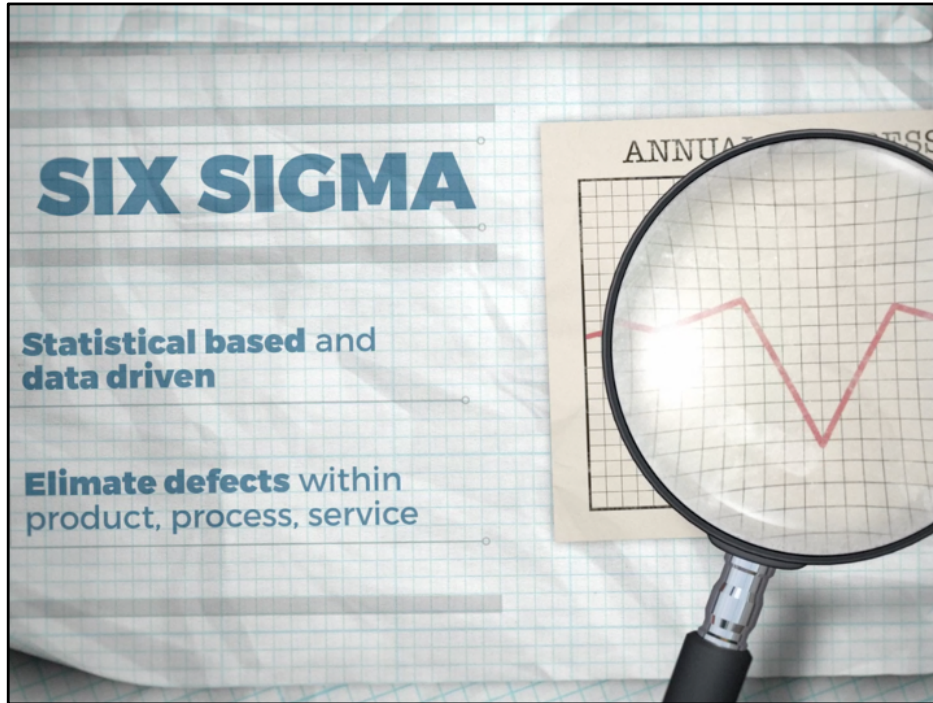




Your notes

Level 5, Continuous Improvement with Industry 4.0



- **Green Belt Six Sigma Quality**

- **Define**

- Process Mapping, SIPOC, Flow Charts, Pareto
- VOC, Uncertainty in Sampling, CTQC

- **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 to support Six Sigma.

- **Analysis**

- Root Cause, Cause & Effect, 5Ys
- Hypothesis Testing, Z-test, ANOVA / F-test Toolset
- Design of Experiments
- Value Stream Mapping

- **Improve**

- PDCA, Risk Management and FMEA.
- Solution Selection Matrix, 5S and Benchmarking

