



Welcome

Continuous Improvement - Lean Six Sigma

GET IN TOUCH:

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made@uwtsd.ac.uk

www.MADECymru.co.uk



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David



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EUROPEAN UNION



Uywodraeth Cymru
Welsh Government

**Cronfeydd Strwythurol a
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**European Structural
and Investment Funds**



University of Wales Trinity St David

MADE Cymru

Manufacture
Advanced
Design
Engineering

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David Jones – who is he?

MADE overview

Course Outline

What is Six Sigma?

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David Jones

Lecturer on Continuous Improvement

Manufacturing Engineering Experience:-
Food Packaging
Offshore Petrochemical Industry – HP connectors
Tier One Automotive – Cooling Packages
Aerospace Industry - Titanium Supplier

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BUILD A FUTURE-PROOF WORK FORCE, TODAY

Short & Flexible University Course:

SMART MANUFACTURING WITH INDUSTRY 4.0

- » Introduction to Industry 4.0
- » Advanced Industry 4.0 or Design for Industry 4.0

Fully
Funded*

“Industry Wales is fully supportive of these EU programmes. At a time of significant change and challenge for the Welsh Manufacturing sector, this operation is both timely and critical. With an established track record in providing industry focused solutions, UWTSO are ideally placed to deliver such an operation.”

James Davies, CEO – Industry Wales.

Introduction to Industry 4.0

Topics include:

- » Lean thinking manufacturing strategies benefitting from Industry 4.0 technologies.
- » Value Stream Mapping to identify potential economic impact technology.
- » Potential benefits of Industrial Internet of Things.
- » Smart manufacturing including Factory of the Future principles.
- » The role of data, including impacts of cloud-based computing and cyber-security.

Advanced Industry 4.0

Topics include:

- » Applications of advanced technology including virtual, augmented and mixed reality.
- » Identifying the benefits of 'digital twin' simulation.
- » Elimination of inefficiencies using the 'digital thread'.
- » Systems leadership, governance and ethics of Industry 4.0 technologies.

Design for Industry 4.0

Topics include:

- » Generative Design and Optimisation techniques for Industry 4.0 manufacturing strategies.
- » Design methodologies for Automated Assembly, Automated Dis-assembly etc.
- » Quality of Design methodologies underpinning technology application.
- » Value Analysis / Value Engineering to achieve economic benefit from Industry 4.0 technologies.

MADE

EMBRACE INNOVATION IN YOUR TEAM

**Fully
Funded***

Short & Flexible University Course:

BUSINESS IMPROVEMENT WITH INNOVATION MANAGEMENT

- » Introduction to Innovation Management
- » Management of New Product Development

“The mix of theory and practical examples of how to manage innovation made the course very accessible on a personal level, and immediately introduced new possibilities for applying the knowledge directly to the company. This encouraged a new surge of optimism to move innovation within the company to the next level.”

Jon Jolley, Managing Director at SRM Engineering Ltd



Introduction to Innovation Management (20 credits)

Topics include:

- » Types of innovation management
- » Managing uncertainty and risk
- » Challenges and barriers
- » Business drivers
- » Technology drivers
- » Measuring innovation
- » Open innovation

Management of New Product Development (20 credits)

Topics include:

- » Brand and product strategy
- » Business models for product development
- » Managing research and development
- » Collaborative product development
- » Circular economy
- » Creating the product design specification

Can you speak to Alan, and pick up something around the diversity and impact of assignments and dissertations? Perhaps another slide?



BUILD A FUTURE-PROOF WORK FORCE, TODAY

Fully
Funded*

Short & Flexible University Course:

CONTINUOUS IMPROVEMENT WITH INDUSTRY 4.0

- » Quality Six Sigma Green Belt
- » Group Project

“The MADE Cymru team at UWTSD really understand manufacturing and have put their years of experience into the 'Continuous Improvement with Industry 4.0' course. We need to grow manufacturing in Wales, now more than ever. This is an easy way to invest in your staff and your organisation for the future.”

Jack Yates, Managing Director at Hi-Mark Automotive.

Green Belt Six Sigma

Topics include:

- » Six Sigma DMAIC Process; Define, Measure, Analyse, Improve and Control.
- » Topics such as Process Flow, Voice of the Customer, Measurement Systems, Process Capability, Nelson's Rules, Data Visualisation, Root Case Analysis, Design of Experiments and Risk Management etc.
- » Effective application of these tools to support each phase of a Six Sigma project.
- » Identification of relevant Industry 4.0 technologies to support Continuous Improvement.
- » Integration of Industry 4.0 technologies for existing and legacy equipment.

