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MFE 4213 Quality & Reliability Engineering



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LECTURE 4 – Six Sigma



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Quality Perspective

**Management Tools
for Quality:**

- Deming
- Juran
- Crosby
- Taguchi

Six
Sigma

**Technical Tools
for Quality:**

- TOPS
- Advanced SPC
- DoE
- Quality in Design
- Reliability Eng



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Outline Lecture 4

- ▶ Introduction
- ▶ 6 Sigma as a Methodology
 - ▶ DMAIC
 - ▶ DFSS
- ▶ Six Sigma as a Management System
- ▶ Six Sigma W/Shop
- ▶ Conclusion

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Lecture 4: ILO

- ▶ ILO 1: **Remember** and **understand** the theoretical and background knowledge of Six-sigma process improvement methodologies.
- ▶ ILO 2: **Apply** the Six-Sigma process improvement methodologies to an engineering case study.
- ▶ ILO 3: **Present** the findings which will be discussed in class

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Introduction to Six Sigma



- ▶ Six Sigma is a **data-driven methodology** that plays a crucial role in enhancing processes and reducing defects in engineering.
- ▶ It has its **roots in Motorola** but has evolved to become a standard in various industries, including manufacturing, healthcare, and service sectors.
- ▶ In this presentation, we'll explore the **fundamental principles and key concepts of Six Sigma** and its application within the engineering domain.

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Introduction to Six Sigma



- ▶ **Significance in Engineering:** Six Sigma is particularly relevant in engineering as it **helps optimize complex processes, minimize errors, and maximize efficiency.**
- ▶ **Key Objectives:** The primary goal of Six Sigma in engineering is to achieve **near-perfect performance by reducing process variation** to within six standard deviations (σ) from the mean.
- ▶ **Structured Approach:** Six Sigma follows a **structured approach** called DMAIC (Define, Measure, Analyze, Improve, Control) to drive process improvements.

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Introduction to Six Sigma



- ▶ **Data-Driven Decision Making:** One of the hallmarks of Six Sigma is its reliance on **data and statistical analysis** to identify and address issues systematically.
- ▶ **Benefits for Engineering:** Six Sigma methodologies lead to **improved product quality, cost reduction, increased customer satisfaction, and greater process efficiency** in engineering projects.

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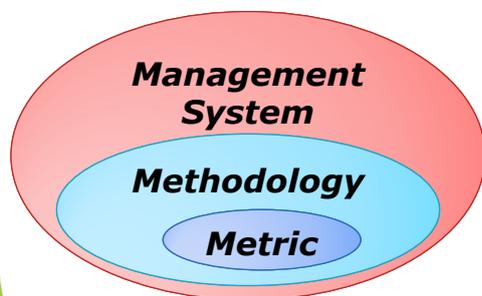
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What is Six Sigma?

The term "Six Sigma" refers to a statistical measure that quantifies how far a process deviates from perfection. It signifies a process that produces only 3.4 defects per million opportunities. Six Sigma places a strong emphasis on quality improvement by reducing variations in processes, ultimately leading to better products or services.



Metric

- Measure Process Variation

Methodology

- Consistent use of DMAIC/DMADV Models
- Team Based Problem Solving
- Measurement-based process analysis, improvement and control

Management System

- Six Sigma drives strategy execution
- Leadership sponsorship and review
- Metrics driven governance process
- Engagement across the organization

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Why Six Sigma?

- ▶ Six Sigma emerged as a natural evolution in business to increase profit by eliminating defects
- ▶ The Current business environment now demands and rewards innovation more than ever before due to:
 - Customer Expectations
 - Technological Change
 - Global Competition
 - Market Fragmentation

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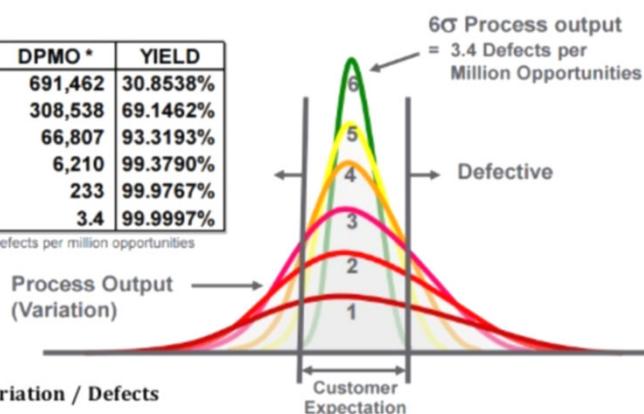
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Six Sigma Levels