- **Control**

- Process Control (Cp, CpK) refresh SPC, 5S

- **Group Project**

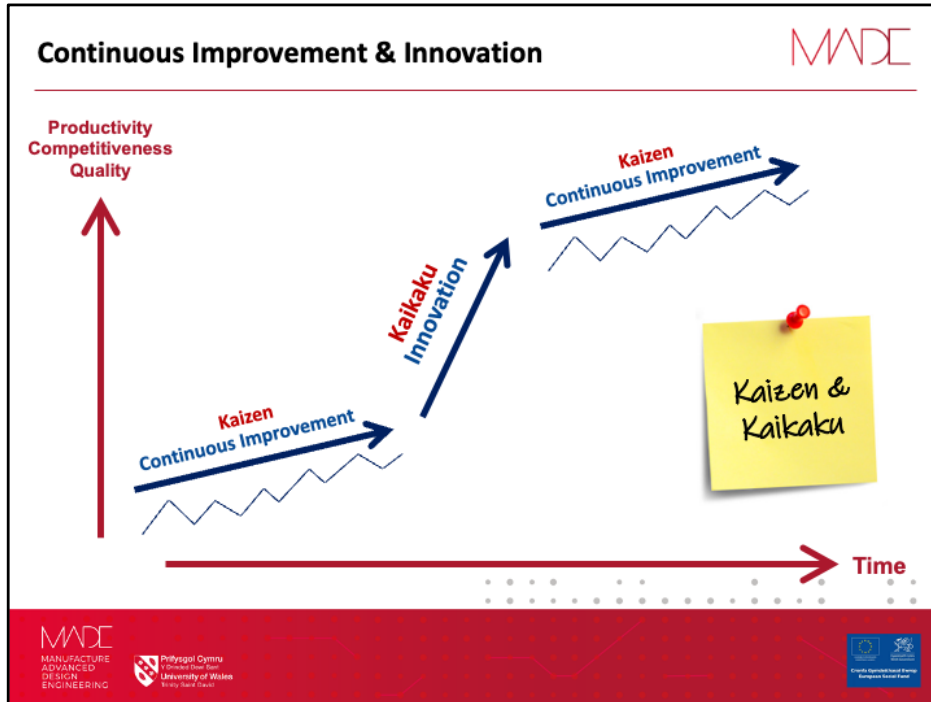
- Introduction to Group Working
- Team Roles and Responsibilities.
- Project Scoping
- A3 Thinking
- Change Management
- Design & Development Process; 4 Square Mapping, Project Gateways
- Negotiation
- Project Tutorials
- Final Project Presentations
- Feedback and Wash-up sessions

- **Assessments**

- Green Belt Six Sigma Quality – 2x 1 hour online tests.
- Group Project – DMAIC Six Panel Project Presentations

2

Your notes



Kaikaku is the Japanese term for "radical change". In business, Kaikaku is concerned with making fundamental and radical changes to a production system, unlike Kaizen which is focused on incremental changes. Both Kaizen and Kaikaku can be applied to activities other than production.

Kaikaku and Kaizen are concepts in Japanese production philosophy that relate to each other. Both have origins in the Toyota Production System.

Kaikaku means a radical change, during a limited time, of a production system. Kaizen, on the other hand, is a system of incremental production system changes, often with the primary goal of solving team-related problems. Kaizen is based on all employees involvement wherein singular changes generally reach an improvement of less than 20%. A cross between Kaikaku and Kaizen is Kaizen Blitz (or Kaizen Events), which target a radical improvement in a limited area, such as a production cell, typically during an intense week.

Kaikaku means that an entire business is changed radically, typically in the form of a project. Kaikaku is most often initiated by management, since the implementation and the result will significantly impact business. Kaikaku is about introducing new knowledge, new strategies, new approaches, new production techniques or new equipment. Kaikaku can be prompted by external factors, e.g. new technology or market conditions. Kaikaku can also be initiated when management judges that diminishing improvements from ongoing Kaizen efforts suggest a need for more radical change. Kaikaku projects often result in improvements in the range of 30-50% and a new base level for continued Kaizen. Kaikaku may also be called System Kaizen.

Kaikaku projects can be of four different types:[1] [2]

Locally innovative implementation - e.g., introducing a production robot, well-known to the industry, but new to the company

Locally innovative methodology - e.g., introducing Six Sigma or TPM methods,

well-known to the industry, but new to the company

Globally innovative implementation - e.g., introducing a new robot design to the industry

Globally innovative methodology - e.g., introducing a new production theory to the industry

Your no

Marginal Gains

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<https://www.youtube.com/watch?v=NQxYlu12ji8>

<https://bit.ly/3boNa8X>

Your notes

What is Lean?

