Housekeeping

- All settings are at the window bottom
- Audio button is at far left
- Chat button for communicating with other attendees is at the middle left
- The Q & A button for submitting questions to the presenter is at the middle right. We’ll answer questions during the Q&A at the end of the presentation.
- We won’t be using the Raise Hand function today.
Just Published!

*Four Types of Problems* helps teams:
- Sort out problems faced
- Avoid “hammer & nail” traps
- Pick the right problem-solving tool
- Sustain gains, go faster

Buy at lean.org/Bookstore/
Learn from Art Smalley in person at the Lean Summit in Houston!

- Take the full day workshop on March 26
- Attend the Learning Session at the summit!

Also learn from:

Register at lean.org/summit
Today’s Presenter: Art Smalley

- Among first Americans to work at Toyota, Japan
- Trained at Kamigo engine plant; maintenance manager created stability for Ohno’s flow production
- Director, lean manufacturing, Donnelly Corporation
- Lean expert, McKinsey & Company
- Art of Lean; LEI faculty
- Author, Creating Level Pull; co-author Understanding A3 Thinking
- Latest book: Four Types of Problems
Short Introduction

**Work Experience Related**
- Toyota Motor Corp Japan
- Director Donnelly Corporation
- McKinsey & Company
- Art of Lean, Inc.

**Home / Family Related**
- Wife & 3 Daughters
- Cypress, California

**Hobby Related**
- Photography
- Woodworking
- Reading
- Judo / Jiujutsu / Kali
Questions / Outline

- How does this link to the LEI Transformation Model
- What are the 4 Types?
- Why propose 4 Types?
- What type of situations does each one best address?
  - Type 1 Troubleshooting / Abnormality
  - Type 2 Gap from Standard
  - Type 3 Target State
  - Type 4 Open Ended / Innovation
Not just what lean tool can I use?

Nor how many kaizen events do I conduct…

Nor how much training do I need…

Etc…
20th Century and Problem Solving

1896
- General Inputs:
  - Scientific Method & Critical Thinking Routines

1910's
- Frederick W. Taylor's scientific management principles
- John Dewey Reflective Thinking

1920's
- Walter A. Shewhart's control chart

1930's
- Vilfredo Pareto introduces 80/20 concept in Italy

1940's
- JUSE 7 QC Tools
- 6 step problem solving & shop floor QC circle activities
- Bell Labs Fault Tree Analysis

1950's
- Sarason & Proztman
- CCS Course in Japan & 5 step problem solving
- Deming SPC lectures & Deming Wheel in Japan
- JUSE PDCA Cycle
- Juran Quality Management & Handbook in Japan

1960's
- U.S. DOD 8D Method
- Kepner Tregoe Rational Analysis Methods

1970's
- Lean problem solving methods
- Six sigma methods
- Design thinking routines
- Mizan Boushi / GD3

1980's
- TWI Methods during WWII
- U.S. DOD standard MIL-P-1629
- Failure Modes Effects Analysis
- TRIZ / TIPS

1990's
- 2000's

2000's
- Alex F. Osborn establishes brainstorming routines for creative problem solving
- Ronald A. Fischer Design of Experiments
- Shewhart cycle of specify, produce & inspect
4 Types of Problems & Approaches

Why 4 Types??
Only the scientific method!!
Just Do It!!
Kaizen!!
PDCA!! Kata!!
Six-Sigma!!
Why 4 Types?

1. Troubleshooting
2. Gap from standard
3. Target condition
4. Open-ended

Improvement through raising standards and solving problems
- Current standard
- Maintain current standard
- Raise the standard

Creative
Reactive

Time
Next standard
External Consideration Factors
4 Types of Problems & Approaches

Type 1 Problem Approach

- Concept of fixing problems now
- First responder mentality
- Protect the customer
- Engage the workforce RFP
- Makes for a better day
- Displaying courage, creativity, and the spirit of challenge
What Do These Have in Common?

Yahoo breaks its own record with new announcement that 1 billion accounts were hacked in 2013

What's known so far about the worst breach on record

Details of the breach
- Yahoo recently discovered a record setting breach of 1 billion user accounts, compromising names, email addresses, phone numbers, dates of birth and passwords
- The incident, which occurred in August 2013, was discovered when, last month, law enforcement partnered the company with info that according to a third party belongs to Yahoo, a leading tech intelligence on file.

