Agenda

• Culture of Caring Safety Moment
• Lean and Six Sigma
• Why Lean?
• Monitoring Optimization: Seeing Lean’s 8 Wastes & Eliminating Wastes
• Selecting Lean Initiatives
• Lean Lessons Learned
Culture of Caring: Avoiding rear-end collisions

7 ways you can help people driving behind you be better drivers

1. Keep space ahead of you (>2-3 seconds)
2. Check mirrors frequently; be aware of the 15-second “bubble” of space around (ahead & behind) your vehicle
3. Signal early for lane changes and turns
4. Brake gradually and smoothly so drivers around you can react
5. Leave a vehicle length ahead of you as you stop
6. Depress brake pedal while stopped so lights stay on
7. Start smoothly; avoid false start & stop
Benefits of Lean

- Increases process efficiency by reducing wastes
- Is the “conceptual site model” for continuous improvement
- IDs & seeks to eliminate non-value-added activities (wastes) in the work process: 
  *planning → sampling → reporting* in long-term monitoring
- Offers a wide framework for improvement initiatives, including traditional optimization tools

**Six Sigma** focuses on reducing defects by minimizing variance from specifications. Some improvement tools overlap between Lean & Six Sigma.

**Lean tools:** standard work, visual management, process maps, mistake proofing, root cause analysis
Lean’s Tools for Improvement and Problem Solving

**Standard Work**
Review and update “living” SOPs, customize where needed but try to use common elements for different tasks, train team to standard work, debrief.

**Visual Management**
Make information obvious, never write when a map or graph will work instead.

**Process Maps**
Understand workflows from planning to field to labs to office to report. Get from “what I think it is” to “what it really is”. Map out “what it should be” when working the current plan, then improve to “what it could be” by seeing and removing waste from the work process.

**Mistake Proofing**
Use visual management and data management tools to help avoid errors (‘soft’ and ‘hard’ approaches to mistake proofing).
Lean’s tools drive a range of improvements

A team engagement model that drives synergy towards goals; discovers improvements outside goals & cost savings

Health & Safety + efficiency

New pumps for technology trials with faster decontamination & improved ergonomics

Focus on data collection

Longer holding-time lab methods avoid out-of-hold-time “defect”; reduces courier/shipment frequency

Improvement ideas

Lean helps teams ID opportunities beyond technical-tool focused optimization and unique to each site
Monitoring Optimization – Identifying the 8 Lean Wastes

Remember Lean’s 8 wastes: D O W N T I M E

Look for these wastes in your projects:

1. **Defects**
2. **Over-production**
3. **Waiting**
4. **Non-utilized** (or, under-utilized) talent
5. **Transportation**
6. **Inventory**
7. **Motion**
8. **Extra-processing**
D O W N T I M E

1. Defects

- Faulty product; data \(\rightarrow\) reporting errors [old=\text{paper}; new=EDC]
- Spills: root cause, standard work (SOP), training, supplies
- Well ID error: visual management, engineering controls
- Site access errors: standard work

2. Over Production

- Excessive scope or frequency, distribution
- 28 reports/yr \(\rightarrow\) 5 reports \& 7 letters/yr, with visual charts (1-pg deliverables) for new requirements
- Regular Sampling Frequency Review
3. **Waiting**

- For data, or for review: non-productive time in process
- Related to transportation, inventory & motion wastes
- Scheduling attention & adequate resources to match work load reduce waiting

4. **Non-Utilized Talent** (underutilized)

People not cross-trained or using all skills
- Biologist arrives for survey; supports sampling
- O&M staff supports surface water → monthly → all sampling + routine transducer downloads
- On-site staff also support other programs field data needs, no waiting or cost from off-site mobilizations

**RESULTS:**
$80K cost savings
$40K per year/two years
5. **Transportation**

- Unnecessary movement of things (objects, data) in a process
- Handoffs: eliminate fragmented steps, retain ownership
- Use simple process maps to see transportation handoffs