Group Project

Topics include:

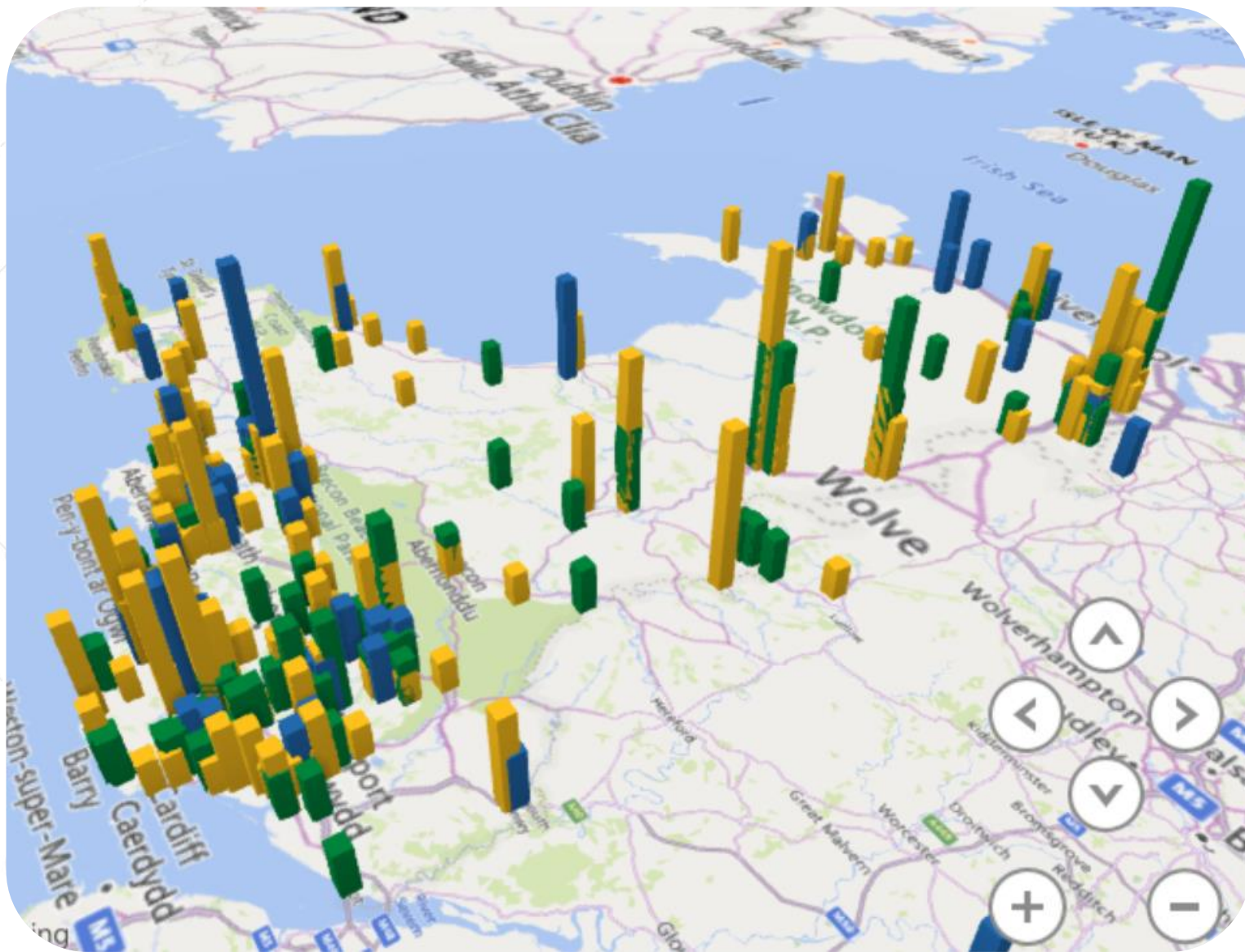
- » Deployment of Industry 4.0 technologies with Six Sigma disciplines in workplace-based projects.
- » Introduction to Team Working methodologies, including team roles and responsibilities.
- » Six Sigma Six Panel reporting methods and presentations.
- » Fortnightly project tutorials with Continuous Improvement practitioners.

Can you speak to Dave Jones, and pick up something around the diversity and impact of projects? Perhaps another slide?



1. Upskilling for Advanced Manufacturing (Industry 4)
2. Continuous Improvement
3. Innovation Management

- Flexible way to learn while you work.
- Friday afternoon online / blended learning delivery (1 or 2 lectures).
- 3 more Entry points (October 2022, February 2023 and June 2023.)
- Hop-on / Hop-off Learning opportunities.
- Bite sized Learning at Level 5 & Level 7
- Fully funded (for limited period).





