Lean Six Sigma and AI

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''What's the difference between a Lean Six Sigma expert and AI?"

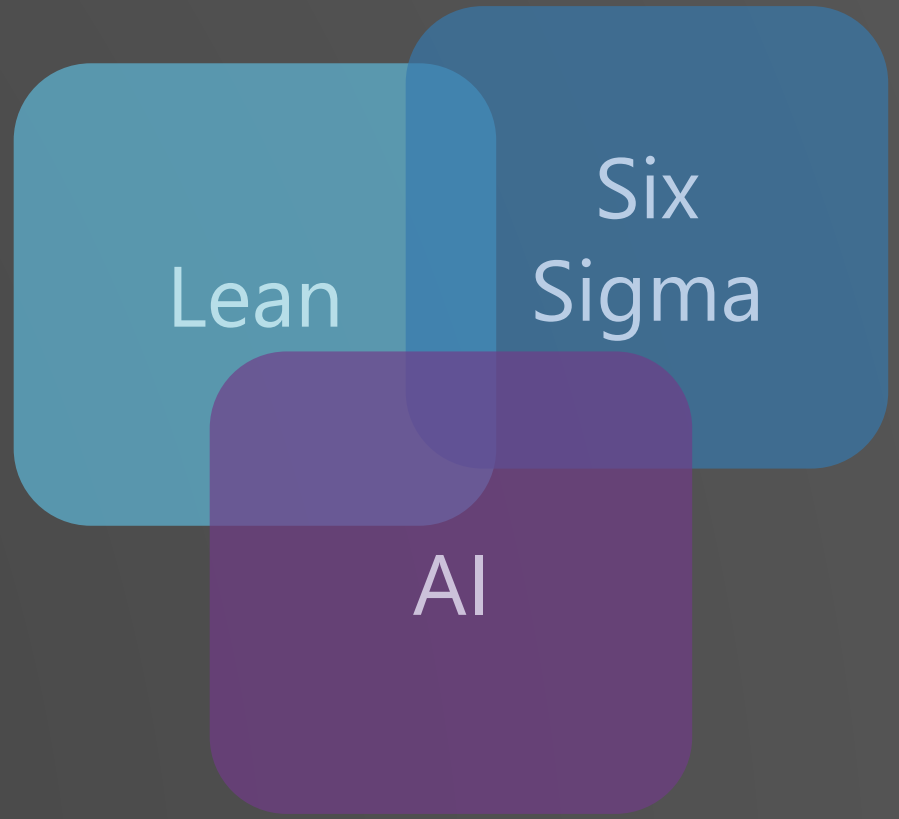
A Lean Six Sigma expert asks the right questions…
AI already has the answers before he finishes asking!

Overview

1. Introduction to Six Sigma
2. Lean Thinking
3. Integration of AI into Lean Six Sigma
4. Case Studies and Examples
5. Conclusion

Traditional Lean Six Sigma drives efficiency through structured problem-solving and waste reduction.

Today, AI supercharges these principles with real-time insights, automation, and predictive intelligence for smarter and faster decisions.



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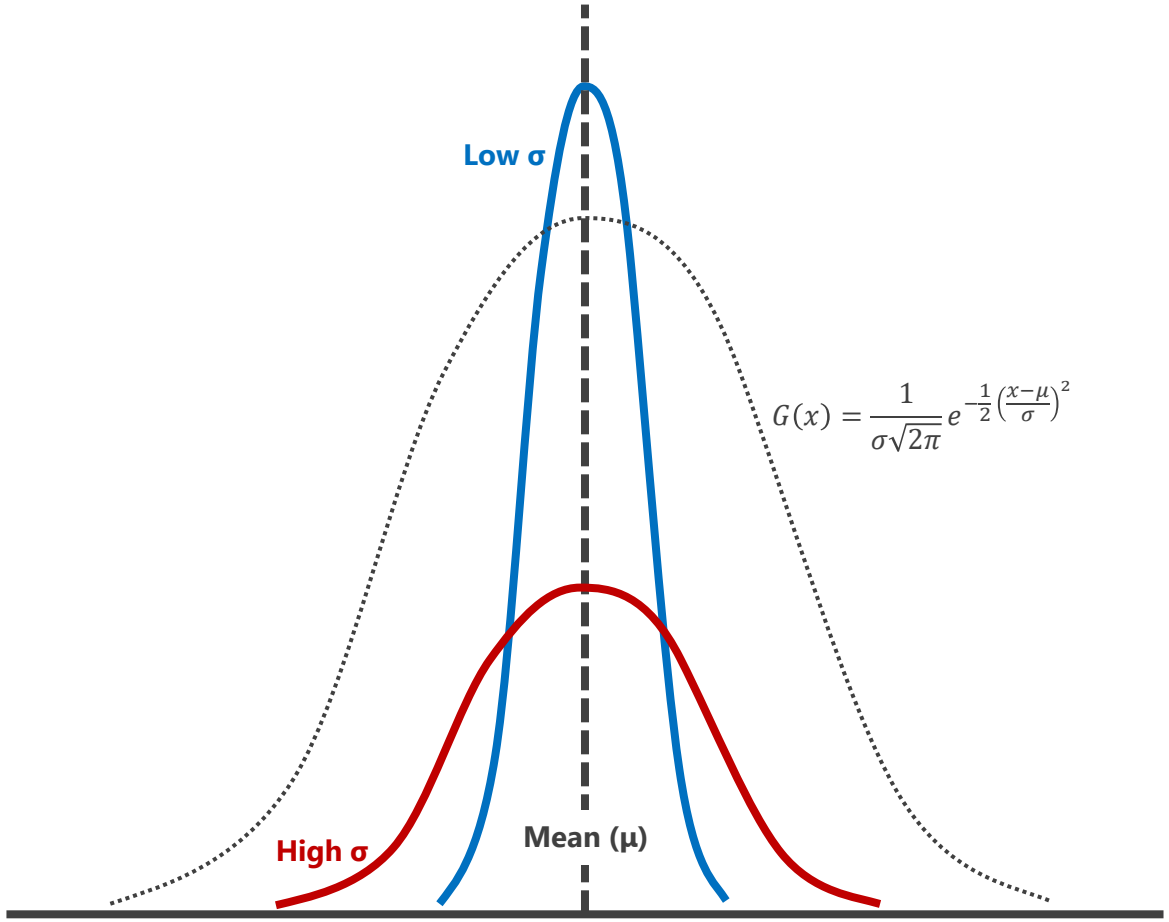
Introduction to Six Sigma

Theory, history, methodology, and goals

The Theory of Six Sigma:

What's Sigma?

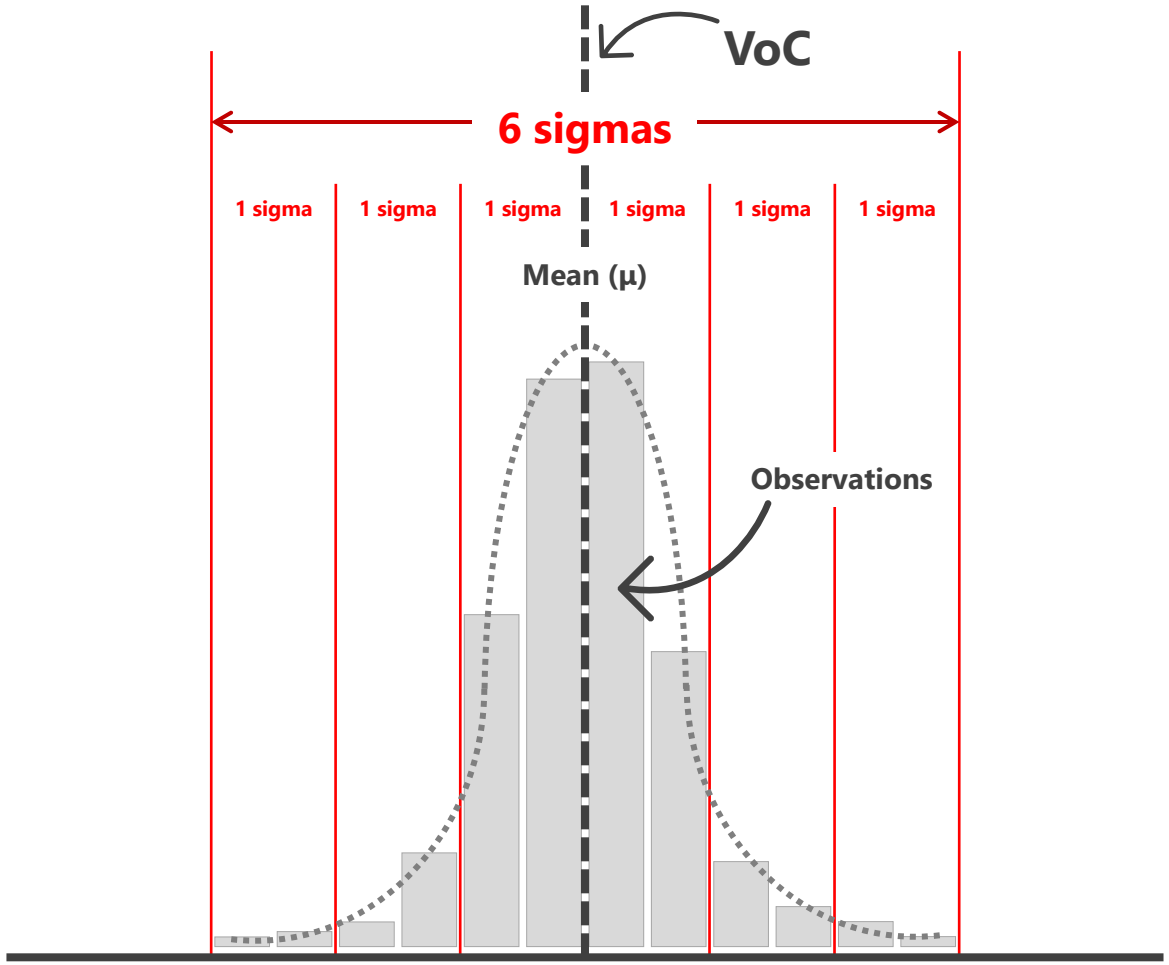
- Sigma (σ) refers to the standard deviation, which is a measure of how dispersed the data is in relation to the mean (μ)
- Low σ means indicates data are clustered tightly around the mean. High σ indicates data are more spread out
- This distribution (G) is called The Normal Distribution or the Gaussian Distribution, where data is symmetrically distributed around the mean



