LEAN SIX SIGMA FOR PRECAST
Sam Lines, Concrete Sealants, Inc.

WHAT YOU WILL LEARN...

• Lean Manufacturing and Six Sigma are living principles for continuous improvement.
• It's not just about the paperwork; it's what you do with the paperwork you keep.
• LSS leads to: improved quality, reduced time, and higher customer satisfaction.
• Some tools you can take back to the plant and begin to apply immediately.

BACKGROUND

• The family tree for Lean
  • Mass Production – the assembly line (Ford)
  • Industrial Engineering (Taylor, Gilbreth, Follett)
  • The Toyota Production System (TPS)
  • John Krafcik created the term “Lean Manufacturing”

BACKGROUND

• The family tree for Six Sigma
  • Quality pioneers early 20th century
  • Motorola 1986
  • General Electric 1995

BACKGROUND

• Lean Six Sigma
  • 2002 – Michael George

AND THE TWO SHALL BE ONE

Lean
- Removes Waste
- Increases Speed
- Removes non-value added process steps
- Fixes connections between process steps
- Focuses on the customer

Six Sigma
- Reduces variation
- Improves Quality
- Reduces variation at each remaining step
- Optimizes remaining process steps
- Focuses on the customer

Speed + Accuracy = Better Delivery Better Quality Satisfied Employees Satisfied Customers
LET'S FIRST LOOK AT LEAN

- Seek out and eliminate waste

**Skills**

Transport

- Transport waste is material movement that is not directly associated with a value adding process
- Processes should be as close together as possible and material flow directly from process to process without any significant delays in between
- Excess transportation may be caused by:
  - Poor layouts
  - Large distance between operations
  - Long, or complex material handling systems
  - Large batch sizes
  - Working to faster rate than customer demand (overproduction)
  - Multiple storage locations

Inventory

- Inventory waste is stock and work in process in excess of the requirements necessary to produce goods or services "just in time"
- Unnecessary inventory that accumulates before or after a process is an indication that continuous flow is not being achieved
- Excess inventory can be caused by:
  - Lack of balance in work flow, forcing inventory build-up between processes
  - Large batch sizes
  - Failure to observe first in first out - stagnant materials
  - Incapable processes
  - Long changeover time
  - Not adhering to procedures

Motion

- Waste of motion is any motion of man and / or equipment that does not add value to the product or service
- Wasteful motion is caused by:
  - Poor workstation layout - excessive walking, bending, reaching
  - Poor method design - transferring parts from one hand to another
  - Poor workplace organisation
  - Large batch sizes
  - Reorientation of materials

Waiting

- Waste of waiting is any idle time produced when two interdependent processes are not completely synchronised
- Operators are kept waiting, or simply work slowly whilst the machining cycles
- Waiting results from:
  - Poor lines / machine coordination
  - Long changeovers
  - Unstable processes / quality
  - Back completions, not single piece transfers between operations
  - Time required to perform work

Overproduction

- Overproduction is the worst kind of waste because it causes other wastes and obscures the need for improvement
- Overproduction waste results from producing more (or faster) than required
- Overproduction is caused by:
  - Large batch sizes
  - Unreliable processes
  - Unstable schedules
  - Unbalanced cells or departments
  - Working to forecast / inaccurate information not actual demand
**Over-processing**

- Over processing is putting more into the product than is valued by the customer.
- Painting of unseen areas
- Unnecessarily tight tolerances
- Cleaning and polishing beyond the level required
- The goal is to do only the level of processing that which is useful and necessary
- Over-processing is caused by:
  - No standardisation of best techniques
  - Unclear specification/quality acceptance standards

**Defects**

- Waste of correction includes additional work performed on a product or service
- Caused by or unclear operating procedure/specifications
- Defects are caused by:
  - Inadequate training
  - Skills short-ages
  - Incapable processes
  - Incapable suppliers
  - Operator error
  - Excessive stock
  - Transportation

