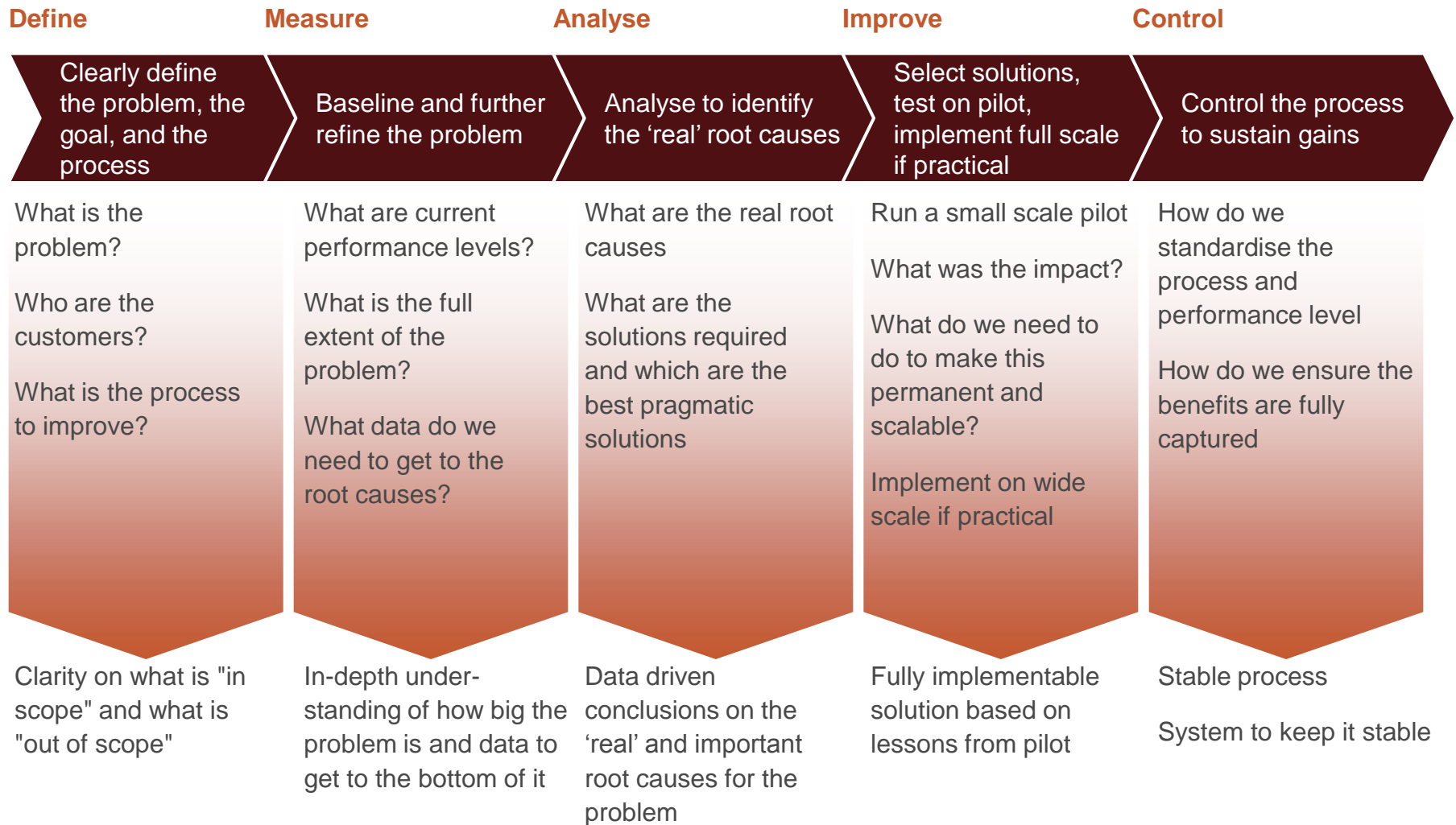
Dedicated and certified resources

- Champions
- Master Black Belts
- Black Belts
- Green Belts

Statistically focused problem solving tools:

- Brainstorming
- Voice of the customer
- Affinity diagrams
- Multi-voting
- Hypothesis testing
- Pareto charts
- Fishbone
- Process mapping

The DMAIC framework offers a problem solving approach when we do not know the answer



Six Sigma trains experienced practitioners as the key drivers of change



Green belt

- Part-time position leading Six Sigma, continues fulfilling current job responsibilities
- Trained in Six Sigma tools, provides functional/ divisional knowledge and expertise
- Communicates Six Sigma methodology to others in the organisation
- Mentored by a Black Belt



Black belt

- Full-time dedication to Six Sigma, leads projects and shares responsibility for deliverables
- Applies the "right" Six Sigma methodology and tools to ensure the quality of the process
- Escalates issues to management
- Trains and coaches team members



Champion / sponsor

- Proposes Six Sigma improvement projects and is responsible for deliverables
- Resolves issues
- Understands Six Sigma strategy, discipline, and tools
- Promotes Six Sigma strategy and methodology

Lean and Six Sigma are different but there are areas of overlap and they can be complimentary

	Lean	Overlap	Six Sigma
Definition	<ul style="list-style-type: none">• An integrated operating system of principles, tools and techniques		<ul style="list-style-type: none">• A structured improvement methodology using a standard approach and statistical tools
Key principle	<ul style="list-style-type: none">• Reduce waste• Smooth flow• Manage variability	<ul style="list-style-type: none">• Basic analytic tools (Pareto etc)	<ul style="list-style-type: none">• Reduce variation
Project selection	<ul style="list-style-type: none">• Value stream mapping and design of end to end system	<ul style="list-style-type: none">• Process mapping• Root cause analysis	<ul style="list-style-type: none">• Piecewise selection focusing on fixing known problems
Problem solving	<p><i>Prescriptive solutions:</i></p> <ul style="list-style-type: none">• One piece flow• Takt / pull systems• Standardised work		<p><i>Prescriptive process:</i></p> <ul style="list-style-type: none">• DMAIC
Resources	<ul style="list-style-type: none">• Lean experts• Team working across organisation (embedded into daily culture)		<ul style="list-style-type: none">• Master Black Belts, Black Belts, Green Belts

Lean Six Sigma approaches support process management and compliment audit and risk management activities

Process Management

- Clearer understanding and documentation of processes – Mapping / standardised work
- Clear process measurement of performance driven by customer requirements – basic statistics and control plans
- Standardised work practices
- Develops repeatable stable processes – Measurable and can be managed
- Improves knowledge management

Risk Assessment

- Tools to measure and manage process risk (FMEA / Process Mapping / Performance measurement)
- Clear link between risks and control points
- Focus on reduced errors and putting in place processes that stop errors occurring
- Project based improvement activities

Improved customer experience

- Reduces lead times for customers
- Reduces rework and errors
- Increases the value provided to customers
- Continual focus on continuous improvement
- Increased probability of meeting customer needs