Level 5 – Continuous Improvement with Industry 4.0



Lecture sessions

- Friday afternoons 1pm – 3pm
- October 14th – April 28th

Tutorials

- You will need to book these with me – generally 30 minutes every few weeks, scheduled on a Friday morning if possible

Moodle access

- Six Sigma Green Belt (ACMA5005)
- Group Project (ACMA5009)

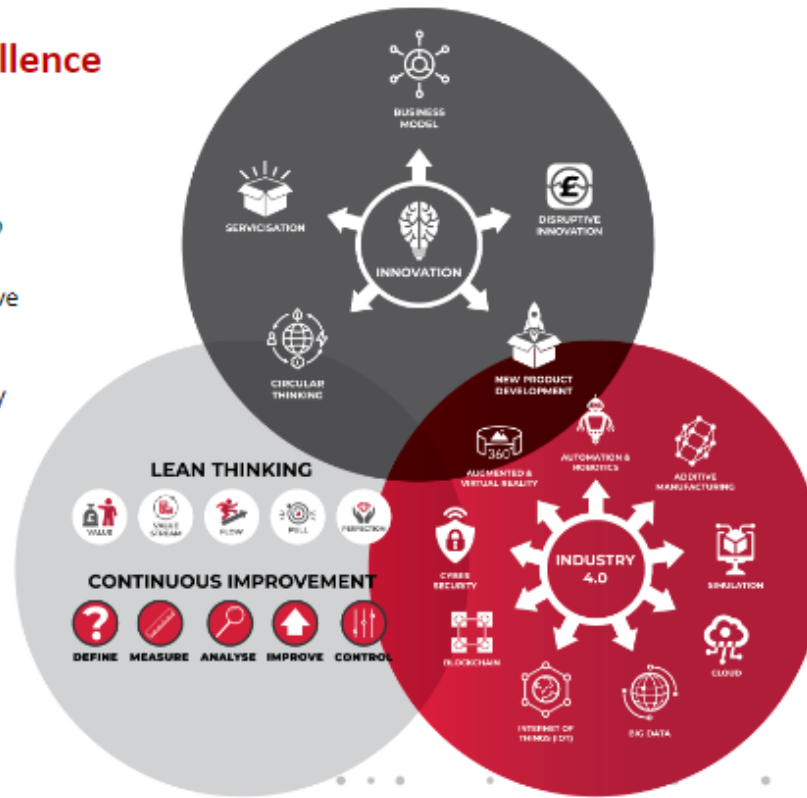


Vital! – Ensuring you have access to Moodle

Level 5 – Continuous Improvement with Industry 4.0

Operational Excellence

- Lean Principles to help us reduce operational complexity and improve productivity.
- Combine with Industry 4.0 technology.



Level 5 – Continuous Improvement with Industry 4.0



Indicative Content

- **Green Belt Six Sigma Quality**
 - Define
 - Process Mapping, SIPOC, Flow Charts, Pareto
 - VOC, Uncertainty in Sampling, CTQC
 - Value Stream Mapping
 - Measure
 - Measurements, MSA, Gauge R&R, Attributes and Collection Plan
 - Charting, SPC, X-Bar, R-Chart, Moving Range, Process Capability
 - Data interpretation, visualization and analysis. *"listen to your SPC"*
 - Introduction of Industry 4 technologies
 - Analysis
 - Root Cause, Cause & Effect, 5Ys
 - Hypothesis Testing, Z-test, ANOVA / F-test Toolset
 - Design of Experiments
 - Improve
 - PDCA, Risk Management and FMEA.
 - Solution Selection Matrix, 5S and Benchmarking
 - Control
 - Process Control (Cp, CpK) refresh SPC, 5S
- **Group Project**
 - Introduction to Group Working
 - Team Roles and Responsibilities.
 - Project Scoping
 - A3 Thinking
 - Change Management
 - Design & Development Process; 4 Square Mapping, Project Gateways
 - Negotiation
 - Deployment of technologies
 - Discrete Event Simulation
 - Project Tutorials
 - Final Project Presentations
 - Feedback and Wash-up sessions
- **Assessments**
 - Green Belt Six Sigma Quality – 2x 1 hour online tests.
 - Group Project – DMAIC Six Panel Project Presentations