6. **Inventory**

- Data accumulating for review; process bottlenecks
- Stockpiling supplies resulting in expiration before use
- Use simple process maps, and watch workload vs. resources to reduce *Waiting*, *Transportation* & *Inventory* wastes
Inventory, Waiting: ID wastes with process mapping

<table>
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<th>Resource</th>
<th>Round 1-6 Statistics Preview</th>
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<tbody>
<tr>
<td>Lab</td>
<td>EDD lab &amp; sub lab data thru rd 6</td>
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<tr>
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<td>Enter - Check, Complete?, Auto DV, ADV Issue?, Data Dump</td>
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<table>
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Detailed Process Maps or Value Stream Maps. Add QC “checks & balances” and ID where reviews, decisions could become bottlenecks.
7. **Motion**
- Unnecessary movement of people (work station, across a site); use Access SOP, combine mobilizations
- Changing tasks or applications – multitasking pitfall

8. **Extra Processing**
- Going beyond required actions or contents
- Avoid excess QC or Data Validation
- Substitute 1-page graphics for frequent reports; transition paper to e-deliverables
- 28-day & 14-day holding time methods replace 24-hour & 48-hour holding time lab methods, removing daily courier constraint
Extra Processing: Avoid Going beyond required contents - simplify deliverables

Monthly pumping regime & hydraulic performance snapshot

Reporting month: Mar 2018
Reporting Qtr: Q1 2018
Extra Processing: Improvement over time

**Diagram:**
- **Number of Monitoring Wells**
- **Annual Cost as Percentage of Year 1 Cost**

- **X-axis:** Years completed in program
- **Y-axis:** Number of wells, % Year 1 cost

**Legend:**
- Percent Annual Cost
- Monitoring Well Count

**Graph Description:**
- The number of monitoring wells increases over time, approaching 180 wells.
- The annual cost as a percentage of the year 1 cost decreases from 100% to 20% over 6 years.
Extra Processing: Improvement over time
Selecting Lean Initiatives

Pareto Chart

- Pareto Principle:
  - 80 – 20 Rule
- Cost of non-conformance
- Select top ~ 60-80%
- Year 1 review, ongoing, plot costs, # occurrences, or time…

![Pareto Chart: Initial Defects: Cost of Non-conformance](chart.png)
Selecting Lean Initiatives

**Impact vs. Effort**

- Benefit or gains from an improvement compared to the cost to implement the change
- Understand effort
- Examples & lesson learned
- Consider “Sunsets”

<table>
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<tr>
<th>IMPACT</th>
<th>EFFORT</th>
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<tr>
<td>Low</td>
<td>Low</td>
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<tr>
<td>High</td>
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- Frequency Reduction in Sampling or Reporting
- Report Streamlining
- SOP optimizing
- Sampling Purge Method Changes
- Lab Method Changes (holding time)
- Analytical Suite Changes

Cost required for approval & making the improvement

Aim Here!
Lean Lessons Learned

✓ **Leverage Engineering Controls**
  - Database & data management / validation team
  - Electronic Data Collection
  - Pre-format data queries for reports

✓ **Leverage Site Personnel**
  - Cross train for field tasks

✓ **Apply Standard Work**
  - Simple useable “living” SOPs
  - Purge rates, tubing, access routes
  - Reporting Process (figures/tables)

✓ 1-page graphics, if possible

✓ **Select Lower-effort Improvement Initiatives**
  - Get “bang for the buck”

✓ **Engage Team**
  - Debrief, ask why, share ideas
  - Recognize & remove wastes and constraints
  - Understand process better
  - Improve, recognize effort & Repeat
  - Deming Plan Do Check Act cycle
Learn More About Lean

USEPA Lean Resources  https://www.epa.gov/lean

Rother and Shook– *Learning to See*
Womack – *The Machine that Changed the World*
Ford, Crowther and Levinson– *The Expanded and Annotated My Life and Work*
Deming – *Out of the Crisis*;  Crosby – *Quality is Free*

GoLeanSixSigma  www.goleansixsigma.com

American Society for Quality  www.asq.org
Lean Enterprise Institute  www.lean.org

UNLV – Lean Six Sigma classes, new offering spring 2019
Thank you!