From the beginning
- In August 2013, the company announced that a state-sponsored hacker breached 10 billion accounts in late 2014, the largest known breach in Yahoo's history.
- Yahoo broke its own record with yesterday's disclosure.
- Though the breach in 2013 and 2014, incidents are linked and coordinated, the 2014 incident was not based on collaboration with a separate security breach in which Yahoo's source code was hacked and used to forge email, which provides a way for users' accounts to be reset.

Verizon: "We will evaluate"
- The company's statement that Yahoo's record hacking event occurred in 2013, noting that the 2014 hack was also a matter.
- After news of the third breach in 2015, Verizon announced it will assess the situation in its upcoming
- Verizon: "We will evaluate"
Troubleshooting vs. Root Cause

Type 1 Focus

How to get home safely?
• Primary navigation impaired in the damaged Service Module. Abort moon landing. Move to LEM.
• Decision to return to Earth using Lunar Module for thrust
• Internal environment fell to 39°F
• Lack of potable water and food
• Dangerous CO² build up
• Free return trajectory around moon using its gravity to return to earth
• Power up of command module from shut down state
• Manual vital burn adjustments

Type 2 Focus

Why did the tanks rupture?
• Oxygen tank dropped in assembly possibly causing some damage
• Tank drain tube misalignment factor
• Thermostat 28 volt vs. 65 volt design spec issue
• High tank temps 1000° & wire insolation came off
• Two of the now-bare wires arced, caught fire, pressure rose, and the tank ruptured.

Rupture of oxygen tank #2 in the service module.

Damaged to a valve in the #1 oxygen tank, causing it to lose oxygen rapidly.

Oxygen stores, water, electrical power, and use of the propulsion system were lost inside of 3 hours.
Apollo 13 Examples

Troubleshooting CO2 build up using only what material was available to establish a temporary countermeasure.

Using the Lunar module to slingshot around the moon and plot a trajectory home.

Commander Jim Lovell re-writing work instructions on the fly in the module for various tasks.
Type 1 – Troubleshooting at Toyota

Abnormality Management System

- Condition based trigger
- Time Constraint
- Human based call for help
- or
- Machine based abnormality

10,000 Andon calls – Not all are equal in terms of impact. What do you do as an organization?
Time & Quantity Trigger Based

Production Analysis Board

Plan Versus Actual
Time & quantity based triggers

Rapid Problem Solving
• Concern
• Cause
• Countermeasure
• Check
Minimal (if any) documentation involved. Mainly discussion, critical thinking, rapid action & follow up.
Birth of the 5 Why’s

3G’s
- Go and See
- Get the Facts
- Grasp the Situation Details

**First Why**
Q: Why has the machine stopped?
A: There was an overload and the fuse blew.

**Second Why**
Q: Why was there an overload?
A: The bearing was not sufficiently lubricated.

**Third Why**
Q: Why was it not lubricated?
A: The lubrication pump was not pumping sufficiently.

**Fourth Why**
Q: Why was it not pumping sufficiently?
A: The shaft of the pump was worn and rattling.

**Fifth Why**
Q: Why was the shaft worn out?
A: There was no strainer attached and metal scraps got in.

**Recurrence Prevention Countermeasure:**
Add fine mesh strainer to inlet port to prevent cutting chips from entering the system.
Some problems are severe, or recurring, or hindering progress...troubleshooting alone won’t solve these.
Type 2 – Gap from Standard

Monthly

Weekly

Daily

KPI

Why???
What really is the true cause???

Emphasis on Step by Step

Why is this such a big issue???

What really is the true problem???

