
	
	purify
protect	
	transport



Entegris

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Understanding the Difference Between Six Sigma and Lean in the Supply Chain

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The Tie Between the Speaker & the Topic

- MS in Reliability & Applied Statistics
- PhD in IE
- Editorial Review Board of [Six Sigma Forum Magazine](#)
- Founding MBB at Seagate TCO, the world largest disc drive design center (1998 - 2005)
- 2 patents in disc drive modeling generated from his Sigma work
- Personally trained dozens of BB/GB's.
- Sr. Mgr., Global Lean Sigma / MBB, Entegris (2005 - present)
 - The group resides in Global Supply Chain, which manages the manufacturing section of the corporation.

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Define “Lean” & “Sigma”

Lean Program

- An improvement approach aimed to primarily improve efficiency through removing wastes.



Six Sigma Program

- An improvement approach aimed to primarily improve process capability through reducing variation.

Lean (Six) Sigma Program

- An improvement program/approach aimed to combine both and improve efficiency & capability through primarily removing wastes & variation.

How Does “Lean” See the World – Waste/ Loss

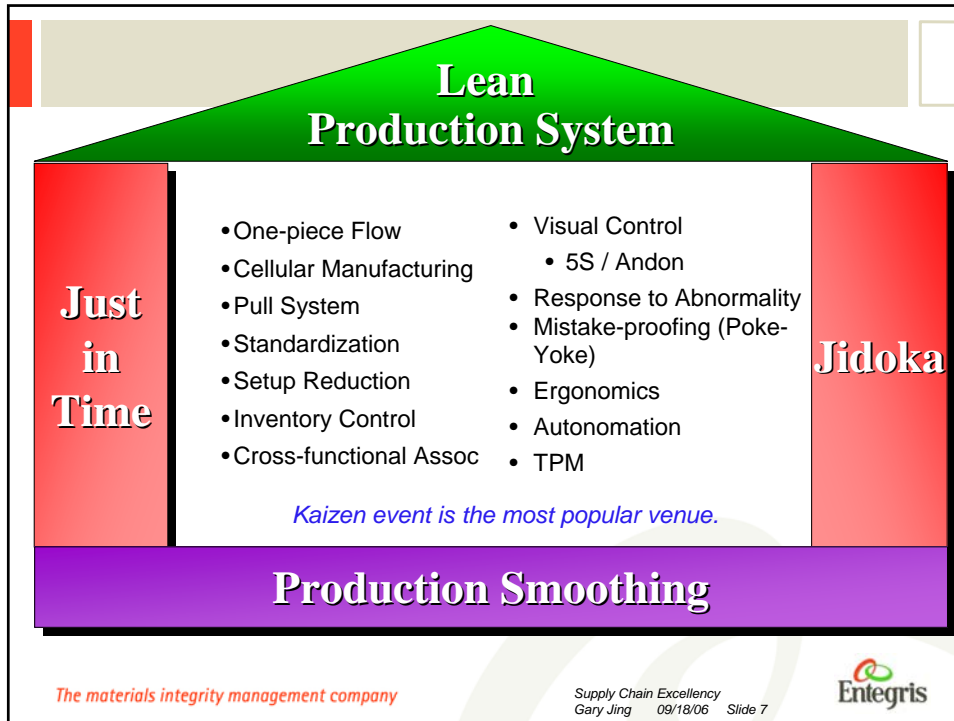
Eight Major Wastes

1. Excess Inventory
2. Waiting
3. Overproduction
4. Rework
5. Over processing
6. Excess motion
7. Transportation
8. Underutilized people

Six Major Losses

1. Breakdown Losses
2. Set-up and Adjustment Losses
3. Idling and Minor Stoppages
4. Reduced Speed Losses
5. Quality Defects and Rework
6. Start-up and Yield Losses





How Does “Six Sigma” See the World

Defects

“Six Sigma” means:

1. A statistical term & business metric.
2. A business strategy & initiative.
3. A problem solving / preventing system & methodology - DMAIC.