Online Tests

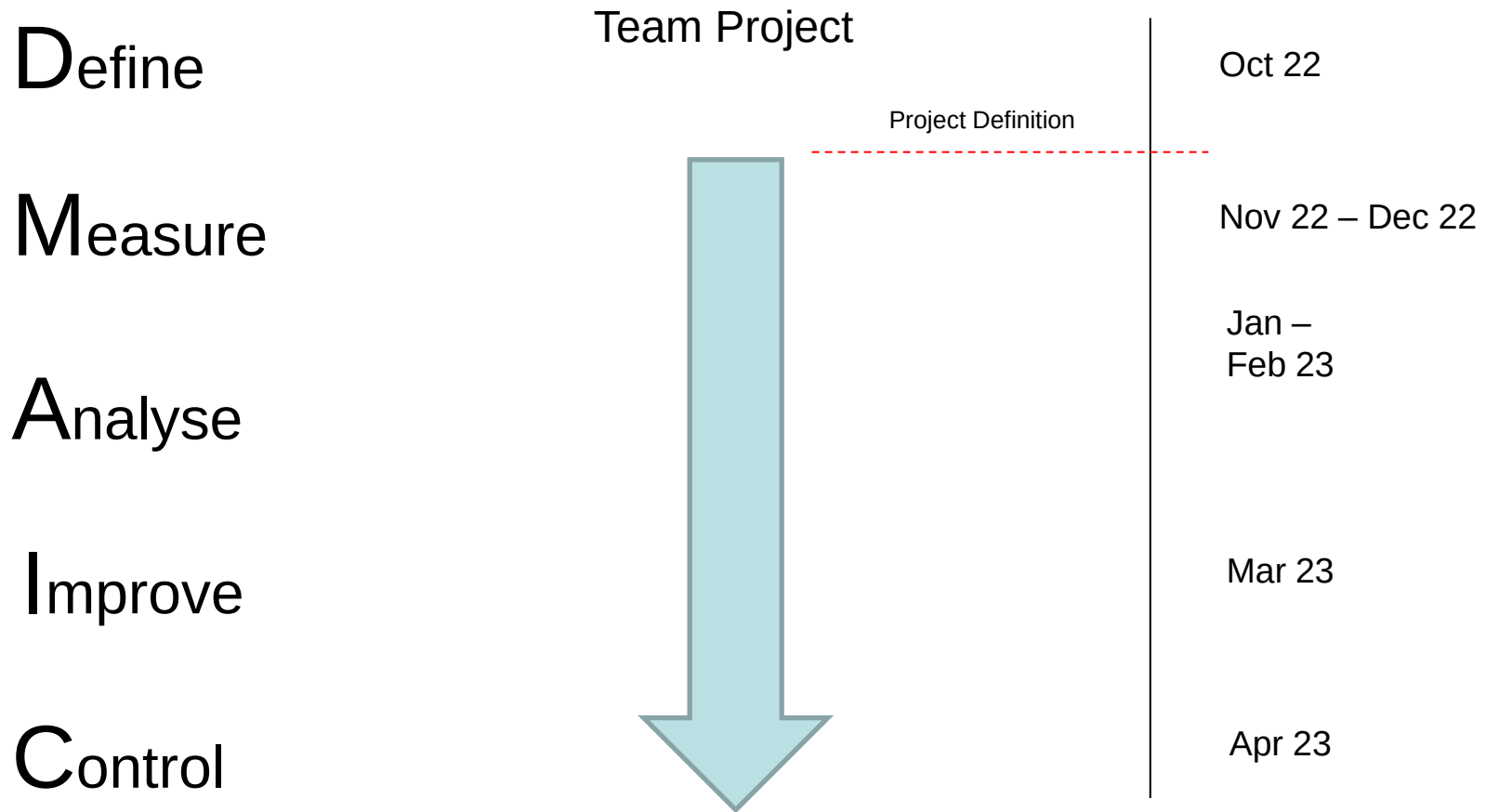
- Six Sigma Green Belt Test #1
- Six Sigma Green Belt Test #2

One hour online, multi-choice, about 45 questions

Group Project

- Pick a project within your sphere of influence/knowledge
- Go narrow and deep – Project Charter is important
- Backs up your learning with practical application

Level 5 – Continuous Improvement with Industry 4.0



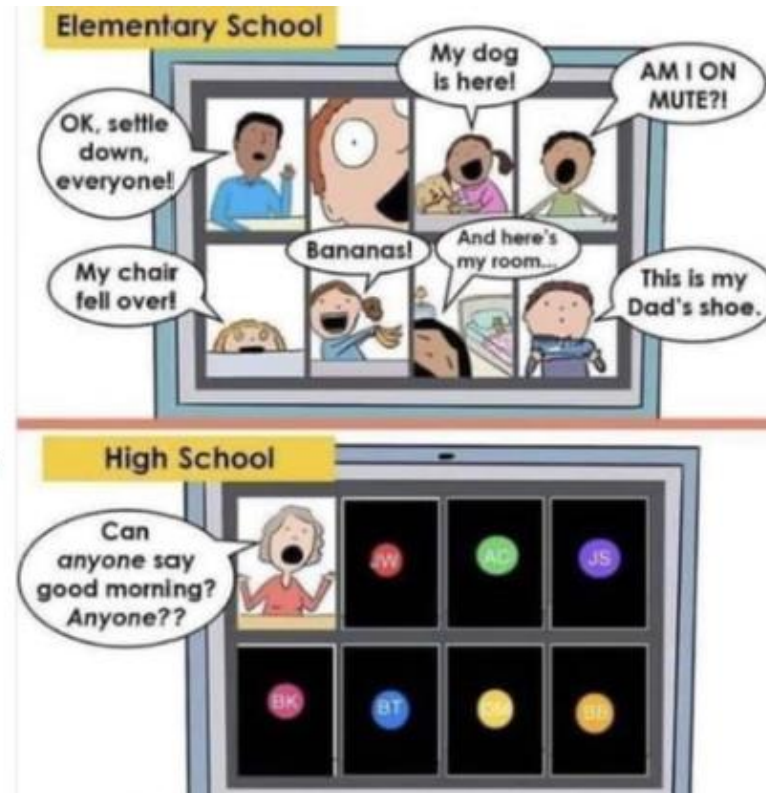
Face to Face Sessions

- Viscose
- Safran
- Eaton
- Aber Instruments
- Reflexallen
- Hanson
- LSN Diffusion
- Russel IPM
- Simply Do
- Rehau
- Fibrax
- Tenneco