The Theory of Six Sigma:

Use of Statistics to Control Processes

- Process capability refers to the ability of a process to deliver a high proportion of output within specification
- In other words, the most capable process has the lowest sigma
- The same process does not always produce the same output
- Process variability refers to the natural deviations that occur in a process's output, and can be caused by various factors such as raw materials, equipment, or human performance



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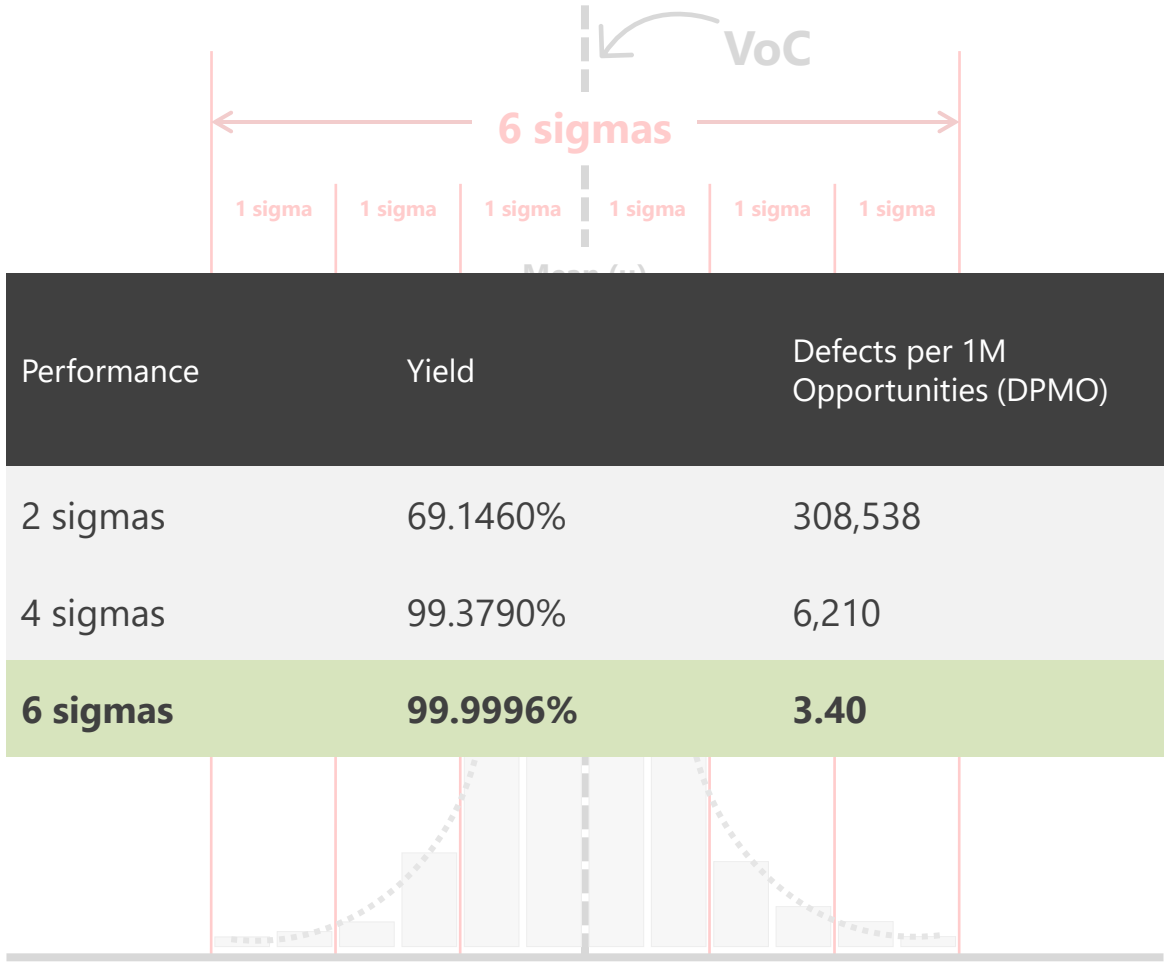
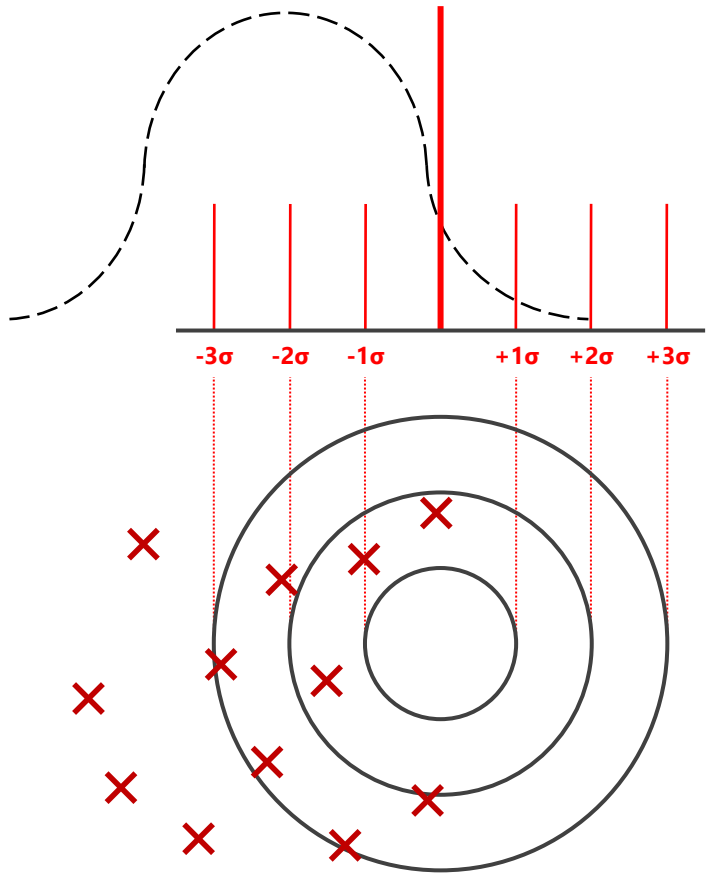


Performance	Yield	Defects per 1M Opportunities (DPMO)
2 sigmas	69.1460%	308,538
4 sigmas	99.3790%	6,210
6 sigmas	**99.9996%**	**3.40**

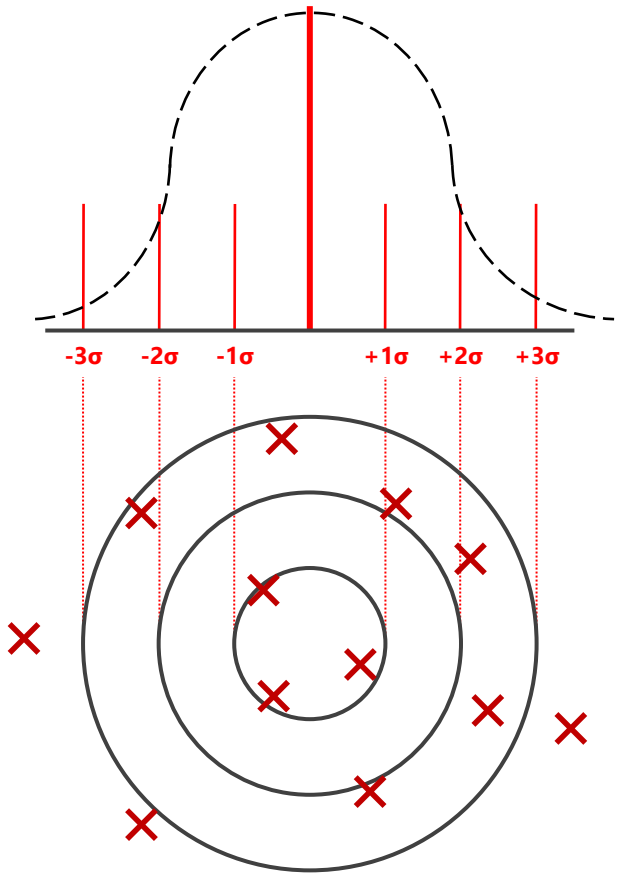
The Theory of Six Sigma:

Process Capability: Spread vs Centring

SPREAD HIGH **CENTERING** LOW



SPREAD HIGH **CENTERING** HIGH



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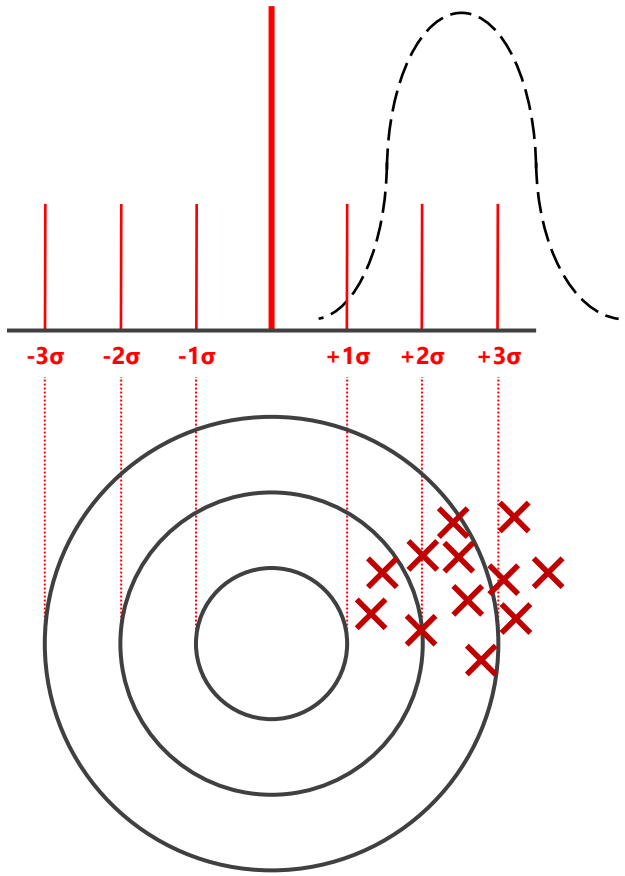