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DMAIC Process (Roadmap)

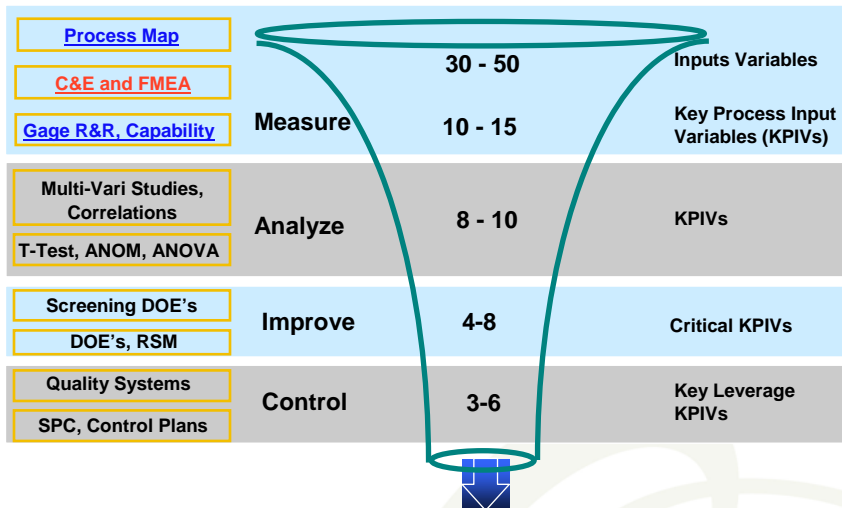
Define	<p>Define the problem;</p> <p>Establish project charter (goals, scope, team & timeline)</p>
Measure	<p>Identify customer requirements / Critical To Quality (CTQ's)</p> <p>Translate into measurable Key Process Output Variables (KPOV's)</p> <p>Verify measurement system</p> <p>Establish present capability</p> <p><u>Identify any factors</u> / Key Process Input Variables (KPIV's) <u>that may potentially affect the outputs</u> (KPOV's) through <u>process mapping</u></p> <p><u>Establish high potential suspects (hypotheses)</u> through <u>cause-effect analysis</u> (subjective analysis using experiences & expertise)</p>
Analyze	<p><u>Validate the suspects / hypotheses using existing data</u> through statistical testing (objective analysis)</p> <p>Reduce list of high potential KPIV's to vital few</p>
Improve	<p>Generate improvement ideas using soft tools (subjective)</p> <p><u>Use DOE to generate new data</u> when no existing data available and <u>to optimize & validate outputs</u> (objective)</p>
Control	<p>Put in place permanent controls</p>

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DMAIC Mind Set



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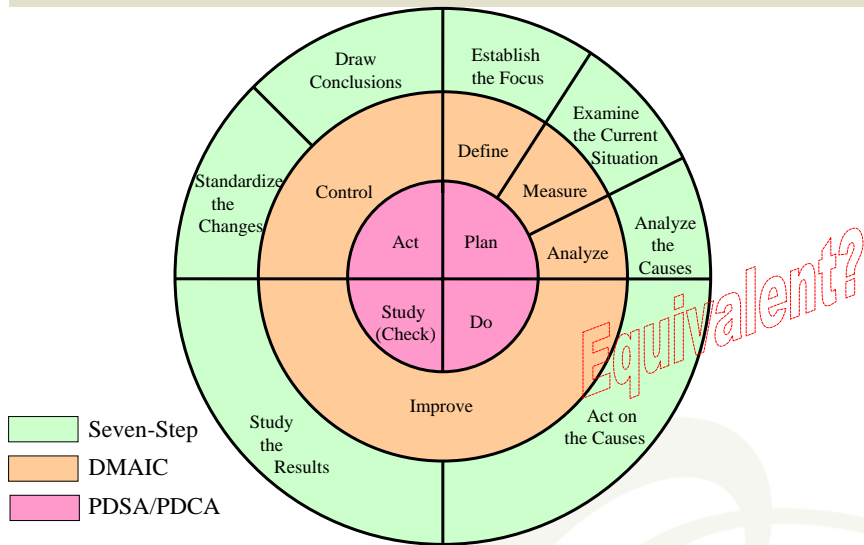
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The Linkage Between Different Problem Solving Approaches

- Although they look different, they are alike in nature

MAIC vs. Alternative Models



Sample Agenda for Six Sigma Training*

Intro to Course	1.0 hr	Sample Size Selection	1.0
Intro to Six Sigma	3.0	Regression Analysis	2.0
Defining Projects	3.0 7.0	Wrap-Up	0.5 7.0
Intro to Measure	0.5	Intro to Improve	0.5
Define the Process	3.0	Introduction to Experimentation	1.0
Cause - Effect Analysis	2.5	2 x 2 Experiments	2.0
FMEA / PPA	1.5	DOE Exercise	2.0
Data and Graphical Analysis	2.5	Improving a Business Process	1.5 7.0
Measurement Sys Analysis	1.5	Intro to Control	0.5
<i>Process Capability</i>	2.0	Surveys	1.5
Wrap Up	0.5 14.0	Control Plan	1.5
Intro to Analyze	0.5	<i>Statistical Process Control</i>	2.0
Basic Statistics - Testing	2.0	Agent of Change	1.0
Contingency Tables	1.0	Wrap-Up, Evaluation	0.5 7.0