Teams Sessions

- Please switch your cameras on! Engage with us and your colleagues.
- Nothing worse for us than talking to a screen of Icons / Initials.
- You will need to use your Student Email to login into Teams sessions.



Level 5 – Continuous Improvement with Industry 4.0

Go to www.menti.com and use the code 6896 6695

Block J first session

Go to
www.menti.com
Enter the code
6896 6695



Or use QR code

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What is six sigma?

Continuous Improvement – Lean Six Sigma

Characterise the Process

Optimise the Process



DEFINE

Define the problem
Listen to the customer (VoC),
KPI's, VSM

Raise project charter



MEASURE

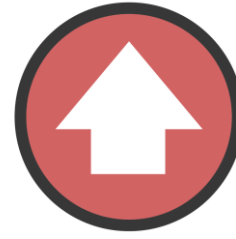
Identify measures.
Check your measuring systems.

Collect data
Listen to your process (VoP)



ANALYSE

Identify the factors which are the main contributors.
(i.e Normality, T tests, correlation, regression, capability)



IMPROVE

Determine the optimal values for the factors.
Improvement tools:-
(i.e., 6 s, TPM, poke yoke, PFMEA, 8 wastes. DoE)



CONTROL

Determine the long-term controls so improvements identified and are embedded in the organization
(i.e., control plans, SOP)