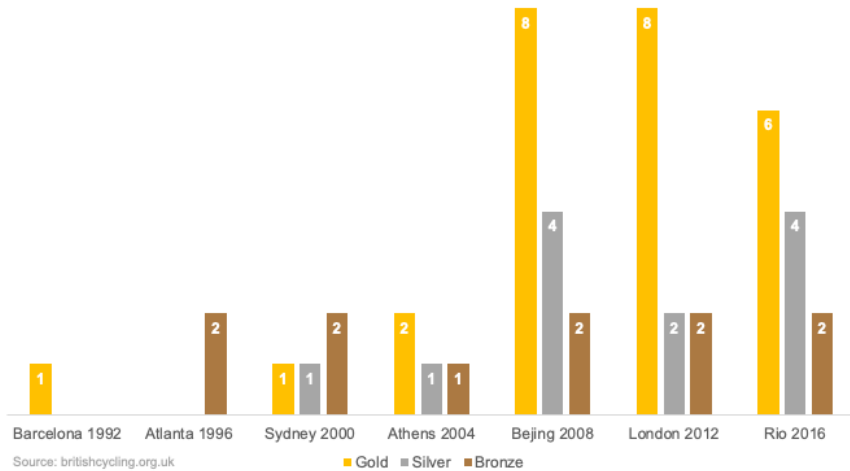
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Your notes

Team GB Olympic Track and Road Medals

MADE



1988 Summer Olympics in Seoul = 0 medals

Berisford - No I in team, but think about What is in this for me?

Put yourself in your teams shoes? How do they see things?

1% Factor.

Your notes

Scheme of Work



- **Six Sigma Green Belt Quality**
- **Introduction to Lean & Six Sigma (DMAIC)**
- **DMAIC: Define**
 - Process Mapping, SIPOC, Flow Charts, Pareto
 - VOC, Uncertainty in Sampling, CTQC
- **DMAIC: 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 to support Six Sigma.
- **DMAIC: Analysis**
 - Root Cause, Cause & Effect, 5Ys
 - Hypothesis Testing, Z-test, ANOVA / F-test Toolset
 - Design of Experiments
- **DMAIC: Improve**
 - PDCA, Risk Management and FMEA.
 - Solution Selection Matrix, 5S and Benchmarking
- **DMAIC: Control**
 - Process Control (Cp, CpK) refresh SPC, 5S
- **Group Project**
- **Deployment**
- **Project Scoping**
- **Project Work**
 - Introduction to Group Working
 - Team Roles and Responsibilities.
 - A3 Thinking
 - Change Management
 - Design & Development Process
 - 4 Square Mapping
 - Project Gateways
 - Negotiation
- **Project Tutorials**
- **Final Project Presentations**
- **Feedback and Wash-up sessions**
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7

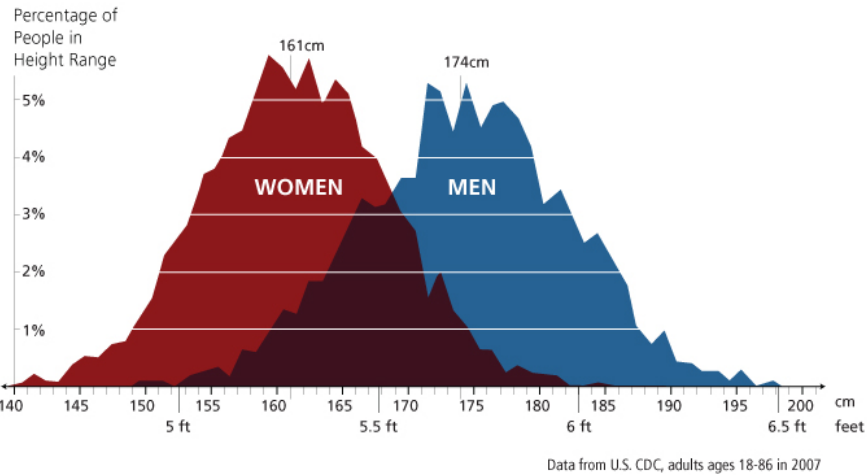
Your notes

The world is 'Bell-shaped'

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Height of Adult Women and Men

