

Lean Six Sigma Techniques in Gravure Processes

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Lean Is Market Driven

Every morning in Africa, a gazelle wakes up. It knows it must run faster than the fastest lion or it will be killed. Every morning a lion wakes up. It knows it must outrun the slowest gazelle or it will starve to death.

It doesn't matter whether you are a lion or a gazelle—when the sun comes up, you had better be running.

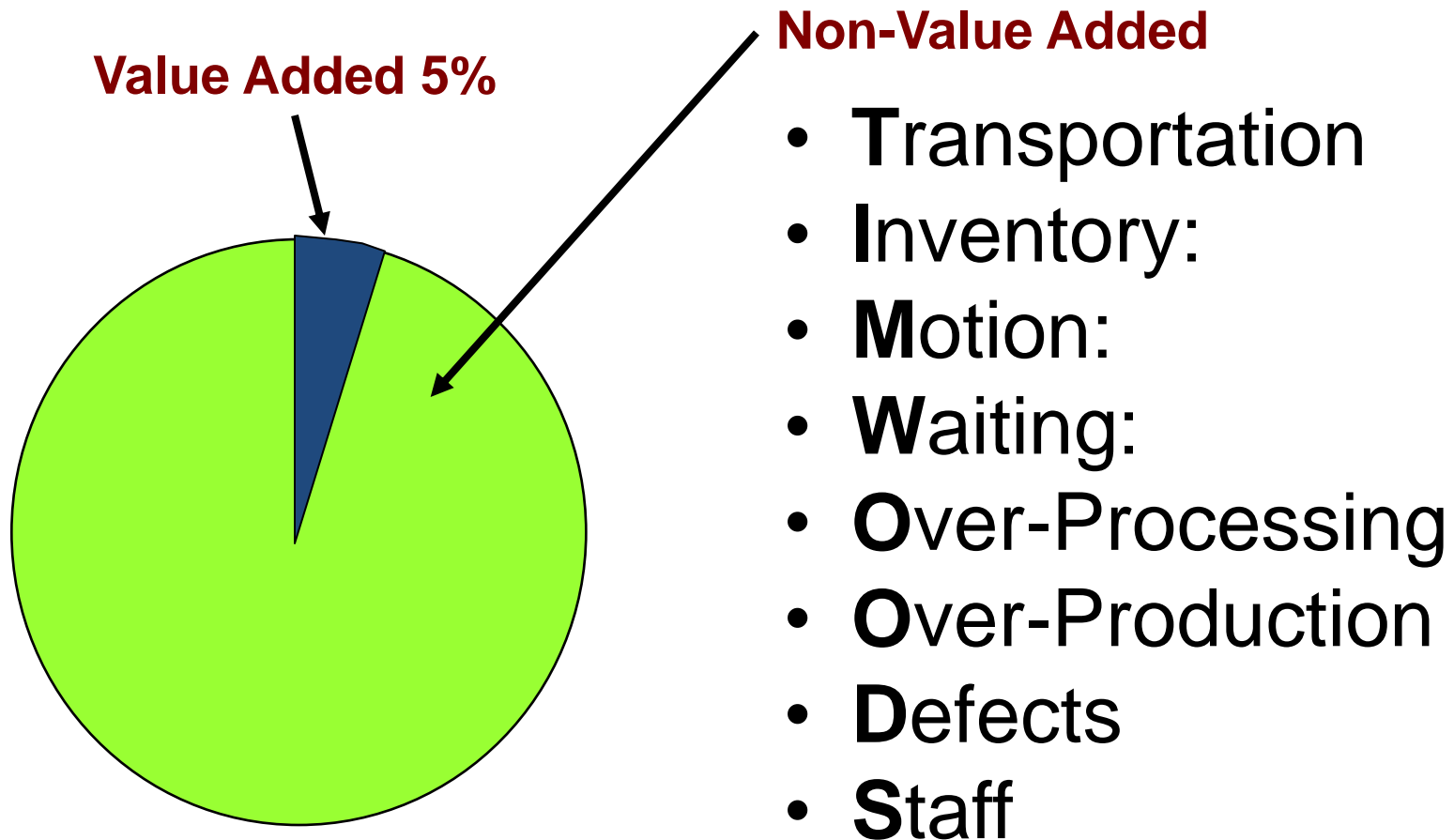


Defining Lean Manufacturing

Lean has been defined in many different ways.

**”A systematic approach
to identifying and eliminating waste
(non-value-added activities)
through continuous improvement
by flowing the product
at the pull of the customer
in pursuit of perfection”**

Lean = Eliminating the Wastes



Typically 95% of all lead time is non-value added

What Is Six Sigma?