**Skills**

- Employees are seen as a source of labor only, not seen as true process experts
- People are told what to do, and asked not to think
- Employees are not involved in finding solutions, opportunities to improve our process are missed
  - Common causes:
    - Management does not involve employees in problem solving
    - Narrowly defined jobs and expectations
    - Old school management, worker relationships

**LEAN TOOLS**

- 5S or 6S
- Value Stream Analysis
- Poke Yoke (Mistake-proofing)
- Visual Workplace
- Just in Time (JIT)
- One Piece Flow
- Single Minute Exchange of Dies (SMED)

**THE 6S TOOL**

6S LEAN WORKPLACE

- SORT
- SET IN ORDER
- SHINE
- STANDARDIZE
- SUSTAIN
- SAFETY

**FIND THE WASTE**

- Take a GEMBA walk
- Seek first to UNDERSTAND
- Look for NON-VALUE ADDED activities
- RESPECT for people

"Helping people create more value on their own represents one of the highest forms of respect."

- John Shook
  Lean Practitioner Academy
LET’S 5S A TYPICAL GARAGE

BEFORE

THE FINISHED STATE

AFTER

FIX WHAT BUGS YOU

• Paul Akers – Fast Cap
  • [https://www.youtube.com/watch?v=NGhBiHP3pZc](https://www.youtube.com/watch?v=NGhBiHP3pZc)
• 2-Second Lean (2SL)
  • [https://paulakers.net](https://paulakers.net)

ADD IN SOME SIX SIGMA

• Structured Problem Solving
• Objective based analysis
• Eliminate or prevent non-conformances
• We need to capture information (data)

WHAT RECORDS DO WE HAVE?

• Pre-Pour Inspection Report
• Post Pour Inspection Report
• Product Assembly Inspection Report
• Field Repair Data
• Testing
  • Compressive Strength
  • Air Content
  • Density (Unit Weight)

DMAIC – STRUCTURED PROBLEM SOLVING METHOD

Phases of Six Sigma

[Diagram showing the phases of DMAIC (Define, Measure, Analyze, Improve, Control)]

- Define: Who is the customer and what are their needs?
- Measure: What are the root causes of the defects?
- Analyze: What are the causes of the defects?
- Improve: How can the causes of the defects be eliminated?
- Control: How to monitor and control the process?
**DEFINE**

- What is the problem we want to solve?
- What does the customer want / value?
- High level look at the process
- Tools:
  - Brainstorming
  - Multivoting
  - SIPOC

**SIPOC**

Pizza Process

**MEASURE**

- Collect data
  - Check sheets
  - Inspection Reports
  - MS Excel
- Record Measures
  - Tests
  - Defects
- Tools
  - Pareto Diagram
  - Run Chart
  - Control Chart
  - Histogram
  - Critical To Quality (CTQ)

**PARETO CHART**

**HISTOGRAM**

**CRITICAL TO QUALITY**

What does the SIPOC for a Septic Tank look like?

What does the CTQ for a Septic Tank look like?
ANALYZE

• Define objectives
• Identify value / non-value
• Root Cause Analysis
• Tools
  • TIMWOODS
  • Fishbone (cause-effect)
  • 5 Why

TOOLS

• Cause and Effect Diagram, Ishikawa Diagram, Fishbone Diagram

WHY IS MY TOAST BURNT?

• Effect: Burnt Toast
• Main Cause
  Categories:
  • People
  • Equipment
  • Methods
  • Materials

PEOPLE

• I don’t usually make the toast
  • My wife is out of town
  • I was not trained on this toaster
    • My wife assumed I was smarter than the toaster
      • Assumptions are bad!