SIGMA	DPMO *	YIELD
1.0	691,462	30.8538%
2.0	308,538	69.1462%
3.0	66,807	93.3193%
4.0	6,210	99.3790%
5.0	233	99.9767%
6.0	3.4	99.9997%

* DPMO = Defects per million opportunities



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Focus: The End User

Central to the Six Sigma methodology is an unwavering emphasis on meeting and exceeding the needs and expectations of the end user or customer.

- ▶ Customer: Internal or External
- ▶ Consumer: The End User

The “Voice of the Customer” must be translated into the “Voice of the Engineer”



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6-Sigma Methodology

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DMAIC

- Define**
 - Define a problem or improvement opportunity.
- Measure**
 - Measure process performance
- Analyse**
 - Analyze the process to determine the root causes of poor performance; determine whether the process can be improved or should be redesigned
- Improve**
 - Improve the process by attacking root causes.
- Control**
 - Control the improved process to hold the gains.

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DMAIC: Project examples

- Manufacturing Sector
- Healthcare Industry
- Financial Services
- Retail Industry
- Information Technology

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Design for 6-Sigma DMADV / DFSS

- Define

- Define design goals that are consistent with customer demands and the enterprise strategy
- Measure

- Measure and identify CTQs (characteristics that are **Critical To Quality**), product capabilities, production process capability, and risks
- Analyse

- Analyze to develop and design alternatives, create a high-level design and evaluate design capability to select the best design.
- Design

- Design details, optimize the design, and plan for design verification.
- Verify

- Verify the design, set up pilot runs, implement the production process and hand it over to the process owner(s).



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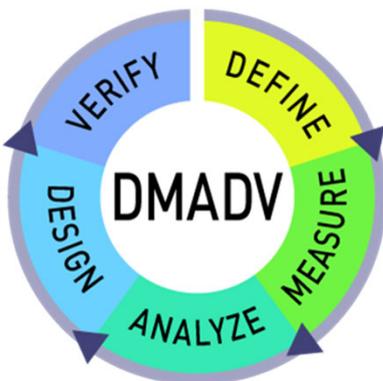
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DMADV: Project examples



- Automotive Industry
- Healthcare Sector
- Electronics Manufacturer
- Aerospace Industry
- Information Technology



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Six Sigma tools

- *Cause & effects diagram*
- *Control chart*
- *Cost-benefit analysis*
- *CTQ tree*
- *Design of experiments*
- *Taguchi methods*
- *Failure mode and effects analysis (FMEA)*
- *Histograms*
- *Quality Function Deployment (QFD)*
- *Pareto chart*
- *Pick chart*
- *Process capability*
- *Process Mapping*
- *Root cause analysis*
- *Run charts*
- *Analysis of variance*
- *Gauge R&R*
- *5 Whys Analysis*
- *Regression Analysis*

**MANY DIFFERENT
QUALITY TOOLS ARE
USED DURING THE
DIFFERENT PHASES OF
BOTH THE DMAIC AND
DMADV PROCESSES**

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**Six Sigma
Management System**

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The Six Sigma Management System

Six Sigma as a best practice is more than a set of metric-based problem solving and process improvement tools. At the highest level, Six Sigma has been developed into a practical management system for continuous business improvement that focuses management and the organization on four key areas:

- ▶ understanding and managing customer requirements
- ▶ aligning key processes to achieve those requirements
- ▶ utilizing rigorous data analysis to understand and minimize variation in key processes
- ▶ driving rapid and sustainable improvement to the business processes.