- A statistical measure for determining process capability (Six Sigma Quality level equates to 3.4 defects per million opportunities)
- A proven set of tools and tactics for reducing variation
- A successful business strategy (in use by GE, Motorola, Texas Instruments and Allied Signal)
- A comprehensive philosophy about operational excellence
- A complementary discipline to existing tools

Focus on Customer Satisfaction, Improving Process Capabilities, and Organization-wide Involvement

Why 99% Is Not Good Enough

- The “goodness level” of 99% equates to:
 - 20,000 lost articles of mail per hour
 - Unsafe drinking water almost 15 minutes each day
 - 5,000 incorrect surgical operations per week
 - 2 short or long landings at most major airports each day
 - 200,000 wrong drug prescriptions each year
 - No electricity for almost 7 hours per month

Lean and Six Sigma Are Essential for Success

Lean

Speed + ~~Waste~~ +
Implicit Infrastructure

- **Goal** – Reduce waste and increase process speed
- **Focus** – Bias for action/
Implementing Toyota tools
- **Method** – Kaizen events,
Value Stream Mapping

Six Sigma

Quality, Cost +
Explicit Infrastructure

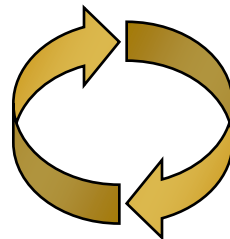
- **Goal** – Improve performance on Customer CTQs
- **Focus** – Use DMAIC with TQM tools to eliminate variation
- **Method** – Management engagement, 1% dedicated as Champions and Black Belts

Lean and Six Sigma Together

- Lean provides improvement tools and fast-attack approach to “turbo-charge” improvement efforts

- Six Sigma provides a “Unifying Framework”
- Six Sigma provides the overriding methodology (DMAIC and DFSS)
- Six Sigma provides the improvement infrastructure
- Six Sigma provides the burning platform for improvement

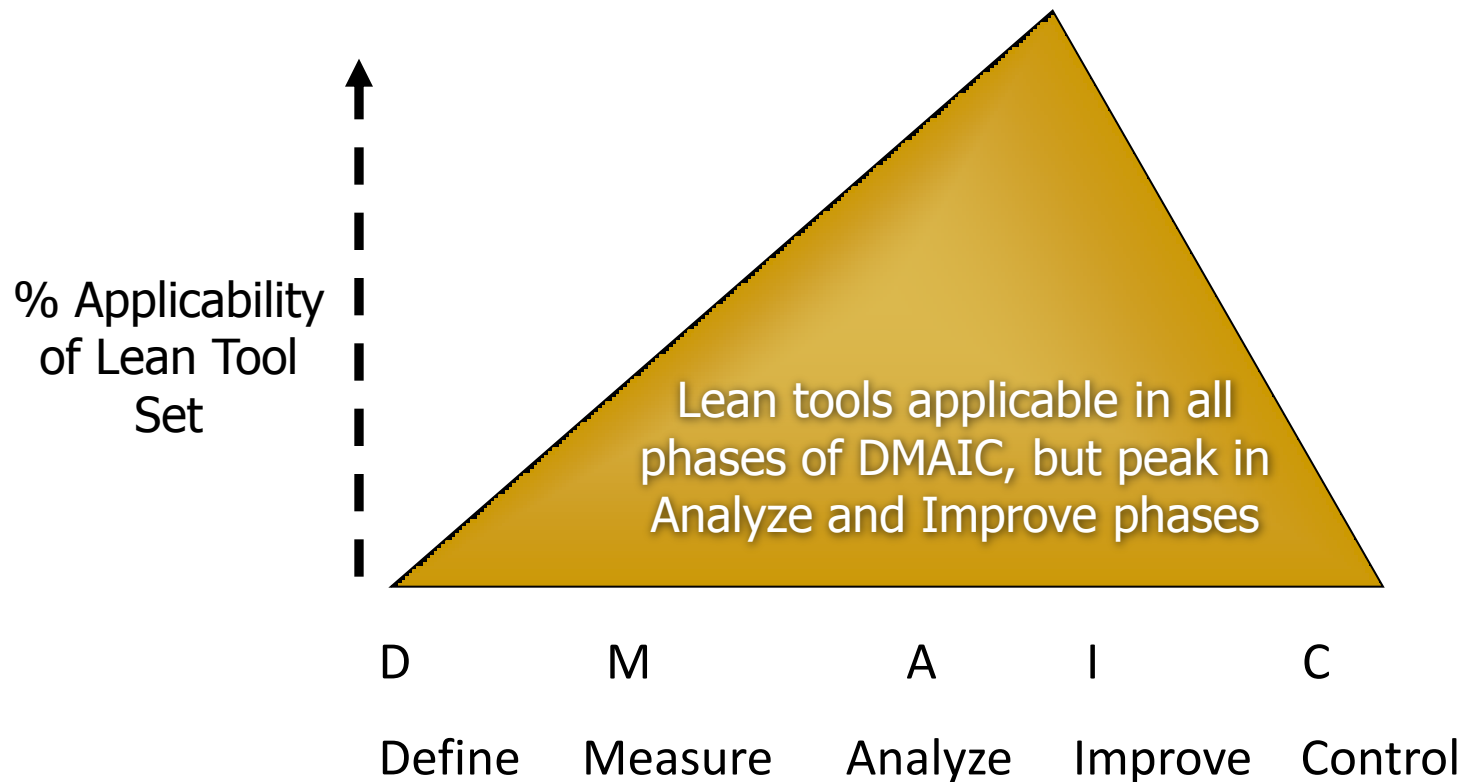
**Lean Speed Enables
Six Sigma Quality
(Faster Cycles of
Experimentation/Learning)**