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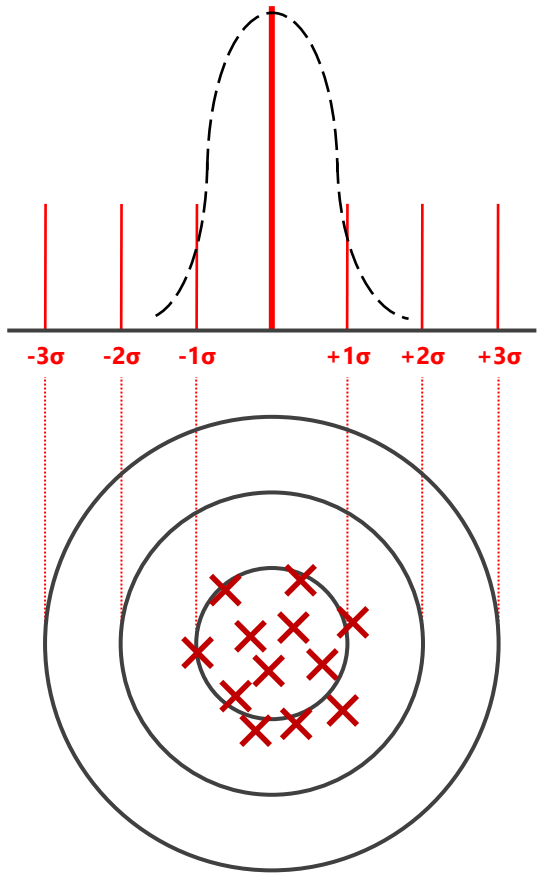
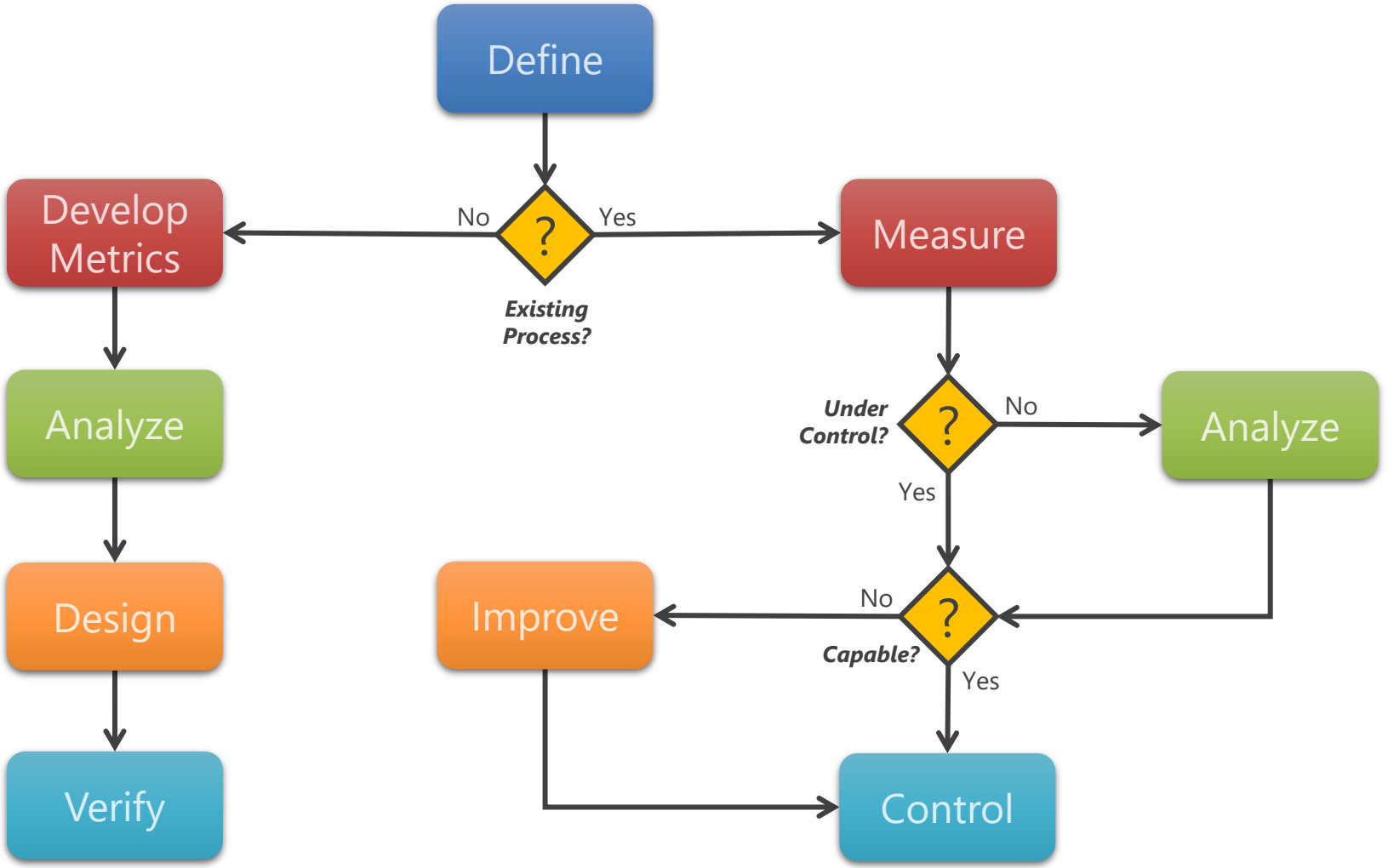


The History of Six Sigma:

Motorola, Honeywell & General Electric

- Six Sigma was first introduced in 1986 at Motorola by Bill Smith and registered as a trademark in the early 1990s
- In 2005, Motorola attributed $17B+ in savings to Six Sigma
- Following Motorola, Honeywell and General Electric were among the first companies to adopt Six Sigma under CEO Jack Welch
- By late 1990s, about two-thirds of Fortune 500 companies had started Six Sigma initiatives