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Six Sigma Roles



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Six Sigma vs. Other Quality Management Approaches

When it comes to improving quality and enhancing processes, Six Sigma is just one of several quality management approaches. Let's compare Six Sigma to some other commonly used quality management methodologies;

- ▶ Six Sigma,
- ▶ TQM – Total Quality Management,
- ▶ Lean Management,
- ▶ ISO 9001,
- ▶ Lean Six Sigma

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Six Sigma Workshop

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Six Sigma Workshop

- ▶ Please divide yourselves into groups of **max 4 and** appoint a **group leader**.
- ▶ You have 1 hr 15 minutes to complete this exercise.
 - ▶ *Step 1: Read the provided case Study*
 - ▶ *Step 2: Identify Six Sigma methodology*
 - ▶ *Step 3: Go through the steps of the selected methodology*
 - ▶ *Step 4: Draw up a plan*
 - ▶ *Step 5: Present your findings (10 minutes to present and answer questions)*

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Conclusion

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Conclusion: 4 Basic Concepts of 6-Sigma

1. Use of **TEAMS** that are assigned well-defined projects that have direct impact on the organization's bottom line.
2. Continuous **TRAINING** in "statistical thinking" at all levels and providing key people with extensive training in advanced statistics and project management. (These key individuals are designated as either Green or Black Belts).
3. Emphasis on the "DMAIC/DMADV" **APPROACH** to problem solving .
4. A management **ENVIRONMENT** that supports these initiatives as a business strategy.

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Questions



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Next Lecture
TOPS (8Ds)

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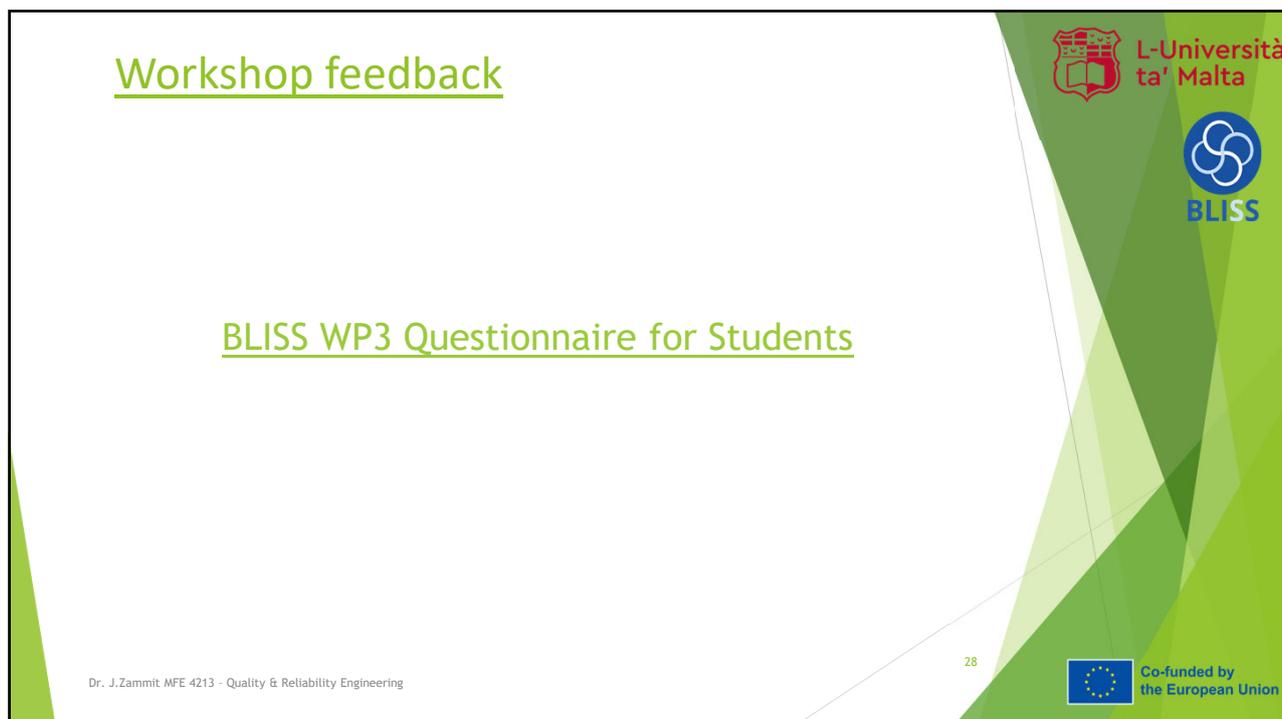


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Workshop feedback

BLISS WP3 Questionnaire for Students

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