Level 5 – Continuous Improvement with Industry 4.0

DATA



SORTED



ARRANGED



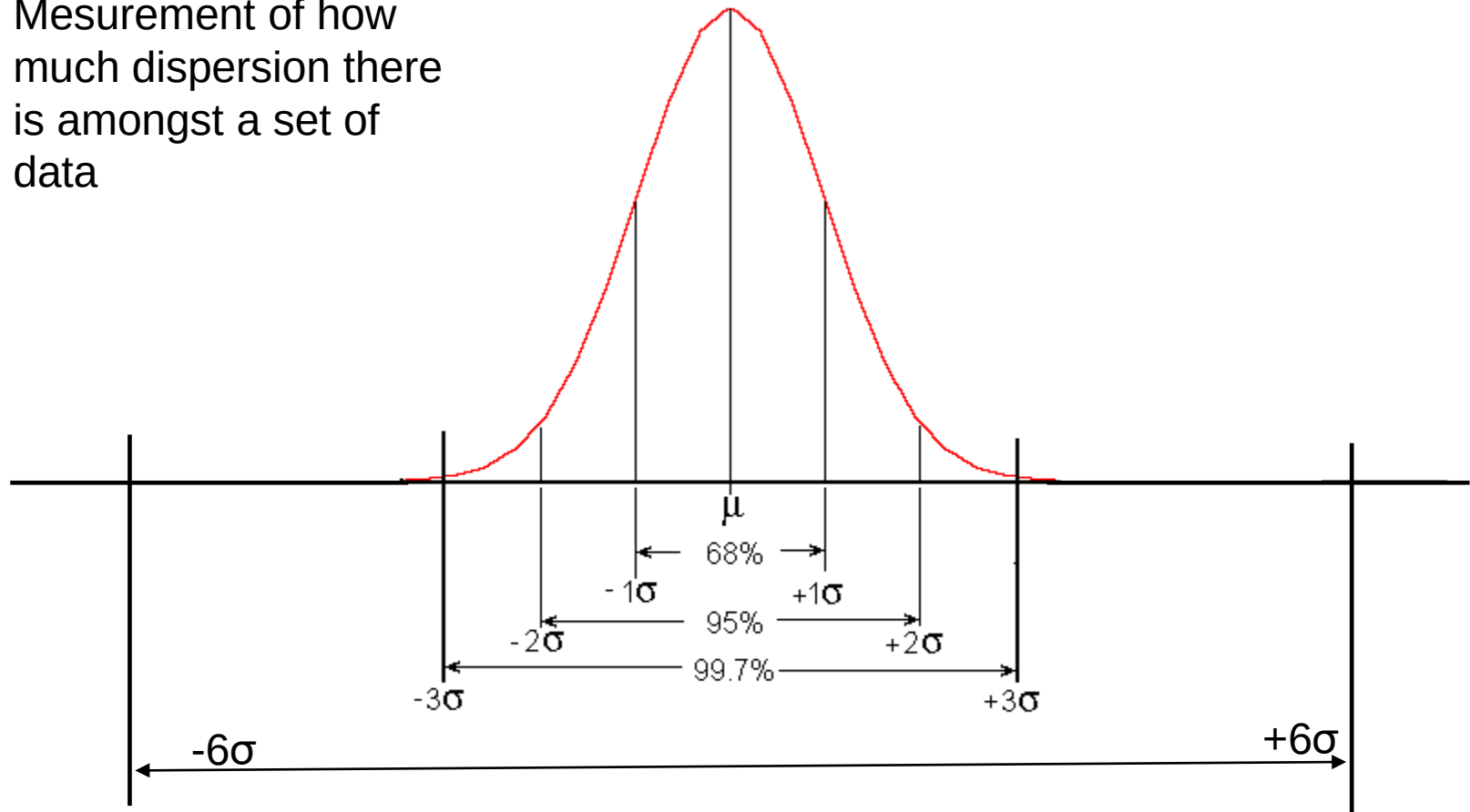
PRESENTED
VISUALLY



EXPLAINED
WITH A STORY



σ = standard deviation
Measurement of how
much dispersion there
is amongst a set of
data

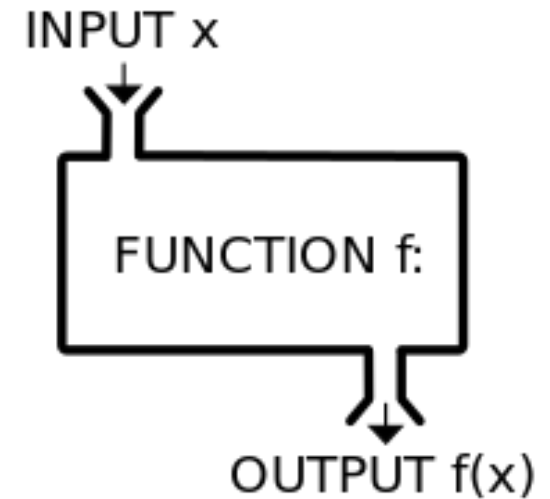


99.99966% (3.4 defects / 1,000,000 opportunities)

$$Y = (f) X$$

$$Y = (f) X$$

Outcome **Y** = (Function **f**) Output **X**



The 'Y' and 'X' Relationship

A fundamental formula used in 6-Sigma training is that “Y” is a function of “X”

$$Y = (f) X$$

In mathematical terminology, “Y” is the dependent variable while “X” is the independent variable. Expressed in another way, “Y” is an output resulting from several inputs or “Xs”

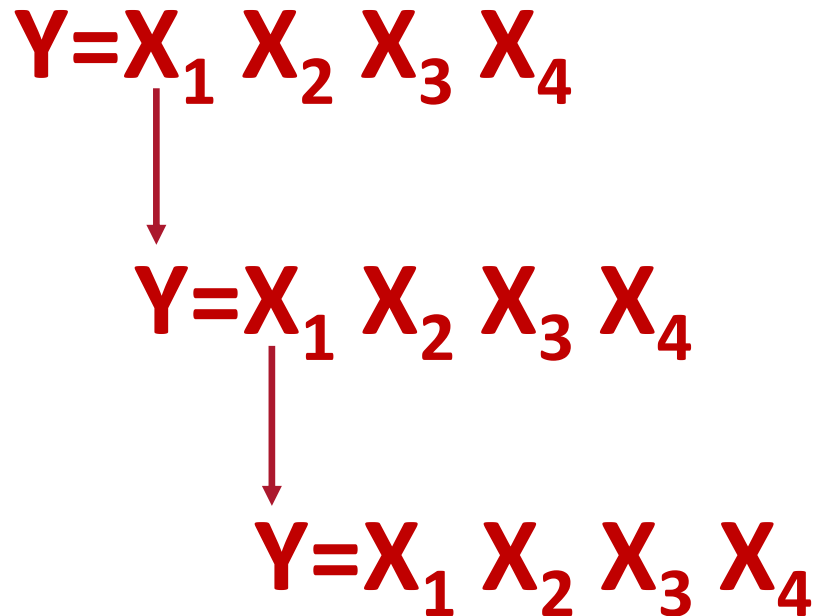
The typical diagram used to communicate this concept in Consumer Driven 6-Sigma training is as follows;

$$Y = X_1 X_2 X_3 X_4$$

The 'Y' and 'X' Relationship

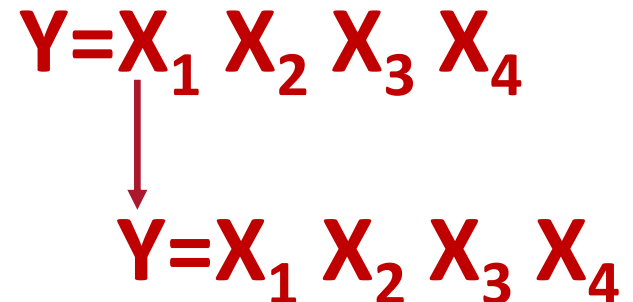
Building on this concept, it can be said that every “X” is correlated to a “Y” at some deeper level in the process.