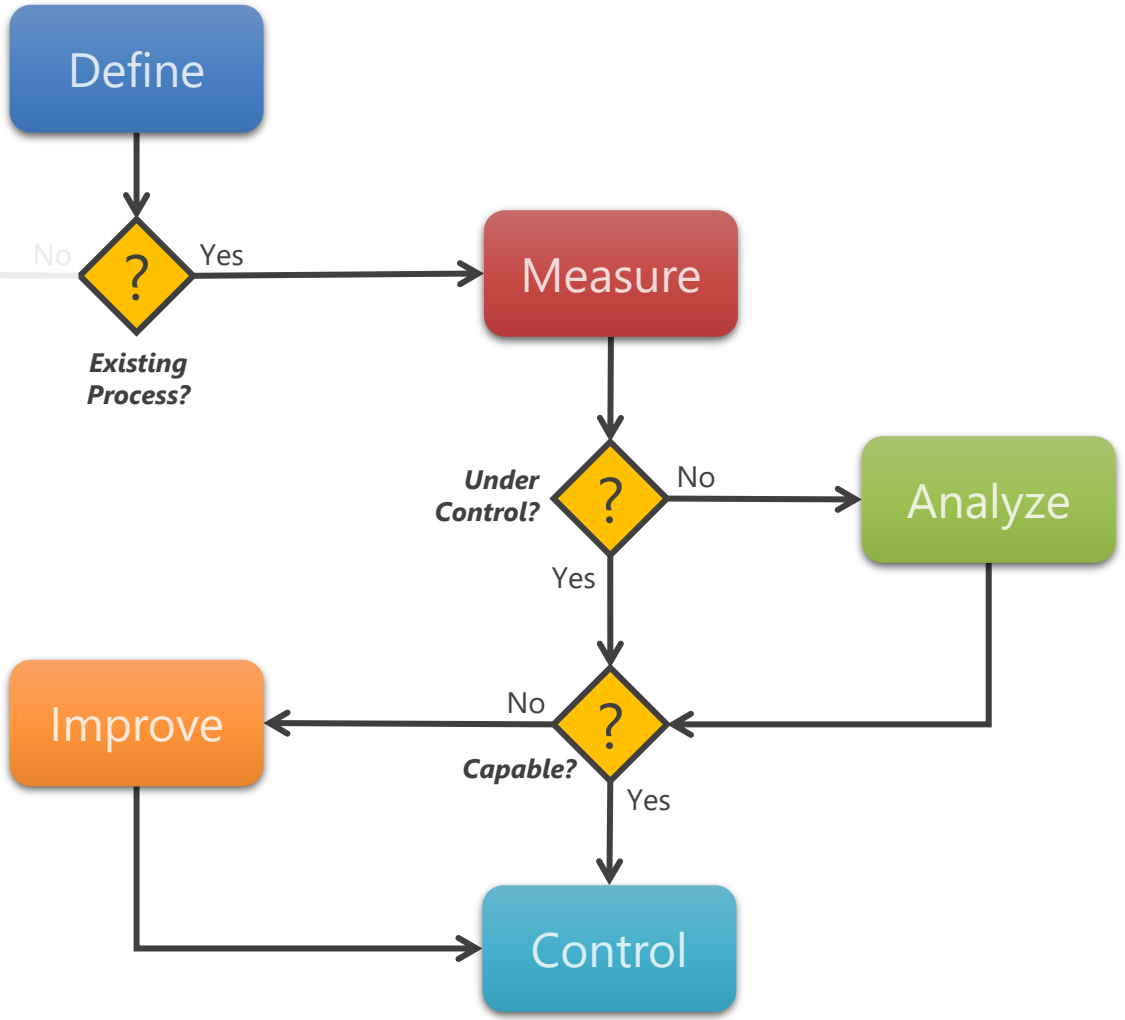
Six Sigma Methodologies:
DMAIC vs DMADV



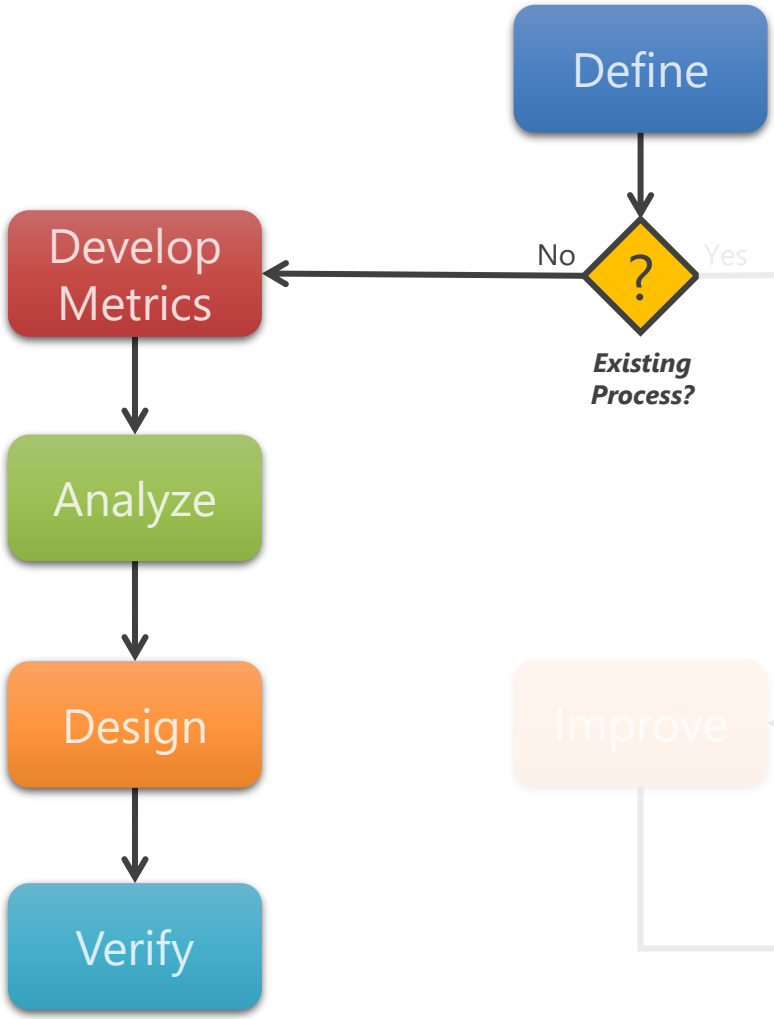
Six Sigma Methodologies:
DMAIC

DMAIC

- Improving existing processes to reduce defects, improve efficiency, and enhance customer satisfaction
- This methodology is used when the problem is well-defined, the need for improvement is clear, and incremental changes can address the issue



Six Sigma Methodologies:
DMADV



DMADV

- Designing new products, services, or processes to meet customer needs and requirements
- DMADV is used when creating new products, services, or processes, or redesigning existing ones to meet evolving customer needs

Six Sigma Methodology:
The DMAIC Method

Define

- Problem definition
- Voice of customer
- Business case
- Project objectives and timeline
- Scope definition
- Stakeholder identification
- Plan for change

Measure

- As-is process maps
- Process documentation
- Metric selection (narrow focus)
- Data collection
- Data analysis tools
- Baseline creation (snapshot of the as-is performance)

Analyze

- Process analysis
- Data display
- Data analysis
- Data verification
- Root cause analysis
- Identify wastes
- Hypothesis testing

Improve

- Solution generation
- Solution evaluation and optimization
- Target process maps
- Pilot testing
- Planning and implementation
- Monitoring and adjusting

Control

- Monitoring systems
- Project benefits validation
- Documentation
- Standardization
- Training and communication

Six Sigma Methodology:
The DMAIC Method

⚠ Before starting DMAIC…

- Proceed with process scoring and prioritization
- Make sure there is potential to improve efficiency and overall performance: automation level, ongoing projects, budget, etc.
- Check if data can be collected about the selected process

Six Sigma Methodology:

The DMAIC Method: Define

Define

- Problem definition
- Voice of customer
- Business Case
- Project objectives and timeline
- Scope definition
- Stakeholder identification
- Plan for change

Process Scoring

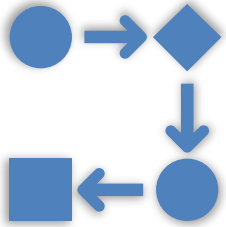
Confirm the problem is a priority through a statement

Make sure all resources are available

Project Charter

Goal Statement Builder

Define the goal through a statement



SIPOC

Value Stream Map

Swimlane Map

Develop high-level process maps

VOC

Tree Diagram

Define the customer

A3

Relationship Map

Stakeholder Analysis

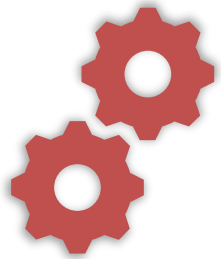
Inform others about project progress

Six Sigma Methodology:

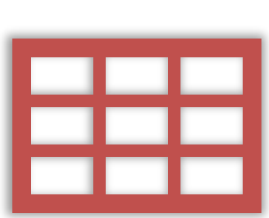
The DMAIC Method: Measure

Measure

- As-is Process maps
- Process documentation
- Data collection
- Metric selection (narrow focus)
- Data analysis tools
- Baseline creation

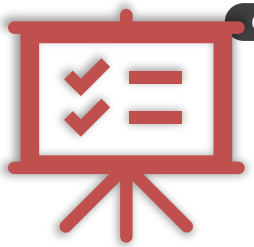


Determine as-is process Performance



Data Collection Plan

Create a plan to collect data



Operational Definitions

Ensure data is reliable

Check Sheet

Project Charter

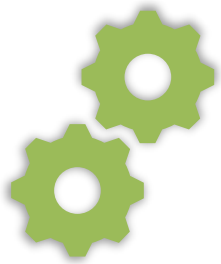
Gather baseline data

Six Sigma Methodology:

The DMAIC Method: Analyze

Analyze

- Process analysis
- Data display
- Data analysis
- Data verification
- Root cause analysis
- Identify wastes
- Hypothesis testing



Value Stream Map

Value Added Flow Analysis

Time Analysis

Examine the process

Run Charts

Histograms

Pareto Charts

Box Plots

Display the data

Ishikawa Diagram

5 Whys

Analyze the data

Root Cause Hypothesis

Project Charter

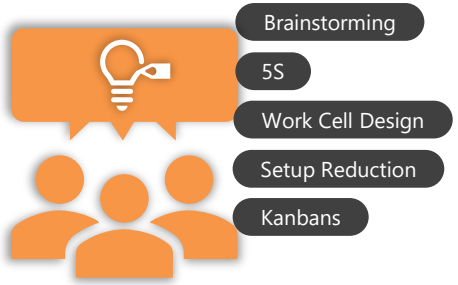
Verify the data

Six Sigma Methodology:

The DMAIC Method: Improve

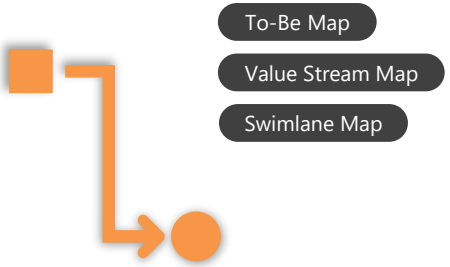
Improve

- Solution generation
- Solution evaluation and optimization
- Target process maps
- Pilot testing
- Planning and implementation
- Monitoring and adjusting



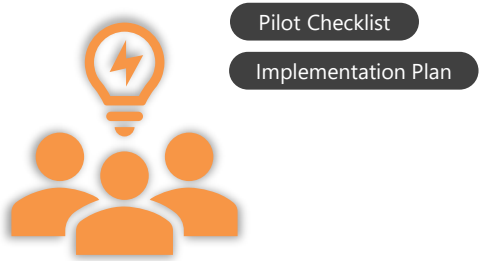
Gather the best ideas to fix the problem

Select the best solutions



Develop target process maps

Run tests



Implement the solutions

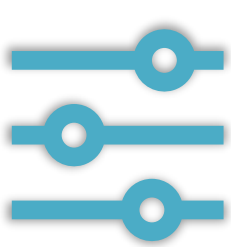
Validate the improvement

Six Sigma Methodology:

The DMAIC Method: Control

Control

- Monitoring systems
- Project benefits validation
- Documentation
- Standardization
- Training and communication



Control Plan

Control Chart

Monitoring & Response Plan

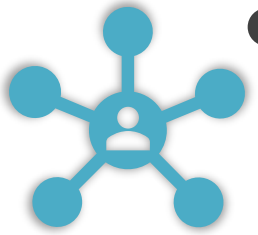
Ensure the target process is managed and monitored

Documentation

Standard Work

Visual Management Checklist

Document the target process



Innovation Transfer Opportunities

Apply improvement into other areas of the organization

Check Sheet

Project Charter

Continuously improve the process

Six Sigma Methodology:
The DMADV Method

Define

- Project Objectives
- Customer Requirements
- SIPOC Diagram
- Voice of Customer
- Quality Function Deployment
- Kano Model

Measure

- Data Collection
- Statistical Sampling
- Descriptive Statistics
- Gage R&R (Repeatability & Reproducibility)
- Process Mapping
- Process Capability Analysis