Within-group variation and between-group overlap are significant



8

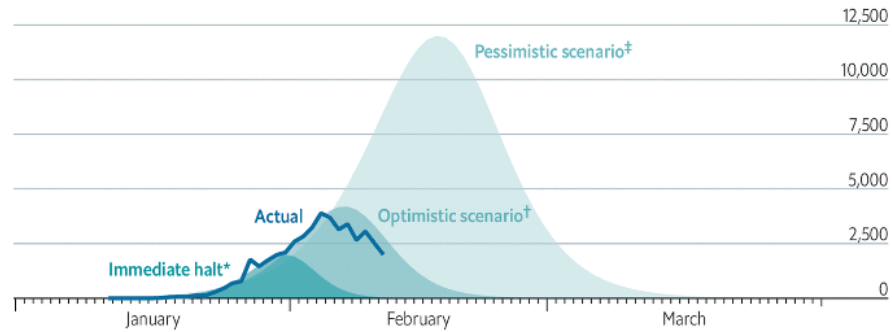
Your notes

The world is 'Bell-shaped'

MADE

Breathe a bit more easily

China, new confirmed cases of Wuhan coronavirus, 2020



Sources: Cheng-Chih Hsu, National Taiwan University; National Health Commission of China
*Hypothetical model of Wuhan quarantine immediately stopping the spread
†Based on estimates by Zhong Nanshan, Guangzhou Institute of Respiratory Disease
‡Based on estimates by Jonathan Read, Lancaster University

The Economist

9

Your notes

Three meanings of Six Sigma...



1. Six Sigma is a Management Philosophy

- Customer based approach used to recognise that product and service defects are expensive.

2. Six Sigma is a Statistic

- Six Sigma processes will produce less than 3.4 defects or mistakes per million opportunities.

3. Six Sigma is a Process

- Define, Measure, Analyse, Improve and Control

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Your notes

Origins of Six Sigma



Six Sigma was first developed in the late 1980s at Motorola in response to their struggle to meet the demanding quality targets for complex manufactured products.

- Become widely known when Jack Welch GE adopted it in 1994
- Initially a quality measurement approach based on statistical principles
- Transformed to a disciplined process improvement technique based on reducing variation within the system with the help of a number of statistical tools

Roots lie in the works of Phillip B. Crosby, George D. Edwards, W. Edward Deming, Walter Andrew Shewhart, Armand V. Feigenbaum, Joseph M. Juran, Kaoru Ishikawa, and Genichi Taguchi

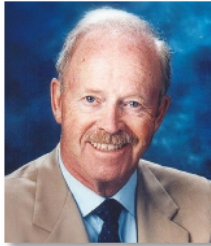
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Your notes

Phillip B. Crosby



- Author of Quality is Free, one of the seminal texts of quality control. Extolled the benefits of doing things right the first time.
- Four cardinal rules of quality management:
 1. the performance standard should be set as zero defects;
 2. quality is the same thing as conformance to requirements;
 3. quality is achieved by preventing defects;
 4. and the measure of quality's value is the cost of nonconformance.



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Your notes

George D. Edwards

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First president of the American Society for Quality.

Head of the inspection engineering department for Bell Telephone Laboratories

Instrumental in advancing Bell Lab's groundbreaking quality assurance program.



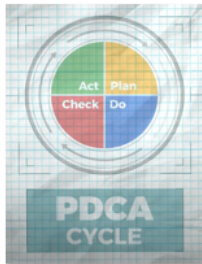
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Your notes

W. Edwards Deming



- One of the fathers of quality control
- Key insight was the use of statistics for quality control
- Another insight was the difference between common- and special-cause variation
- Best known for defining the “**seven deadly diseases of the workplace**” and “**14 points for management.**”
- **PDCA ((Observe) > Plan > Do > Check > Act)**



PDCA <https://www.youtube.com/watch?v=kLNkIMBb3ak>

14

Your notes

Who is Tim Woods?