What really is the true cause???
Type 2 Analysis Patterns

Convergent
Disciplined
Focused
Analytic / Quantitative
C&E Relationship
Standard attainment
Results emphasis
A3 is simply a tool for aiding the problem solving process, showing your thinking, communicating and reporting progress.
**Structured Investigation Sequence**

1. Measure actual dimensional extent of problem
2. Look for obvious contamination or abnormalities
3. True and re-dress grinding wheel and observe status
4. Check actual grinding wheel (check “pores”)  
5. Confirm actual (not theoretical) stock removal
6. Send part to QC Mat’l lab for hardness and HT depth check
7. Check actual cutting conditions  
   - Wheel RPM  
   - Feed Rate, Depth of Cut, etc.  
   - SFPM
8. Confirm status of datum features
9. Measure spindle run out
10. Coolant check  
    - Flow rate / pressure  
    - Nozzle condition and direction  
    - Temperature  
    - Concentration

**Cpk**  
- 1.15  
- 2.33
Divergent / Lateral Thinking
Focus is less clear initially
Analysis / Synthesis
Creativity emphasis
Improvement over existing standard
Scope is usually larger
Type 3 Target State

Acceptable (Current State) Situation

(Future) Ideal Situation

Normal Status

Type 2 - “Gap from Standard”

GAP

Type 3 - “Target State”

改善方法
Kaizen Methods
Creative Thinking

問題解決
Problem Solving
Critical Thinking
• Many problems / opportunities
• 7 Wastes everywhere
• Not generally a single root cause
• Systemic issues
• Creativity over Capital

Long lead-time
Excess inventory
Poor quality
Low flexibility
Poor responsiveness
Customer complaints
Some Type 2 “Gaps” & Type 3 “System”
Process Level Example (SMED)

- Dedicated Press
  - Part A
  - Dedicated Press
  - Part B
  - Dedicated Press
  - Part C

- Flexible Press
  - Parts A, B, & C

3 Dedicated Machines
No Flexibility
Each 30% Utilization

1 Machine / 3+ Tools
Change Over Flexibility
90% Utilization

Set-Up Reduction History in Toyota

- > 98% reduction
- Methods and technology improvements

1945-1960
4-6 hrs

1962
15 min

1973
3 min
There is no single root cause:

- Make a smaller cutting chip
- Contain the chip inside the machine
- Create proper coolant flow
- Flush the chip out properly
- Avoid the problem in the first place
4 Types of Problems

Small, medium, & large
Open ended
Divergent / Lateral Thinking
Focus is less clear initially
Analysis / Synthesis
Creativity emphasis
Breakthrough concept
### Ten Types of Innovation

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit Model</td>
<td>Make money</td>
<td>Gillette, Target</td>
</tr>
<tr>
<td>Network</td>
<td>Connect with others to create value</td>
<td>Whole Foods, Zara</td>
</tr>
<tr>
<td>Structure</td>
<td>Align your talent and assets</td>
<td>OXO, Zappos</td>
</tr>
<tr>
<td>Process</td>
<td>Use signature or superior methods to do your work</td>
<td>Virgin, Wii</td>
</tr>
<tr>
<td>Product Performance</td>
<td>Employ distinguishing features and functionality</td>
<td>Nespresso</td>
</tr>
<tr>
<td>Product System</td>
<td>Create complementary products and services</td>
<td></td>
</tr>
<tr>
<td>Service</td>
<td>Support and enhance the value of your offerings</td>
<td></td>
</tr>
<tr>
<td>Channel</td>
<td>Deliver your offerings to customers and users</td>
<td></td>
</tr>
<tr>
<td>Brand</td>
<td>Represent your offerings and business</td>
<td></td>
</tr>
<tr>
<td>Customer Engagement</td>
<td>Foster distinctive interactions</td>
<td></td>
</tr>
</tbody>
</table>

#### Design Thinking

1. **Empathize**
2. **Define**
3. **Ideate**
4. **Test**
5. **Prototype**

#### Set Based Design

- **User/Market needs**
- **Concepts**
- **Target/Range specifications**
- **Deploy operational value stream**
Product Offering Example
4 Types of Problems & Approaches

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
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<td><strong>Open-ended</strong></td>
</tr>
<tr>
<td><em>Caused</em></td>
<td><em>Created</em></td>
<td><em>Reactive</em></td>
<td><em>Proactive</em></td>
</tr>
</tbody>
</table>

Where are you?
What next?
Good luck on your improvement journey!
Questions?
Questions and Answers

Type your questions for Art Smalley

2019 Lean Summit, March 27-28

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