Analyze

- Benchmarking
- Pugh Matrix
- Failure Modes and Effects Analysis
- Decision Tree Analysis
- Monte Carlo Simulation

Design

- Design of Experiments
- Computer-Aided Design
- AI-powered Design
- Tolerance Analysis
- Design for Manufactur-ability
- Design for Reliability

Verify

- Test Plan
- Design Verification Plan and Report
- Pilot Production
- Statistical Process Control Charts
- Process Validation
- Monitoring
- Feedback

Benefits of Six Sigma

- 30-50% of the costs are attributable to slow processes
- Much of the cost comes from non-value-adding activities
- Only a fast and dynamic process can achieve a high level of quality

	Defects per 1M Opportunities (DPMO)	Ratio Cost/Revenue	Status
2σ	308,538	30-40	BANKRUPTCY
3σ	66,807	20-30	
4σ	6,210	15-20	CURRENT STANDARD
5σ	233	10-15	
6σ	**3.40**	**10 or less**	WORLD CLASS

Goals of Six Sigma

Reduce Defects

- Achieve a defect rate of 6σ from the norm, or 3.4 defects per million

Improve Quality

- Eliminate errors/defects and reduce waste
- Use statistical process control to recognize and remove the causes of non-quality
- Improve consumer loyalty and enhance profitability

Reduce Variability

- Enhances chances to make products in alignment with customer expectations
- Defects comes with costs: rework, recycling, storage
- Lower variability to maximize profit and reduce non-quality costs

Improve Productivity

- Achieve small increases in process productivity following several implementations of Six Sigma
- Streamline processes to maximize processing time and minimize idle time (lean thinking)

Know the Stats

- Understand how many items do not meet customer requirements
- Know the consistency level as opposed to competitors
- Develop KPIs around quality, efficiency, and customer satisfaction

Provide Career Advancement

- Deliver career growth targets
- Keep people involved and interested through training and certifications
- Push career forward through learning and practice

Improve Culture

- Promote culture of excellence across the organization
- Encourage data-driven thinking
- Build leadership commitment
- Reduce resistance to change and align goals

2

Lean Thinking

Definition, history, principles, and goals

Lean Thinking:

What is it?

- In today's highly competitive business environment, organizations must constantly explore strategies to streamline manufacturing processes, minimize waste, and boost efficiency
- Lean is a management framework made up of principles and practices, and a powerful methodology for achieving these objectives
- It's a way of thinking about an activity and seeing the waste generated by the way the process is designed

History of Lean Thinking

1913
Moving Assembly Line (Ford Motor Company)

Lean Principles

1930s–1940s
Beginning of Toyota Production System: Emphasis on JIT and automation with a human touch

JIT

Jidoka

1950s–1970s
Maturity of Toyota Production System: Toyota becomes a global leader in efficient manufacturing

Kanban

Kaizen

Heijunka

1980s
Western companies begin studying Japanese manufacturing success

Quality

Process Improvement

1990
The machine that changed the world: introducing the term ''Lean Production''

Lean Production

1996
Lean Thinking book published, outlining five core principles

Lean Thinking

2000s
Lean expands beyond manufacturing: healthcare, software development, banking services, and startups

Lean Six Sigma

Lean Startup

2010s–Present
Digital Lean & Industry 4.0: integration of lean with digital tools, automation and data analytics

Agility

Sustainability

Customer Centricity

Principles of Lean Thinking

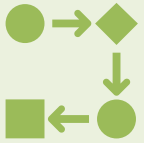
Value

- **Definition:** Value is defined from the perspective of the customer
- **Goal:** Identify what the customer truly needs and is willing to pay for
- **Action:** Eliminate features, processes, or services that don't add value

Value Stream

- **Definition:** The entire flow of a product or service from concept to delivery
- **Goal:** Map out all steps in the process and identify which add value and which do not
- **Action:** Remove waste to streamline the process

Flow



- **Definition:** Ensuring that the value-creating steps occur in a tight sequence
- **Goal:** Avoid interruptions, delays, and bottlenecks
- **Action:** Redesign processes to ensure smooth, continuous flow of work

Pull

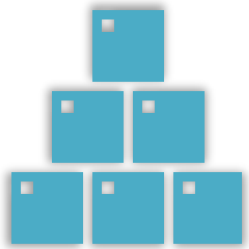
- **Definition:** Work is pulled based on customer demand rather than pushed based on forecasts
- **Goal:** Produce only what is needed, when it is needed, and in the amount needed
- **Action:** Implement systems that respond to real-time demand

Perfection

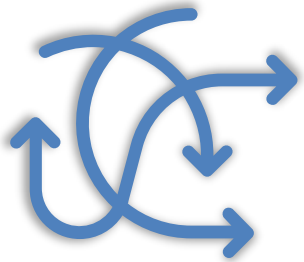
- **Definition:** The pursuit of continuous improvement
- **Goal:** Strive for zero waste and perfect value delivery
- **Action:** Encourage a culture of ongoing learning and refinement

Lean Thinking:
Types of Waste (TIMWOOD+UT)

Transportation

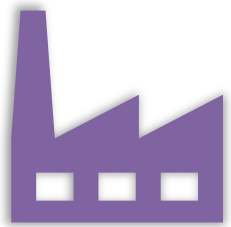


Inventory

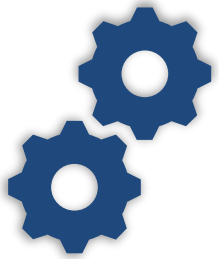


Motion

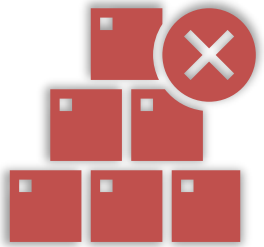
Waiting



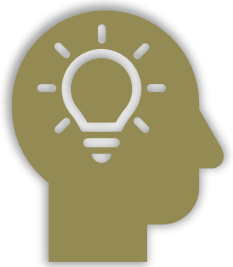
Overproduction



Overprocessing



Defects

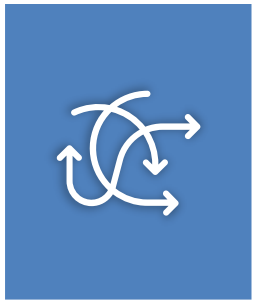


Unused Talent

Goals of Lean Thinking

Maximize Product Value

- Deliver exactly what the customer wants, when they want it, with the highest quality
- Focus on understanding and meeting customer needs



Eliminate All Types of Waste

- Identify and remove non-value-adding activities
- Common types of waste include overproduc-tion, waiting, defects, excess inventory, unnecessary motion, overprocessing and unused talent

Improve Process Efficiency

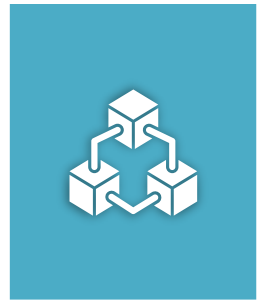
- Streamline workflows to ensure smooth and continuous operations
- Reduce delays, bottlenecks, and redundancies

Enhance Product Quality

- Build quality into processes rather than inspecting it in afterward
- Use root cause analysis and problem-solving techniques to prevent defects

Lower Operational Costs

- Lower operational costs by minimizing waste and improving resource utilization
- Avoid unnecessary spending on materials, labor, and time



Increase Process Flexibility

- Adapt quickly to changes in customer demand or market conditions
- Use pull systems and just-in-time production to stay agile

Foster Kaizen Culture

- Encourage all employees to contribute ideas for improving processes
- Promote learning, experimenta-tion, and incremental progress

Involve & Empower Employees

- Involve workers in decision-making and problem-solving
- Provide training and tools to support ownership and accountability

Lean+Six Sigma

=Lean Six Sigma

Lean	Six Sigma	Lean Six Sigma
Improves business productivity by eliminating or reducing waste	Improves business productivity by reducing variations in the business process	Improves business productivity by reducing wastes and variations in the business process
Focused on workflow	Focused on problem	Focused on quality improvement by increasing flow and solving problems
Observation-driven approach, does not require statistical analysis	Data-driven approach, requires statistical analysis	Uses both the observation techniques of Lean and statistical analysis of six sigma

Lean Six Sigma:
Project Types: Quick Win

Scope

- Small, low-risk improvements

Context

- Simple solution to a known issue
- The root cause is known, and the fix is painless
- The problem is contained in one department

Tools

- Basic Lean tools (5S, visual management)

Duration

- A couple of days to a few weeks

Good To Know

- Quick Win projects are also called “Just-Do-It” or “Fast Track”
- Example: rearranging a workspace to reduce motion waste

Lean Six Sigma:

Project Types: Process Improvement

Scope

- Focused, team-based improvements

Context

- Incremental reduction of defects, cycle time or cost
- The presenting issue has an unknown cause
- Solutions are not predetermined

Tools

- Lean tools, value stream mapping, root cause analysis

Duration

- 3-5 days (intensive)

Good To Know

- Process improvement projects are also called DMAIC, Lean or PDCA
- Example: Streamlining a billing process to reduce cycle time

Lean Six Sigma:
Project Types: Process Design

Scope

- Designing new processes or products

Context

- Creation of brand-new, non-existent process
- Benchmarking and collection of VoC are required as there is no existing process to analyze

Tools

- DMADV

Duration

- Longer-term, strategic

Good To Know

- Process design projects are also called DFSS or DMADV
- Example: Creating a new customer onboarding process

Lean Six Sigma:

Project Types: Process Redesign

Scope

- Complex problems with unknown root causes

Context

- Overhaul of non-capable existing process
- Incremental improvements will not be able to satisfy requirements

Tools

- DMAIC

Duration

- Weeks to months

Good To Know

- Process redesign projects are also called Process Reengineering
- Example: Reducing defects in a manufacturing process

Lean Six Sigma:

Project Types: Infrastructure Implementation

Scope

- Build support systems

Context

- Establishment of key measurement systems
- Monitoring of process capability and VoC are established to better focus improvement efforts