* GB Transactional. A BB training is like a mini MS program in IE. [48hr]

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Six Sigma Tools

Soft Tools

- 5 S's
- Structured Brainstorming
 - Mind mapping
 - Affinity diagram
- Cause Effect
 - "5 Whys"
 - Fish Bone Diagram
 - Root Cause Analysis
- Process Mapping
 - Non value added
 - Hidden factory
- Preventive Control Plan
 - PPA
 - FMEA
- Error Proofing

Overlap between Lean and Six Sigma can be seen in the soft tools.

Hard Tools

- Gage R&R
- Capability Analysis
- Multi-Variant Studies
- T-Test
- Correlation
- Regression
- ANOM
- ANOVA
- DOE
- SPC

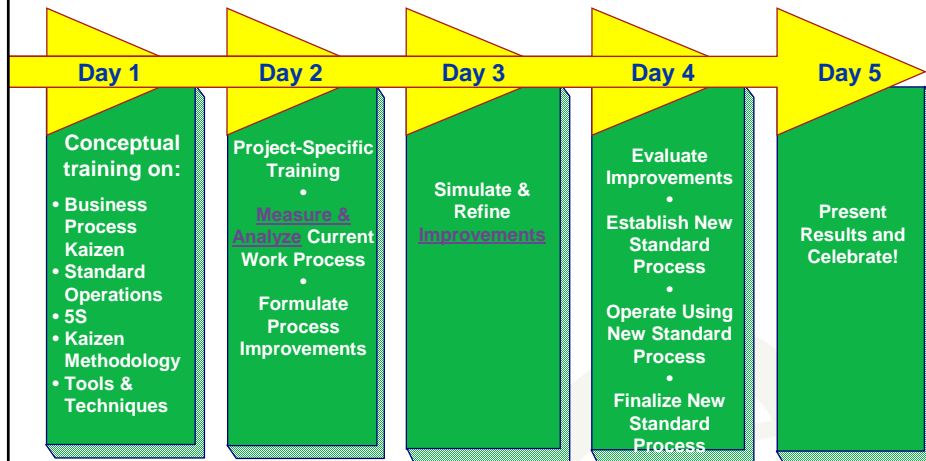
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DMAIC Embedded in Kaizen

Kaizen Breakthrough Methodology from TBM



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A Comparison Between Lean & Six Sigma

- Everyone develops a perspective upon exposure to both
 - Much Literature available
 - What's my take?

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A Comparison Between Lean and Six Sigma

Differentiation	Lean	Six Sigma
Primary Interest	Remove waste	Reduce variation
The Way They Look at the World	Flow / waste	Problem / defect
Primary Effect	Reduce waste and smooth flow	Reduce defects through reducing variation
Secondary Effects	Less inventory, fast throughput, better performance, more uniform output, less variation, improved quality.	Improved quality, better performance, less waste, less inventory, fast throughput, uniform process output.
Format	Typically Kaizen event format; concentrated resources in short timeframe; best for quick & initial gain .	Project format; resources spread over months; suitable for long-term, in-depth study .

A Comparison Between Lean and Six Sigma (cont.)

Differentiation	Lean	Six Sigma
Approach	Has selected sets of approaches for selected sets of situations: e.g., 5S, visual control, setup reduction, etc.	Generic approach DMAIC ; one size fits all.
Efficiency	More efficient in selected sets of situations: e.g., 5S, visual control, setup reduction, leadtime reduction, etc.	Allows more thorough study, more "science", but not as efficient in selected applications.
Limitation	Statistical data analysis not emphasized ; relies more on intuition & common sense.	System view limited; may " overspend " when problem and solutions are simple and apparent.
Tools	<i>Six Sigma tools ~ Lean tools + Statistics.</i>	

Problem Types to be Solved

Problem Type	Lean	Supply Chain	Six Sigma
Cycle Time Reduction	x	x	x
Inventory Reduction	x	x	x
Defect Reduction	x		x
Cost Reduction	x	x	x
Low Efficiency Improvement	x	x	x
Process Design & Improvement	x		x

They each have their own emphasis, but can ultimately achieve similar results with different efficiency.