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<https://bit.ly/3bqmQew>

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PDCA Cycle 1:09 2 views • 2 months ago

Nelsons Rules 2:23 3 views • 2 months ago

The Circular Economy 1:46 21 views • 6 months ago

MADE - The Student Journey 2:17

Welcome to MADE 1:37

What is MADE? 1:24

15

Your notes

Walter Andrew Shewhart

MADE

- The father of statistical quality control
- Formulate the statistical idea of tolerance intervals and to propose his data presentation rules, which are listed below:
 - Data has no meaning apart from its context.
 - Data contain both signal and noise. To be able to extract information, one must separate the signal from the noise within the data.
- Originated the Plan-Do-Check-Act cycle popularized by Deming
- Long-time collaboration with Deming, who championed Shewhart's ideas



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Your notes

Armand V. Feigenbaum

MADE

- Promoter of TQM
- Known for his 9 M's of quality; markets, management, men, money, motivation, materials, machines, modern information sources, and mounting (constantly improving) product requirements.
- One of the first to insist that the customer's perspective be used to assess quality



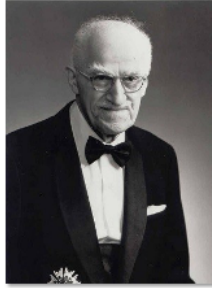
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Your notes

Joseph M. Juran

MADE

- Known for his three main components of quality management;
 - Use of statistical quality control
 - Quality improvement
 - Quality planning
- Also one of the first to insist that the customer's perspective be used to assess quality
- Advocated deep management involvement in the quality improvement process



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Your notes

Kaoru Ishikawa and Genichi Taguchi



Kaoru Ishikawa

- Developed the Ishikawa or fish diagram for root cause analysis
- Major advocate of TQM and developed Quality Circles



Genichi Taguchi

- Another advocate of TQM in Japan
- Promoted the use of statistics in quality management
- Wrote The Design of Experiments



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Your notes

The philosophy of Six Sigma



- Defects are expensive; both in resources and in customer satisfaction
- Competitive Advantage is gained by meeting customer expectations
- Focus on processes
- Strong alignment to organizational goals
- Reducing process output variation to stay within the limits defined by the customer will yield significant returns.
- Therefore, continuous improvement of an organization's processes is pursued via data analysis and the application of specific variance-reduction techniques

By utilizing Six Sigma to identify and optimize the vital few variables impacting quality and throughput, an organization can realize sustainable breakthrough performance.

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Your notes

What are the Key Organisational Drivers?



- In general terms they are;
 - Profit
 - Market Share
 - Customer Satisfaction
 - Efficiency
 - Product Differentiation
- While quality is not mentioned above, it is key to successfully delivering on the above drivers.
- Take profit for example; a non-Six Sigma company typically spends 25%-40% of its revenues fixing problems. Whereas Six Sigma companies typically spend less than 5 percent of their revenues fixing problems

22

Your notes

Organizational Drivers and Metrics



In order to both understand where an organization is and how it is progressing, one needs quantifiable metrics to baseline and to track progress.

- The selected metrics must map back to the organizational drivers and will measure process and financial performance
- These metrics must be relevant to the problem or goal in mind.
- All roads lead back to the concept of the Cost of Quality
- There are widely-used financial metrics as well as balanced scorecards
- Six Sigma also provides us with a set of key metrics

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Your notes

Key Six Sigma Metrics



- DPU – Defects Per Unit
- DPO – Defects Per Opportunity
- DPMO – Defects Per Million Opportunities
- FTY – First Pass Yield
- TPY – Throughput Yield
- FY – Final Yield
- RTY – Rolled Throughput Yield
- Cycle Time
- TAKT Time

24

Your notes

Key Financial Metrics



- **Return on Investment (ROI)** = (Net Profit/ Investment) × 100
- **Return on Assets (ROA)** = Net Income /Average Total Assets
- **Net Present Value (NPV)** = Each cash inflow/outflow is discounted back to its present value (PV). Then they are summed to give the NPV

$$\frac{Rt}{(1 + i)^t}$$

- Where t is the time of the cashflow, i is the discount rate
- Rt is the net cashflow at time
- **Internal Rate of Return (IRR)** - the annualized effective compounded rate of return

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Your notes

Lean Principles in the Organization



- Lean a comprehensive system for decreasing waste and increasing cycle times and quality
- The modern Lean approach was pioneered by Taiichi Ohno at Toyota during the 70's
- Goal is to identify processes that do not add value and eliminate them as much as possible
- The concept of Value is from the customer's perspective.
- In Lean, inventory is considered a drag, rather than an asset; so a lean business will do everything it can to minimize inventory



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Your notes

Lean Principles in Toyota



- **The Toyota Way**

These are the beliefs and values that create the working environment that allows Toyota to challenge the way we do things and not to be afraid to raise concerns.