**Six Sigma Quality Enables
Lean Speed
(Fewer Defects Means
Less Time Spent on Rework)**

DMAIC Methodology and Lean

- ◆ Lean Tools apply principally during the **Improve** phase:



Lean Technique -Kaizen

Kaizen - *Kaizen is a Japanese **philosophy of action** signifying change for the better or continuous improvement.*

*Kaizen = **Kai** [to take apart and make new]
+ **Zen** [to think about so as to help
others]*

Kaizen = Thoughtful Acts of Continuous Improvement!

Kaizen - Event

A Kaizen event is used to “make a leap”

A cross functional team is formed and for a 3-5 day period they focus on resolving a problem.

It is characterized by the following:

- *A short burst of intense activity & effort (3 to 5 days only with up to 30 days of follow up)*
- *Biased toward action over analysis*
- *Focused on improving the value stream*
- *Driven to resolving a specific problem*
- *Focused on a specific area or process (either plant or office)*
- *Managed with daily reviews of progress*
- *Aimed at achieving specific improvements in a short time*

Six Sigma Experimentation

- Experimentation has been used for a long time. Some experiments have been good, some not so good
- Early experiments can be grouped into the following general categories:
 1. Trial and Error
 2. One-Factor-at-a-Time (OFAT)
 3. Classical Full Factorial
 4. Fractional Factorial
 5. **Kaizen Design of Experiment**
 6. Taguchi Technique
 7. Others

Kaizen Design of Experiment (KDOE)

- Combine the Speed of the Kaizen event with the power of the Full Factorial Design of Experiment
- Uses the DMAIC approach (Define, Measure, Analyze, Improve, Control)
- Uses the 8D tools
- Short event to improve a specific process or product issue
- No statistics, use graphical analysis
- Set controls at the end of the event
- Keep management involved with the **Report Out Gate Review**

When Could I Use Kaizen Design of Experiments?

- Identification of critical factors to improve performance
- Identification of unimportant factors to reduce costs
- Reduction in cycle time
- Reduction of scrap/rework
- Scientific method for setting tolerances
- Whenever you see repetitive testing
- Validate equipment or processes

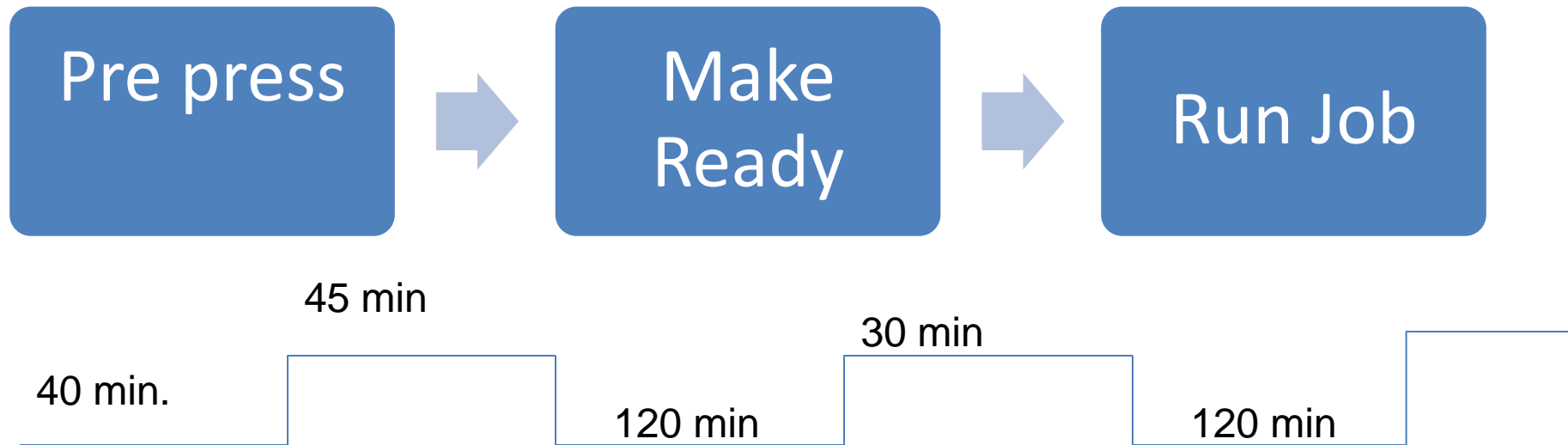
Steps for Implementation of KDOE

1. Identify the Project Area
2. Develop Value Stream Map of Area
3. Construct Cause and Effect Diagram
4. Rank and Select the Factors
5. Develop the Design Matrix
6. Coordinate Data Collection
7. Data analysis and Conclusions