Conclusion

- Lean & Sigma each emphasizes and is *more efficient* than the other *in certain areas*.
- Going deeper, each *alone* can *achieve the very similar results*; yet *combined* they can leverage each other and be more *efficient* & effective.
- *Practitioners should learn both Lean & Sigma.*

Various Lean - Sigma Integration Models Adopted by Various Companies

Possible Integration Model: Tier-Based Integration

(Line gets blurred after reaching a certain level)

Differentiate the problem	Lean (Kaizen)	Six Sigma
By size	Small or tactical projects (< 1 Mon). The first step in improvement. The 1st punch.	Large or strategic projects (> 1 Mon). The second step in improvement. The 2nd punch.
By timeframe (to solve)	Weeks	Months
By format	Fulltime dedicated team - event	Part time dedicated team - project
By nature	Time reduction / waste	Process variation
By the doer	Lean practitioner	Sigma practitioner

Most people differentiate by one or a combination of them.

Various Integration Models In Practice

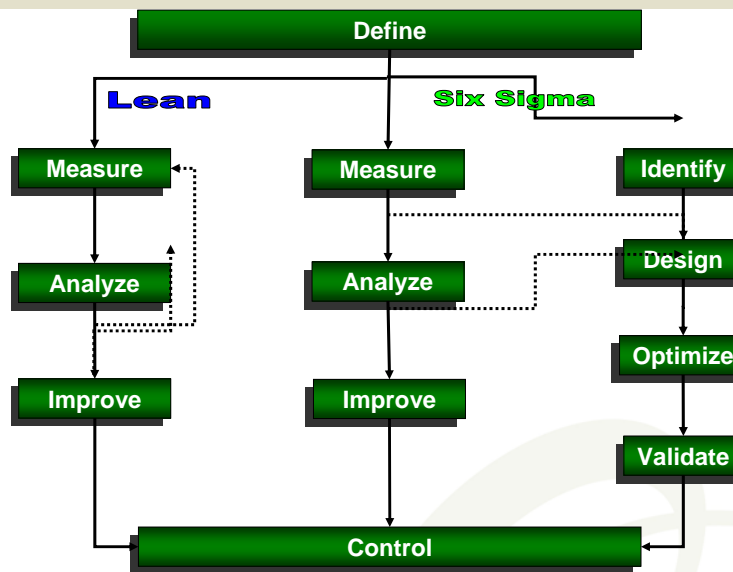
Entegris Model:

- Tier based application +
- Embed Sigma in Kaizen: Example - [Kaizen event involving DOE](#)
- Embed Kaizen in Sigma: Example - [Scrap reclaim project](#)

Seagate Model:

- GB projects cover traditional Kaizen level improvements
- Lean focuses more on higher-level, supply chain activities.

Seagate Model: Improvement Methodologies



Challenges in Integration

- When Bringing Sigma into a Heavily Lean-Oriented Environment
 1. Lack of understanding of the differences between Lean & Sigma.
 2. Deeply-rooted mindset to use Lean way to see & solve problems.
 3. “We don’t need Sigma if we really do Lean well”.
 - From a [Shingo award winner](#).
- Tips / experience:
 - I was forced to develop a module (like this one) to address the relationship.
 - Quick success of a couple of Sigma projects with good impact will be very helpful in turning the tide.

Challenges in Integration (cont.)

- When Bring Sigma into a Poorly Managed Environment (e.g., some of our sites) - Reality is Far From Ideal
 - Unstable organization.
 - Frequent management changes / Candidates move around
 - Trainees over-committed: adding up various commitments from management requires 150~200% of nominal work hours
 - “[Remodeling while the house is on fire.](#)”
- Tips / experiences
 - More improvements are achieved through Lean activities in nature.
 - Leverage can be acquired by tying projects to daily work.
 - Need strong centralized leadership, personal level incentives/metrics.

Our Takes – The Summary

- *Lean & Sigma each emphasizes and is more efficient than the other in certain areas.*
- *Lean & Sigma are embedded within each other and can provide a “one – two punch”.*
- *Differentiate Lean & Sigma activities by size, time, nature, format or simply the practitioner.*
- *Practitioners should learn both to be more efficient & effective.*
- *There are challenges when adding Sigma to Lean. Some tips / experiences are shared.*

Your Takes – Q&A

Literatures

1. [How to Compare Sigma, Lean & the Theory of Constraints](#), Dave Nave, *Quality Progress*, March 2002, p73 - 78.
 2. [Lean & Six Sigma – A One-Two Punch](#), Bonnie Smith, *Quality Progress*, April 2003, p37 - 41.
 3. [Claiming Six Sigma](#), Gary Jing, et. al, *Industrial Engineer*, February 2004, p37 - 39.
 4. [The Value of Combining Best Practice](#), Cheryl Harelstad, et al, *Six Sigma Forum Magazine*, August 2004, p19 - 24.
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