Tools

- Operating procedures, training plans, dashboards

Duration

- Variable

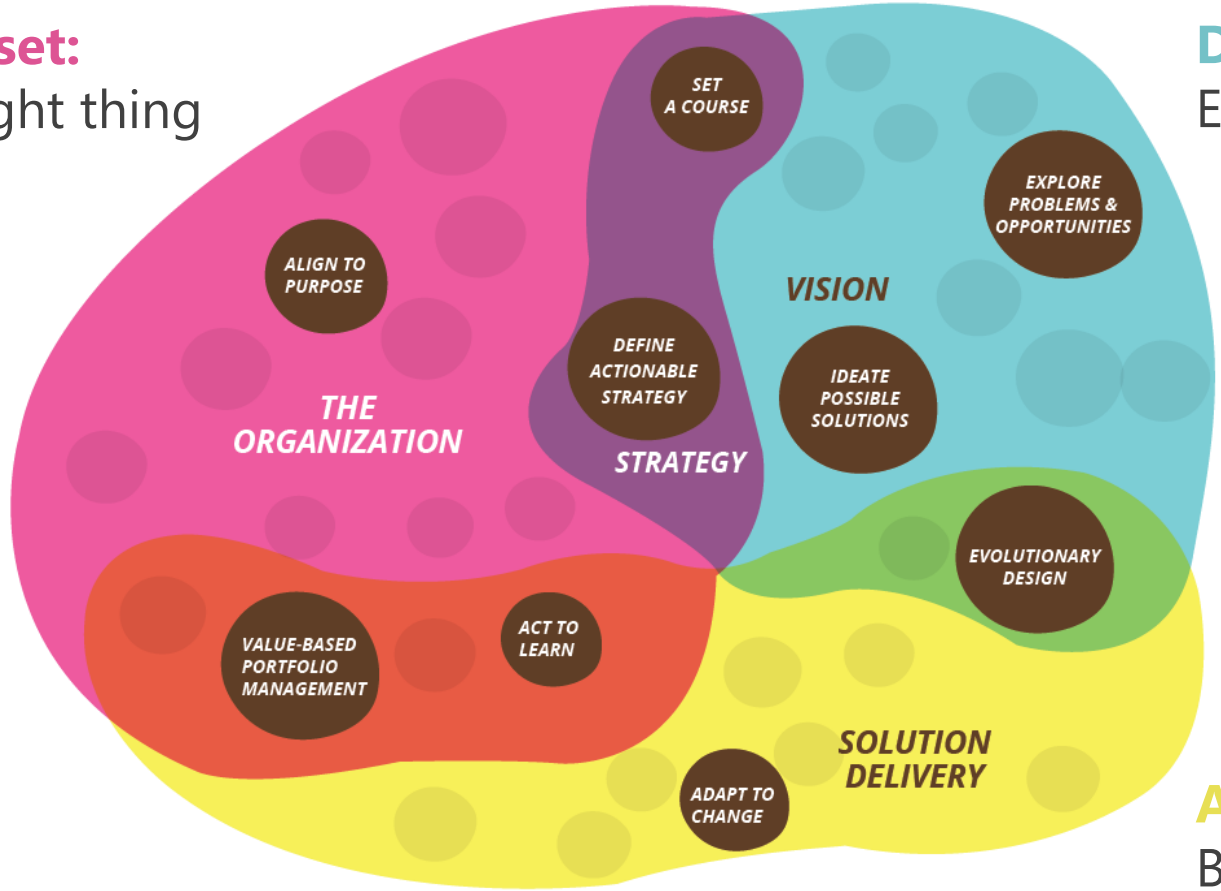
Good To Know

- Infrastructure implementation projects are also called Process Management Projects

Lean, Design Thinking and Agile:

How The 3 Mindsets Overlap

Lean Mindset:
Build the right thing



Design Thinking Mindset:
Explore the problem

Agile Mindset:
Build the thing right

Source:
@jonnyschneider
www.thoughtworks.com

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Integration of AI into Lean Six Sigma

AI’s Role, Applications, and Benefits

AI's Transformative Role in Lean Six Sigma

- AI plays a transformative role in Lean Six Sigma projects by enhancing data-driven decision-making, improving process efficiency, and enabling predictive capabilities
- AI accelerates data analysis, reducing project cycle time
- Scalability: AI tools can handle vast datasets across multiple processes or locations
- Continuous Improvement: AI systems can learn and adapt over time, supporting ongoing Lean Six Sigma efforts
- In the following, a breakdown of how AI integrates into each phase of a typical Lean Six Sigma DMAIC project

AI's Transformative Role in Lean Six Sigma

Define

- Problem definition
- Voice of customer
- Business case
- Project objectives and timeline
- Scope definition
- Stakeholder identification
- Plan for change

- **Natural Language Processing:** Analyze customer feedback, surveys, and complaints to identify pain points
- **Text Mining:** Extract themes and sentiments from unstructured data (e.g., support tickets, reviews)
- **VoC Analysis:** AI tools can process audio/text to extract key concerns and expectations

NLP stands for Natural Language Processing. It's a branch of artificial intelligence that focuses on enabling computers to understand, interpret, and generate human language

IBM Watson

IBM Watson NLP analyzes customer feedback to identify key issues

MonkeyLearn

MonkeyLearn extracts themes from surveys and complaints

Google Cloud Natural Language API detects sentiment and topics in unstructured text

AI's Transformative Role in Lean Six Sigma

Measure

- As-is Process maps
- Process documentation
- Data collection
- Metric selection (narrow focus)
- Data analysis tools
- Baseline creation (snapshot of the as-is performance)

- **Sensor Data Analysis / IoT Integration:** Collect real-time data from machines or processes
- **Computer Vision:** Measure defects or anomalies in manufacturing using image recognition
- **Anomaly Detection:** Use machine learning to identify outliers or unusual patterns in process data

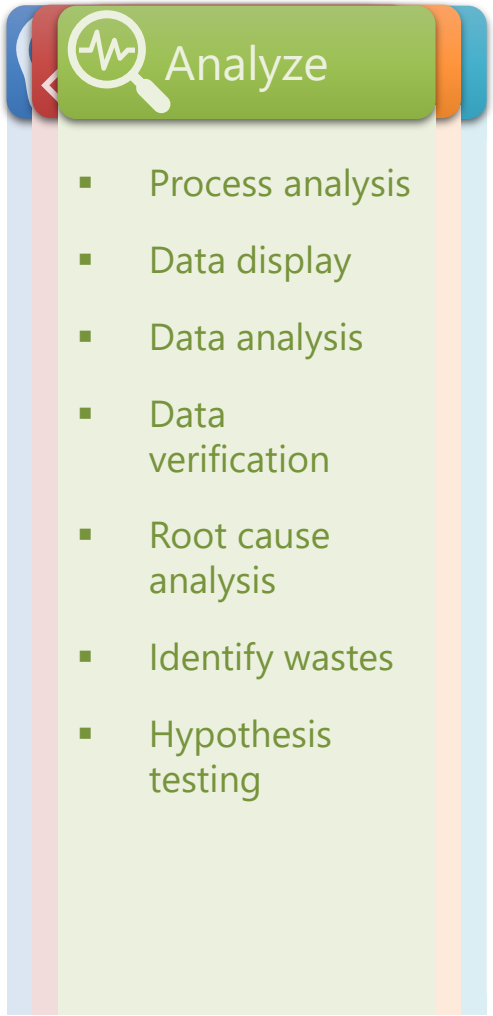
AI automates data collection by intelligently extracting and organizing information from sources like websites, sensors, and documents. It improves speed, accuracy, and scalability across various data environments

Microsoft Azure Text Analytics extracts key phrases and classifies feedback

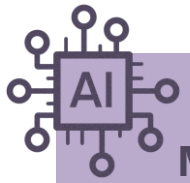
RapidMiner automates data collection and quantification of text data

MonkeyLearn categorizes feedback into measurable categories

AI's Transformative Role in Lean Six Sigma



- **Machine Learning:** Use classification or regression models to find relationships between variables and outcomes
- **Clustering Algorithms:** Segment data to uncover hidden patterns or groupings
- **Causal Inference Models:** Determine cause-effect relationships beyond correlation



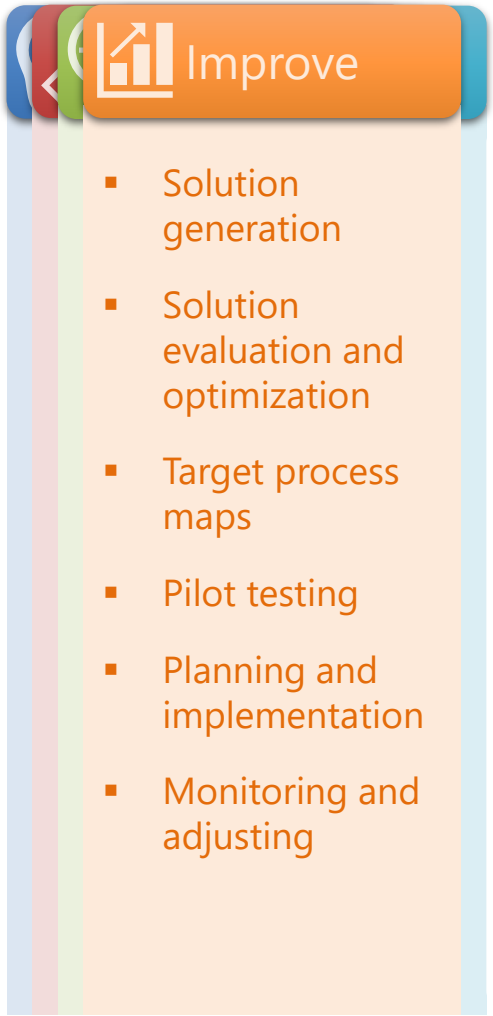
Machine learning models learn patterns from data to make predictions or decisions without being explicitly programmed. They power applications like recommendation systems, image recognition, and fraud detection