We can show this as a cascade;



- Type of lemon ingredient X_1
- Amount of sugar added X_2
- Type of water used X_3
- Amount of ice added X_4

- Fresh squeezed lemon (potential $\mathbf{X_1}$)
- Liquid concentrate (potential $\mathbf{X_2}$)
- Frozen concentrate (potential $\mathbf{X_3}$)



The 'Y' and 'X' Relationship example

Examining the “*Fresh Squeezed Lemons*” factor (X_1) which now becomes our Y , the “X” variables might include:

- Where the lemons were grown (potential X_1)
- How the lemons were transported (potential X_2)
- Age when squeezed (potential X_3)
- How lemons were squeezed (potential X_4)

$$\begin{array}{c} Y = X_1 X_2 X_3 X_4 \\ \downarrow \\ Y = X_1 X_2 X_3 X_4 \\ \downarrow \\ Y = X_1 X_2 X_3 X_4 \end{array}$$



DMAIC CYCLE

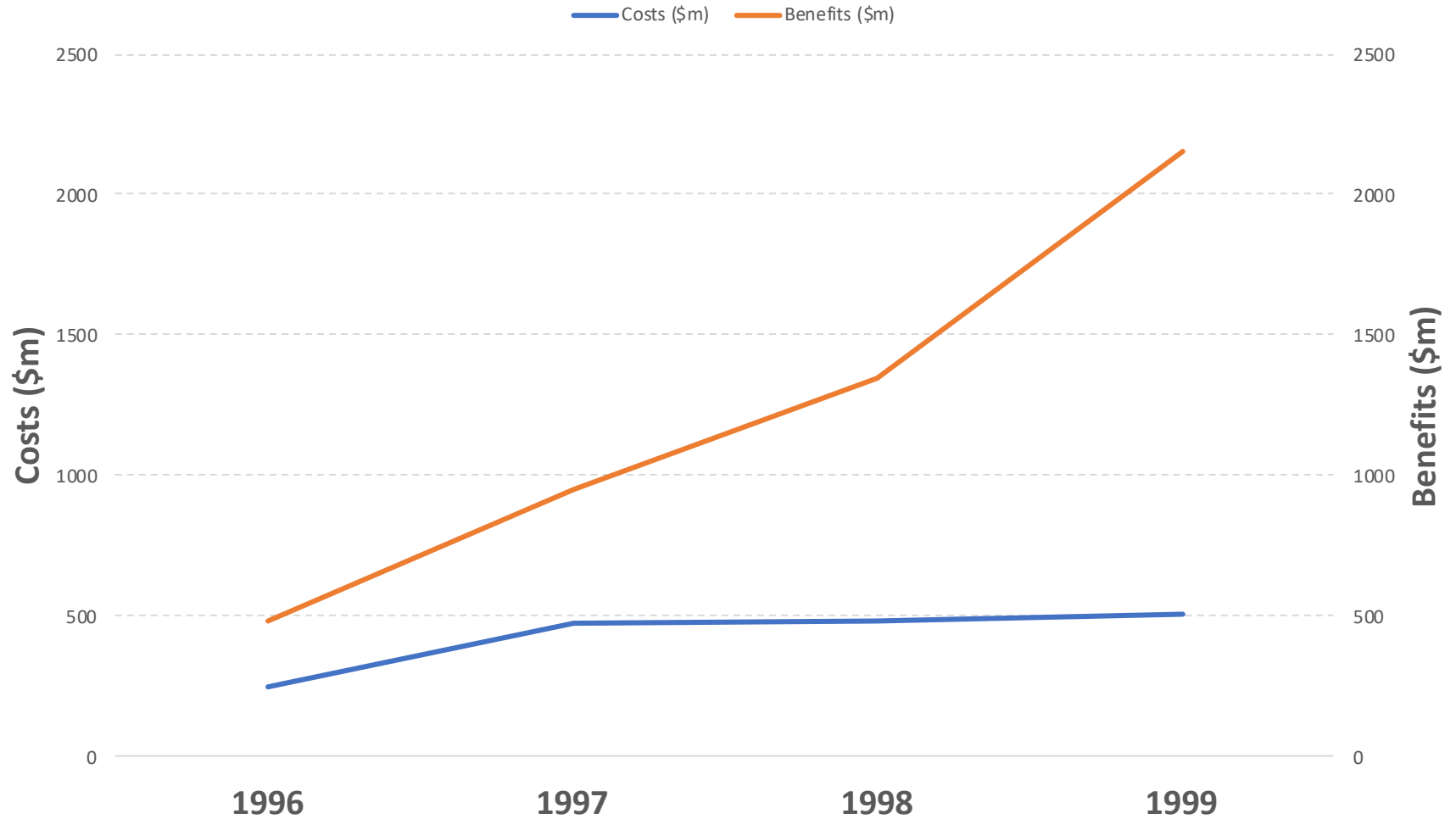
5 Phases of Continuous Improvement

Where to start?