No Fear No Blame, Toyota culture.

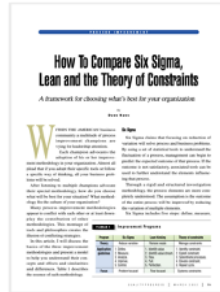
Respect for People, Respect for Teamwork



- **The Toyota Production System**

These are the tools and techniques we use to highlight problems and inefficiencies within our processes to try to continuously improve how we work.

Opportunities (problems or necessity)



.../L/Lean Thinking/England NHS (2014) Bringing Lean to Life.pdf
.../L/Lean Thinking/Nave (2005) How to compare Six Sigma, Lean and TOC.pdf

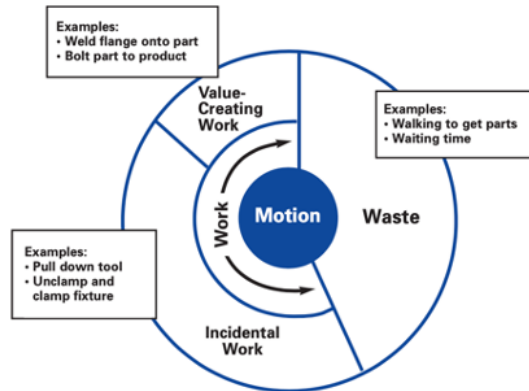
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Your notes

Value-Added vs. Non-Value-Added Activities



- Value chain is a chain of activities that an organization performs in order to deliver a valuable product or service to its customers
- **Value is defined by the customer, not by management**
- Process is then improved to reduce or eliminate non-value-added activities thus improving the value chain



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Your notes

Lean philosophy encompasses three areas



1. Transparency

- Easy access to useful information. An organization has achieved transparency when processes can be observed and measured

2. Velocity – Also called Flow

- The speed a process is completed. The ultimate measure of velocity is the interval between when a customer places an order and the delivery of the good or service they ordered. The ultimate goal of Lean is to increase velocity in order to improve responsiveness to the customer.

3. Value

- The set of qualities or characteristics for which a customer is willing to pay. It is always assessed from the customer's perspective

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Lean Principles – Theory of Constraints