SAS Visual Text Analytics performs deep text mining and clustering

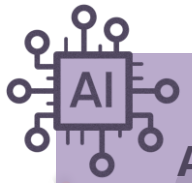
Google Cloud Natural Language API identifies patterns and relationships in text

IBM Watson Studio supports regression analysis and anomaly detection

AI's Transformative Role in Lean Six Sigma



- **Simulation and Optimization:** Use AI to simulate process changes and optimize parameters (e.g., genetic algorithms)
- **Reinforcement Learning:** Optimize decision-making in dynamic environments
- **Predictive Modeling:** Forecast the impact of proposed changes before implementation



AI accelerates solution development by optimizing processes, predicting outcomes, and automating improvements. It enables data-driven decisions through simulations, machine learning, and intelligent automation

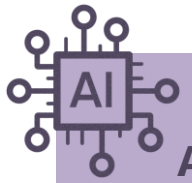
DataRobot builds predictive models to simulate process improvement

H2O.ai – Optimizes process changes using machine learning

Simul8 – Simulates process flows and tests improvements virtually

AI's Transformative Role in Lean Six Sigma

- **Real-Time Monitoring Dashboards:** Use AI to track KPIs and alert deviations
- **Predictive Maintenance:** Forecast equipment failures to prevent or reduce downtime
- **Automated Control Systems:** AI-driven systems that adjust parameters in real-time to maintain optimal performance



AI helps maintain process improvements by monitoring key metrics in real time and detecting deviations using predictive models. It enables proactive adjustments, ensuring sustained quality and performance

Tableau with AI Extensions monitors KPIs and visualizes anomalies

Microsoft Power BI with AI Insights tracks process stability and alerts deviations

AWS Lookout for Metrics detects anomalies in real-time operational data

Privacy Heads-Up

When applying AI across all phases of DMAIC, it's crucial to address data privacy and ethical considerations. AI systems often process sensitive operational, customer, or employee data, so organizations must ensure:

- Compliance with data protection laws
- Transparency in how AI models make decisions
- Data minimization—only collecting what's necessary
- Secure storage and access controls to prevent unauthorized use
- Bias monitoring to ensure fairness in AI-driven insights and actions

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Case Studies and Examples

Real-World Applications and Impact

Real-World Applications – Case Study #1:

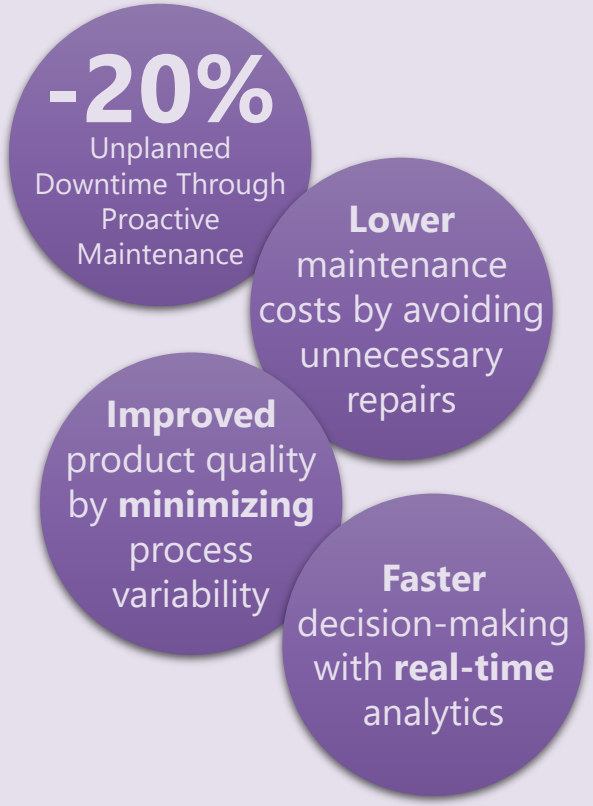
Predictive Maintenance in Manufacturing

Foundation and Evolution of Integrating AI into Lean Six Sigma

GE's journey with Lean Six Sigma began in the mid-1990s under CEO Jack Welch. The company embedded Six Sigma deeply into its culture through mandatory training, mentorship structure and performance incentives.

- **Root Cause Analysis Automation:** AI algorithms helped identify patterns and anomalies in production data, speeding up root cause analysis—a core component of Six Sigma's DMAIC methodology (Phase A of DMAIC)
- **AI-Powered Predictive Analytics/Machine Learning for Failure Prediction:** GE used AI models trained on historical sensor data from manufacturing equipment to predict failures before they occurred. This aligns with Six Sigma's goal of reducing defects and downtime (Phase C of DMAIC)
- **Digital Twins:** GE developed digital replicas of physical assets (like turbines or engines) to simulate performance and predict wear and tear. These digital twins use real-time data and AI to forecast maintenance needs, reducing unplanned outages
- **Prescriptive Analytics:** Beyond predicting failures, AI suggested optimal maintenance schedules and operational adjustments, improving overall equipment effectiveness (OEE)

Benefits of Combining AI with Lean Six Sigma



Real-World Applications – Case Study #2:

amazon Supply Chain Optimization (1/2)

Foundation and Evolution of Integrating AI into Lean Six Sigma

Amazon has strategically integrated AI technologies into its Lean Six Sigma framework to optimize its supply chain operations:

- **AI-Driven Forecasting and Inventory Optimization:** Amazon uses machine learning models through AWS Supply Chain to:
  - Predict demand more accurately across regions and product categories
  - Optimize inventory placement by analyzing historical data, seasonality, and real-time trends
  - Reduce overstock and stockouts, which are key Lean Six Sigma goals for minimizing waste and variation
- **End-to-End Supply Chain Visibility:** AI enables Amazon to:
  - Unify fragmented data sources across suppliers, warehouses, and logistics partners
  - Provide real-time visibility into inventory levels, shipment statuses, and potential disruptions
  - This supports Lean Six Sigma's DMAIC methodology by improving the M and A phases

Benefits of Combining AI with Lean Six Sigma

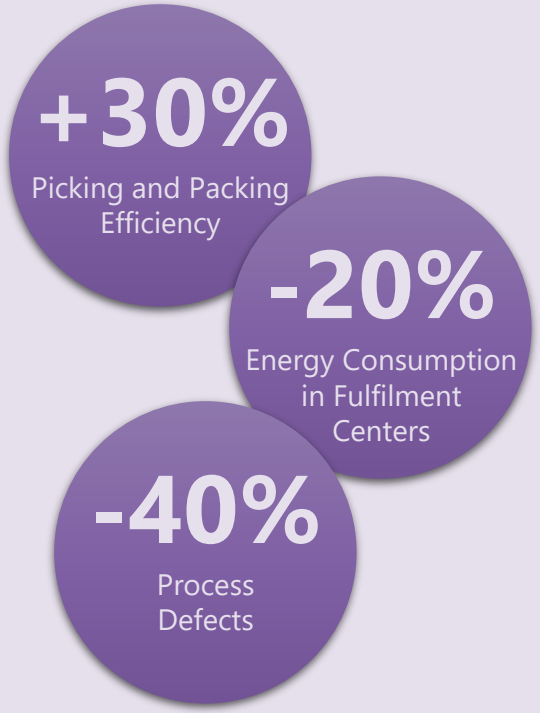
Real-World Applications – Case Study #2:

amazon Supply Chain Optimization (2/2)

Foundation and Evolution of Integrating AI into Lean Six Sigma

- **Process Automation and Robotics:** Amazon employs AI-powered robotics and automation in fulfillment centers to:
  - Streamline picking, packing, and sorting processes
  - Reduce human error and increase throughput
  - These improvements align with LSS's focus on defect reduction and process efficiency
- **Continuous Improvement with AI Insights:** AI tools help Amazon:
  - Continuously monitor KPIs and detect anomalies
  - Use predictive analytics to identify potential bottlenecks or inefficiencies before they escalate
  - This supports the C phase of Six Sigma by maintaining process stability and performance
- **Customer-Centric Optimization:** Amazon also uses AI to:
  - Personalize delivery options and optimize last-mile logistics.
  - Enhance customer satisfaction, a key metric in Lean Six Sigma's Voice of the Customer (VoC) approach

Benefits of Combining AI with Lean Six Sigma



Real-World Applications – Case Study #3:

Cleveland Clinic Healthcare Process Improvement (1/2)

Foundation and Evolution of Integrating AI into Lean Six Sigma

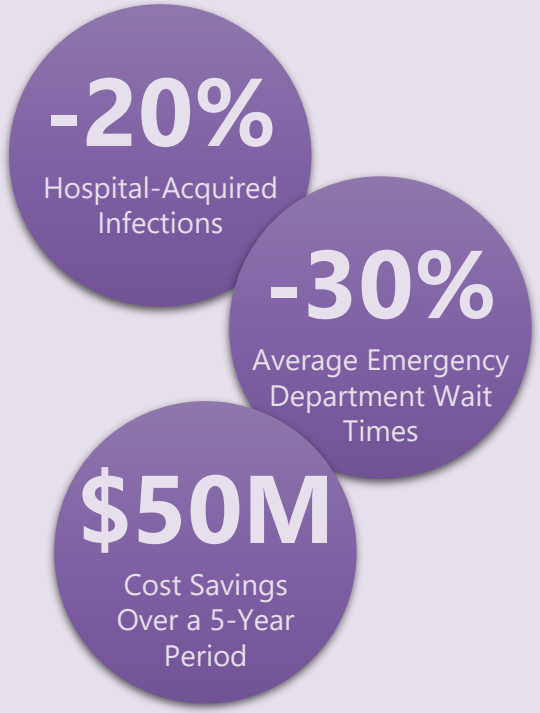
Cleveland Clinic combines Lean Six Sigma with AI and data analytics to:

- **Empower caregivers to identify and solve problems daily:**
  - Standardize processes while enabling innovation
  - Use data-driven insights to reduce variation and improve quality
- **Predictive Analytics for Clinical Decision Support: AI models are used to:**
  - Predict patient deterioration in ICUs and general wards
  - Identify high-risk patients for readmission or complications