EQUIPMENT

• The toaster is old
  • The toaster is full of bread crumbs
    • The toaster is not maintained
      • I didn’t know it mattered
      • My wife wasn’t complaining about it
    • She knows what she’s doing
  • The settings were changed
    • A different material was used last time
    • There are no instructions

METHODS

• There are no work instructions
  • I thought it seemed easy
    • I am smarter than a toaster
      • Re-evaluate my self worth
  • I didn’t adjust the settings
    • Don’t know what setting it should be
      • Lack of instructions
**MATERIALS**

- The bread is stale.
  - Didn’t use it fast enough
  - Not home for breakfast
  - Leave early for work
  - Working on a special project
- The bread is thinner than usual
  - We change brands
  - Save money

**CAUSE AND EFFECT: BURNT TOAST**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>People</th>
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<tr>
<td>Material is different</td>
<td>I don’t usually make the toast</td>
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<tr>
<td>The settings were changed</td>
<td>I was not trained on this toaster</td>
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<tr>
<td>No instructions</td>
<td>My wife assumed I was smarter than the toaster</td>
</tr>
<tr>
<td></td>
<td>Bad assumption</td>
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<td></td>
<td>The toaster is old</td>
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<td></td>
<td>The settings were changed</td>
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<tr>
<td></td>
<td>The toaster is full of bread crumbs</td>
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<tr>
<td></td>
<td>My wife hadn’t complained</td>
</tr>
<tr>
<td></td>
<td>She knows what I’m doing</td>
</tr>
<tr>
<td></td>
<td>My wife didn’t change the settings</td>
</tr>
<tr>
<td></td>
<td>She didn’t know what setting to use</td>
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<tr>
<td></td>
<td>Material is different</td>
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<tr>
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<td>No instructions</td>
</tr>
<tr>
<td></td>
<td>Lacks knowledge</td>
</tr>
<tr>
<td></td>
<td>Need training</td>
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</table>

**5 WHY’S**

- Ask “Why” 5 times
- Best used when people are involved
- Great for auditing a process to gain understanding
- Can be 4 or 6 why’s

**Problem Statement:** You are on your way home from work and your engine dies.

1. Why did your engine die?
   - Because your car ran out of gas
2. Why did your car run out of gas?
   - Because I didn’t buy any gas on my way to work
3. Why didn’t you buy any gas this morning?
   - Because I didn’t have any money
4. Why didn’t you have any money?
   - Because I lost it all last night in a poker game
5. Why did you lose your money in last night’s poker game?
   - Because I’m not very good at “bluffing”

**SOLUTION**

- Good solution: Stop bluffing
- Better solution: Set a dollar limit
- Best solution: Stop playing poker for money

**IMPROVE**

- List 3 – 5 Solutions
- Select one to try
- Roll it out (try it!)
- Evaluate and correct
- Tools:
  - Brainstorming
  - S.W.O.T.
  - FMEA
  - Project Plan
CONTROL

• Verify
• Document and standardize
• Celebrate

• Tools:
  • Control Chart
  • Control Plan
  • Balanced Scorecard
  • Mistake Proofing

MISTAKE PROOFING

• Poka yoke: the Japanese work for mistake proofing
  • Go / no-go gauge
  • Warning lights
  • Color coding
  • Proportionate to the risk and/or cost of a future failure

EXAMPLES OF POKA-YOKE

Lights and gauges

Tethers and holders

Posted Signs and Instructions

THREE RULES OF POKA YOKE

• Don’t accept a defect
• Don’t make a defect
• Don’t pass on a defect

An error proofing system should take into consideration these three simple rules:

Ideally, design the product so that the product cannot be assembled wrong.
**DO IT WITH DATA**

- Compressive Strength Data
- Use software (Excel)

### Descriptive Statistics

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<th>Metric</th>
<th>Value</th>
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<tr>
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<tr>
<td>Smallest(1)</td>
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<td>Confidence Level(95.0%)</td>
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### Concrete Age (Days)

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### Fly Ash Strength Data

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### Slump Data

- Actual Slump
- Maximum
- Minimum
**CONCLUSION**

- Find and eliminate waste in the process
- Mistake proof the process
- Make small improvements constantly
- Use inspection records to record information
- Compile data to see trends and runs
- Use the data to make decisions to get better
- Reduce cost | Increase speed | Improve quality

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**LEAN SIX SIGMA FOR PRECAST**

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