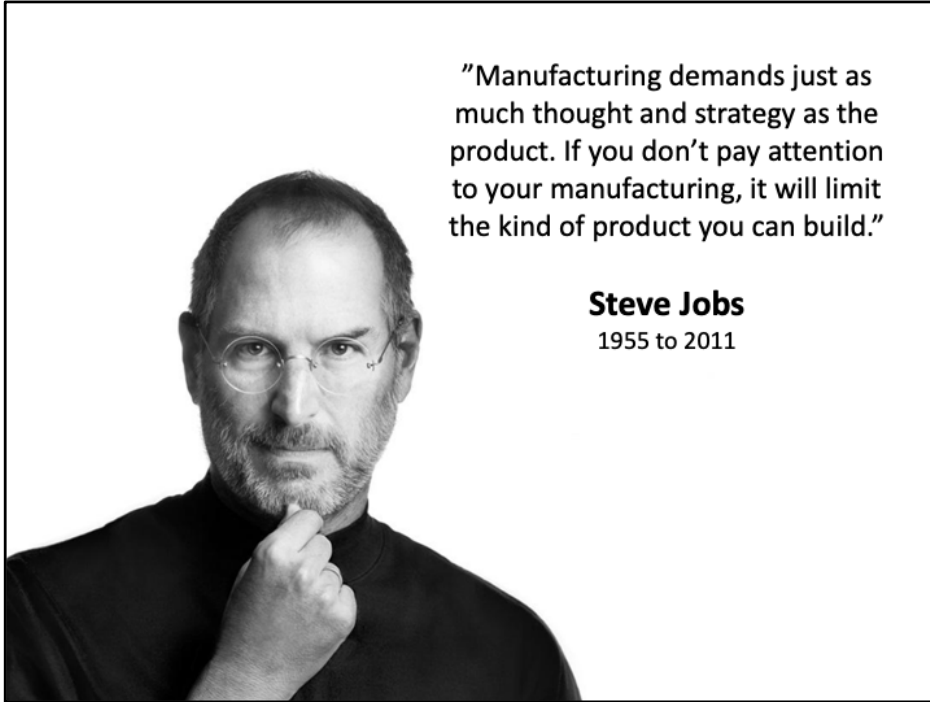


The Theory of constraints is an approach to improving processes by focusing on their most problematic areas

- These areas are known as constraints
- Even the smoothest process has constraints
- Improvement efforts are devoted to improving performance by removing or reducing constraints without sacrificing quality elsewhere
- Encourages businesses to improve continuously by diagnosing weaknesses and addressing them
- Exploiting the constraint is when an organization develops effective strategies for maximizing the potential of the constrained area

30

Your notes



"Manufacturing demands just as much thought and strategy as the product. If you don't pay attention to your manufacturing, it will limit the kind of product you can build."

Steve Jobs
1955 to 2011

Your notes

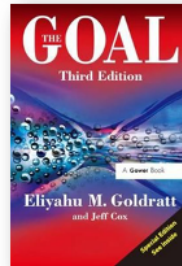
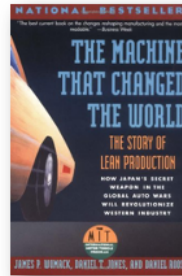
Further reading....

Lean production is a term that embraces many topics such as flexible manufacturing, minimizing work-in-process, "pull" systems of production control, and setup time reduction

The term "lean production" was coined around 1989 with the popularity of Womack and Jones book, The Machine that Changed the World.

Alex Rogo is a plant manager working ever more desperately to try and improve performance. His factory is rapidly heading for disaster. He has 90 days to save his plant - or it will be closed by HQ, with hundreds of job losses. It takes a chance meeting with a colleague from student days; Jonah - to help him break out of conventional ways of thinking to see what needs to be done.

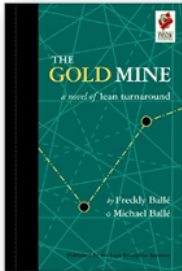
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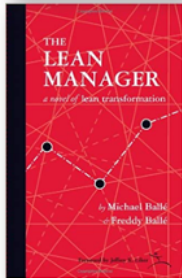
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Further reading....



Novel of Lean Turnaround deftly weaves together the technical and human pieces of implementing lean manufacturing in an engaging story that readers will find both compelling and instructive.

At the heart of the Gold Mine is Bob Woods, a curmudgeonly sensei coaxed out of retirement by his son Mike to help boyhood friend Phil Jenkinson save his struggling company.



Despite terrific products and a backlog of orders, Phil's company cannot generate enough cash from its operations to pay its bills. And so Mike enlists Bob to help his pal fix this crisis. "You're trying to deal with your mess as if it was a technical problem," Bob tells Phil. "Move this machine here, change this design there, which it is to some extent, but it's all about people.

You have a leadership problem not just a production or business problem." As Phil begins to tackle the key challenges necessary to improve his company's operations, he comes to understand the deeper points of lean.

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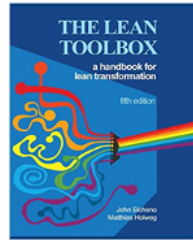
Your notes

Lean Toolbox – John Bicheno

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We've got a copy of John Bicheno's 'The Lean Toolbox' on it's way to you.

Other books available online....



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Your notes

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Your notes