  These predictions feed into Lean Six Sigma projects aimed at reducing adverse events and improving care pathways
- **Process Optimization in Patient Flow:** Using AI and LSS, the clinic has:
  - Reduced emergency department wait times by optimizing triage and bed assignment
  - Improved surgical scheduling by predicting no-shows and cancellations

  These improvements align with Six Sigma's goal of reducing process variation and waste

Benefits of Combining AI with Lean Six Sigma



Real-World Applications – Case Study #3:

Cleveland Clinic Healthcare Process Improvement (2/2)

Foundation and Evolution of Integrating AI into Lean Six Sigma

- **Cost and Waste Reduction:** AI helps identify:
  - Unnecessary tests or procedures, which are then targeted in Lean Six Sigma projects
  - Inefficiencies in supply chain and staffing, leading to cost savings and better resource utilization
- **Cultural Transformation:** The integration of AI and Lean Six Sigma is part of a broader cultural shift:
  - Over 10,000 caregivers have been trained in continuous improvement practices
  - AI tools are embedded in daily huddles and tiered escalation systems to support real-time problem-solving

Benefits of Combining AI with Lean Six Sigma

-17%
Unnecessary Diagnostic Procedures

10K+
Caregivers Trained in Continuous Improvement

Real-World Applications – Case Study #4:

Quality Control in Automotive (1/2)

Foundation and Evolution of Integrating AI into Lean Six Sigma

Toyota has strategically integrated AI into its Lean Six Sigma and quality control practices to enhance efficiency, precision, and continuous improvement in its automotive manufacturing processes:

- **Jidoka with AI (Autonomation):** Modern Jidoka incorporates AI and IoT to automatically detect abnormalities in real time—such as through computer vision or sensor data analytics—and halt production to prevent defective products from progressing
- **Six Sigma + AI:** Toyota uses Six Sigma's DMAIC framework enhanced with AI to:
  - Analyze massive datasets from production lines
  - Predict defects before they occur using machine learning
  - Optimize processes by identifying root causes of variability
- **Predictive Quality Control:** AI models analyze historical and real-time data to predict potential defects in components like engines or transmissions. This allows Toyota to intervene proactively, reducing waste and rework

Benefits of Combining AI with Lean Six Sigma

-25%
Costs Reduction (Exact Figures Vary by Plant)

Few Days
Entire Inventory Turnover

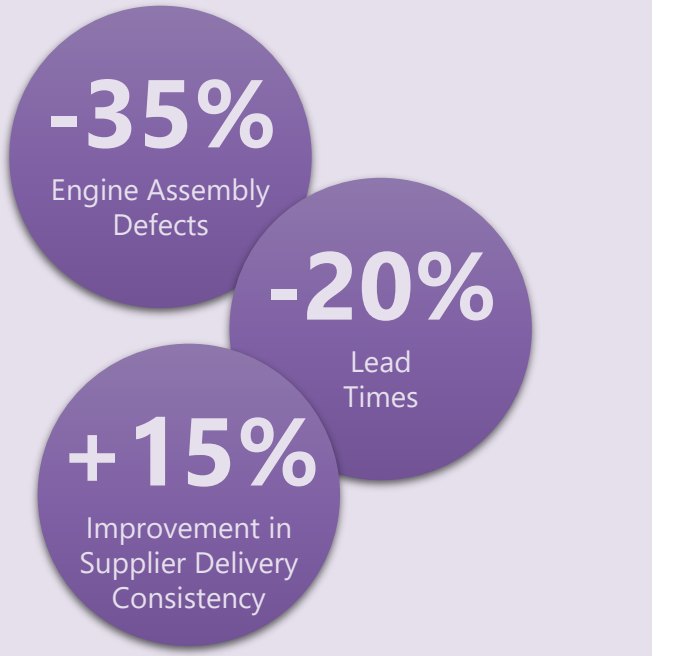
Real-World Applications – Case Study #4:

Quality Control in Automotive (2/2)

Foundation and Evolution of Integrating AI into Lean Six Sigma

- **Intelligent Process Monitoring:**
  - AI-powered systems continuously monitor production metrics
  - Anomalies are flagged instantly, enabling real-time corrective actions
- **Machine Learning for Root Cause Analysis:** Instead of manual analysis, Toyota uses machine learning algorithms to identify patterns and correlations in defect data. This accelerates the Analyze phase of Six Sigma
- **Smart Automation:** Robots and automated systems equipped with AI can self-adjust based on quality feedback, improving consistency and reducing human error
- **Engine Assembly Line:** AI-enhanced Six Sigma helped Toyota reduce inconsistencies, leading to a significant drop in defect rates
- **Supply Chain Optimization:** AI analyzed supplier data to identify bottlenecks, improving delivery times and consistency

Benefits of Combining AI with Lean Six Sigma



Real-World Applications – Case Study #5:

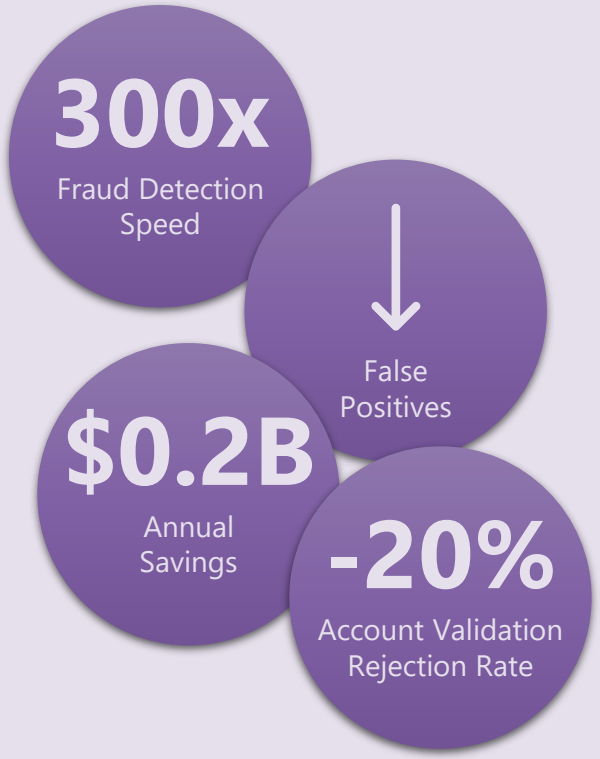
JPMorganChase Fraud Detection

Foundation and Evolution of Integrating AI into Lean Six Sigma

JPMorgan Chase has successfully integrated AI into its Lean Six Sigma framework to revolutionize fraud detection. This integration has led to significant improvements in speed, accuracy, and cost-efficiency

- **Real-Time Monitoring:** AI models analyze millions of transactions daily to detect anomalies such as unusual transaction amounts, locations, or patterns. This aligns with M and A phases of Six Sigma, where data is continuously assessed for deviations
- **Behavioral Analysis:** Machine learning algorithms build behavioral profiles for each customer. Deviations from normal behavior trigger alerts before the transaction completes
- **Process Optimization:** Lean Six Sigma's DMAIC is enhanced by AI's ability to:
  - Define fraud patterns
  - Measure transaction risk in real-time
  - Analyze root causes of fraud
  - Improve detection models
  - Control false positives and customer impact

Benefits of Combining AI with Lean Six Sigma



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Conclusion

Future Trends
and Call to Action

AI and Lean Six Sigma:
Future Trends

Predictive Analytics

- AI enables predictive analytics that can forecast process inefficiencies, equipment failures, or quality issues before they occur
- This aligns with Lean's goal of waste reduction and Six Sigma's focus on defect prevention

Data Collection & Analysis

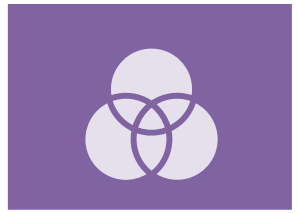
- Traditional LSS relies heavily on manual data gathering. AI automates this process, allowing real-time data analysis and faster root cause identification
- **Benefit:** Speeds up the DMAIC cycle and enhances decision-making accuracy

Autonomous Process Optimization

- AI agents can autonomously monitor and adjust processes based on real-time data, reducing the need for human intervention in routine tasks
- **Trend:** Integration of AI agents into continuous improvement loops for dynamic process control

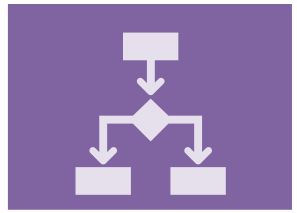
NLP for VoC

- NLP tools analyze unstructured data like customer reviews, support tickets, and social media to uncover hidden pain points
- **Use Case:** Retailers using NLP to detect packaging issues from social media complaints



IoT & Big Data Synergy

- IoT devices feed real-time data into AI systems, enabling granular monitoring of processes. Combined with big data analytics, this enhances visibility/control
- **Application:** Smart factories using IoT sensors for real-time quality checks and AI for anomaly detection



Digital Twins & Simulation Modeling

- AI-powered digital twins simulate entire processes, allowing LSS practitioners to test improvements virtually before implementation
- **Advantage:** Reduces risk and cost of process changes

AI-Enhanced Training

- AI can personalize Lean Six Sigma training, recommend tools based on project context, and preserve institutional knowledge through intelligent systems

Call to Action:

Embrace the Future of Continuous Improvement

The future of operational excellence lies at the intersection of Lean Six Sigma and Artificial Intelligence.

Don’t wait for disruption—lead it. Start by identifying high-impact processes where AI can enhance data analysis, automate decision-making, and predict outcomes. Upskill your teams, invest in smart technologies, and pilot AI-driven Lean Six Sigma projects today.

The organizations that act now will be the ones defining industry benchmarks tomorrow.

Lean Six Sigma and AI

Saad Mnissar
Chief Business Analyst, Payments
National Bank of Canada

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