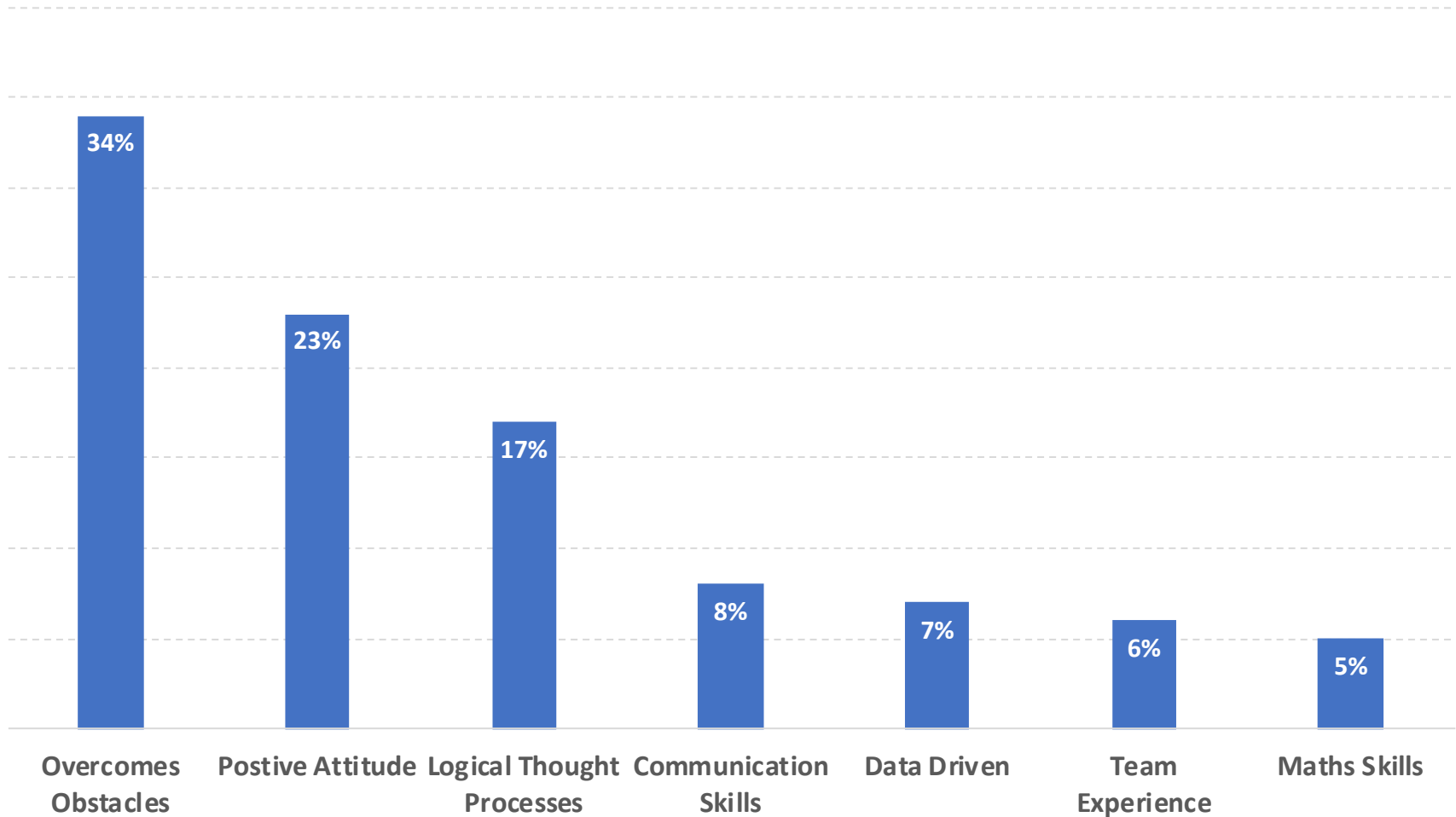
1. Observe some important aspect of your business or operation.
2. Develop a tentative explanation, or hypothesis (theory), consistent with your observations.
3. Based on your hypothesis, make predictions.
4. Test your predictions by conducting experiments or making further careful observations.
 - a. Record your observations.
 - b. Modify your hypothesis based on the new facts.
 - c. If variation exists, use statistical tools to help you separate signal from noise.

Repeat Steps 3 and 4 until there are no discrepancies between the hypothesis and the results from experiments or observations.

GE's Reported cost of Six Sigma versus Benefits



Skills and their Relative Importance



Six Sigma Deployment and Roles

The power of Six Sigma revolves around Black Belt and Green Belt projects, and involves many others.