Case study of KDOE in Gravure

Problem: Haze appears on film substrate which takes time and effort by pressmen to control which results in lost time, lost material and wasted resources

Value Stream Map of Process



Haze KDOE Factors

Factors	Level Low	Level High
1. Pigment Ink	White	Green
2. Cylinder Rz	24 RZ	16 RZ
3. Solvent Blend	Fast Drying	Slow Drying

Haze Test Matrix

Haze KDOE Data Collection Matrix

	A. Rz High(24)	A. Rz High(24)	A. Rz Low(16)	A. Rz Low(16)	
	B. Ink High (Green)	B. Ink Low (White)	B. Ink High(Green)	B. Ink Low(White)	
	<u>HHH</u>	<u>HLH</u>	<u>LHH</u>	<u>LLH</u>	
C. High(Slow drying)	-	-	-	-	
	-	-	-	-	<u>total</u>
	-	-	-	-	
	-	-	-	-	
	<u>HHL</u>	<u>HLL</u>	<u>LHL</u>	<u>LLL</u>	
C. Low(Fast drying)	-	-	-	-	
	-	-	-	-	<u>total</u>
	-	-	-	-	
	-	-	-	-	
	<u>total</u>	<u>total</u>	<u>total+</u>	<u>total</u>	

Haze Test Matrix with Data

Haze_KDOE Data Collection Matrix

	A. Rz High(24)		A. Rz High(24)		A. Rz Low(16)		A. Rz Low(16)		
	B. Ink High (Green)		B. Ink Low (White)		B. Ink High(Green)		B. Ink Low(White)		
	1	<u>1</u>	<u>1,1</u>		<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	
C. High(Slow drying)	<u>1</u>	<u>1</u>	<u>1,1</u>		<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	
	<u>1</u>	<u>1</u>	<u>1,1</u>		<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	total=50
	<u>1</u>	<u>1</u>	<u>1,1</u>		<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	
	<u>1</u>	<u>1</u>	<u>1,1</u>		<u>3</u>	<u>3</u>	<u>2</u>	<u>2</u>	
	<u>1</u>	<u>1</u>	<u>0,0</u>		<u>0</u>	<u>0</u>	<u>1</u>	<u>1</u>	
	<u>1</u>	<u>1</u>	<u>0,0</u>		<u>0</u>	<u>0</u>	<u>1</u>	<u>1</u>	
C. Low(Fast drying)	<u>1</u>	<u>1</u>	<u>0,0</u>		<u>0</u>	<u>0</u>	<u>1</u>	<u>1</u>	total=20
	<u>1</u>	<u>1</u>	<u>0,0</u>		<u>0</u>	<u>0</u>	<u>1</u>	<u>1</u>	
	<u>1</u>	<u>1</u>	<u>0,0</u>		<u>0</u>	<u>0</u>	<u>1</u>	<u>1</u>	
	total=20		total=10		total+=30		total=30		

Deployment Principles That Always Work

1. Executive engagement (CEO and direct reports)
2. A strong and respected Corporate Deployment Champion should report to CEO
3. P&L owners own resources & are accountable for project results
4. Deploy critical mass of key resources full-time (Black Belts/Champions)
5. Resources should be selected from “future leaders of the company”
6. Establish a process for Value Based Project Identification and Selection within the business(es)
 - a) Select Value Streams based on customer needs and value creation
 - b) Prioritize and staff critical projects in the Value Stream based on delay time
 - c) Use Kaizen Blitz for 5-30 day, Black Belt teams for >30 day projects and longer
7. Actively reduce Projects in Process to reduce project cycle times
8. Track results rigorously: Lean Six Sigma results should “pay as you go” and be confirmed by objective parties
9. Champions, Black Belts, Green Belts must have team leadership skills
10. Provide a “performance improvement” platform that allows for future innovations

Thoughts on the Future

“We had no stake in the past, to us change meant opportunity”

– Alfred Sloan, in 1921 as GM approached insolvency

“We will dream no small dreams.”

– Erik Jonsson, founder of Texas Instruments

“Good is the enemy of great. And that is one of the key reasons why we have so little that becomes great.”

– Jim Collins, author of Good to Great

Thank you

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