Teaching Lean

Experiential Learning is Essential:

- Lego Lab at Auburn
- In-Box Moresteam/TPG
- Stickle Brick MDS/TPG

D. Scott Sink, Ph.D., P.E.
Moderator and Presenter
Adjunct Professor, Virginia Tech
Sr. Advisor, The Poirier Group

Tom Devall
ISE @ Auburn University

Jared Frederici
The Poirier Group

Webinars that Matter in Times of Turblence
1 December 2020
Our Global Personal and Professional Development Series for IISE Members and Customers…….

THEMES:

• Enterprise Transformation and OpEx
• Operational Analytics
• Cultures to support Perf Excellence
• Integration of People, Strategy, Process and Technology
• Integrated LeanSigma
• Industry, Service, Healthcare 4.0
• Personal and Professional Learning and Development
• Change Leadership and Management
• Navigating through Turbulent (VUCA) times
• Supply Chain and Logistics Optionality
Thank You to Our Partners and Sponsors

Corporate Sponsors

IISE Professional Affinity Groups
Operational Excellence Division

Mission

• To provide its membership with the operational excellence practices body of knowledge, networking opportunity, recognition, and educational programs to stay competitive in the global market.

Vision

• To be the hub that facilitates knowledge development and sharing in the domain of operational excellence, lean six sigma, and all continuous improvement practices.

Sponsor of the Lean Six Sigma Track at the IIESE Annual Conf.

Division Awards

Best Student Paper Competition

Teaching Award

Best Practice Competition

Volunteer Opportunities

Share your experiences/knowledge through our Social Media Channels

Provide content for Newsletters

Provide case studies and/or technical content for Webinars

Support Conference Tasks (IIESE Annual & ELSS Conf.)

Serve on the Division’s Board (Professional and Student Leadership)

Connect with us


LinkedIn Group: https://www.linkedin.com/groups/4032305/

IISE Connect: https://bit.ly/3l21dV0

Nadiye Ozlem Erdil · 1st
Associate Professor at University of New Haven
ISE’s Create Value by Integrating People, Strategy, Process and Technology

- **Strategy**: Enhancing the way you think and plan
- **Organizational Alignment**: What we do and how we do what we do.
- **People**: Changing the way we exchange value with our employees and manage our culture.
- **Process**: Leveraging hyper-connectivity and the full power of IT Enablement.
- **Technology**: Performance Excellence
This Webinar is a Natural Evolution from Recent Global IISE Webinars

- Benchmarking Industry: How to Engineer Performance Excellence
- Pioneering and Engineering a New World
- Creating Cultures that Support Full Potential Performance/Operational Excellence
- How to design and develop and execute Flow Workshops in Healthcare
- Principles for Creating Ideal Behaviors from Employees
- Becoming a Change Master
- Creating and Ensuring Superior Client Experience
- Achieving Full Potential Performance: Managing Transformations in Yourself, Others, in teams and organizations

This Link gets you to these great Archived Webinars in our Virtual Learning Library

Performance Excellence

Lean Related Webinars in our Series

- Lean Transformation—Learnings, Lessons, Tips
- Engaging Employees in Operational Excellence: 2-Second Lean Case Studies
- The Agile Scrum Process for Process Improvement
- Principles for Creating Ideal Behaviors from Employees
- Operational Analytics: Sustainable Visible Measurement Systems
- How to Design, Develop and Executive Flow Workshops
- Creating Cultures that Support Full Potential Performance/Operational Excellence
- Principles and Tools to Ensure Optimal Process Improvement
- Rapid (AGILE) Deployment and Execution of Integrated Systems Engineering Principles and Methods in periods of disruption
- Benchmarking Industry: How To Engineer Performance Excellence
- Putting People in Operational Excellence Programs

• over 850 professionals, academicians, students attended our most recent Virtual Annual Conference.

• We envision over 2000 at next year's Virtual Annual IISE Conference.

• No Travel, lower registration fees, pick and choose live sessions, have access to session recordings and presentations for up to a year!

• Virtual Networking worked great!!

• Can purchase access to our library of sessions from the conference even if you did not get a chance to attend.
A webinar recording will be made available after the session, follow up e-mail you will receive tomorrow.

Download the presentation **DURING** the Webinar, before it ends!! and request extra handouts after the webinar.

Questions? Scott will review them as they come in and integrate into the dialogue as appropriate and time permits

Follow up questions are welcomed and contact information is provided at the end of the presentation.

And, the Recording and Presentation pdf will be available on IISE’s website for IISE members shortly after the webinar date—Training/Webinars/Performance Excellence. **Membership Has Privileges!!**

• 11:00-11:07 Quick tee up for Session and Tom

• 11:07-11:22 Tom Devall—“Fixed” Structure, Highly Detailed, comprehensive, physical simulations that represent end2end, extended value stream, sequential interdependence (mostly), and HVLM applications.”

• 11:22-11:40 Jared Frederici—Virtual Simulation (computer based) but interactive with team and individual engagement that represent fairly complex Transactional Processes and leverage emerging interactive technologies (e.g. Miro, Mural, Teams, Zoom)

• 11:40-11:50 Scott Sink—”Have Kit Will Travel” version of Auburn’s simulation—Sticklebrick. Robust enough to reflect different types of interdependence as well as transactional systems. The foundational ‘lab’ for most trainers.

• 11:50-12:00 Q&A and Close-out
Fixed Structure Physical Simulation that is complex, comprehensive and that includes extended value stream dynamics.

High Volume, Low Mix, Sequential Interdependence focused.

Tom Devall · 1st
Director of Automotive Manufacturing Initiatives, Auburn University
Industrial and Systems Engineering
Tiger Motors - Lego lab
Acme Inc. Tier 2 Supplier

War Eagle Inc. Tier 1 Sequenced Supplier

All 15 Work Stations

Raw Material

Super Market

Raw Material

ASRS Warehouse

- 4,000 Sq. Ft
- 15 work stations
  - 2 Sub Assy. Cells
  - 1 Final Line Assy.
- Heijunka / Kanban
- ASRS System
- PLC Lab
  - 19 training stations

Electronics Test Area
• SUV – 234 pieces
• SPEEDSTER - 277 Pieces
• Takt Rate = 70 Seconds
• Line Cycle Time= 60 Seconds
• Challenging Goals: Students required to build 39 vehicles in 45 minutes with zero defects
• Goal not achieved in first eight years
Lab Features

Sub Assembly Cell

Manufacturing Cell

Auto Storage and Retrieval System

Supermarket
Lab Features

5S – Shadow Board

5S – Sustainment

Standard Work

PLC Training Stations
Lab Features

Andon in each station tied to PLC

Vision Inspection

Augmented Reality – Work Instruction

Poka Yoke - Fixturing
Lab Features

Heijunka / Kanban

Value Stream Mapping

SMED

Kaizen

Tom Devall
Director, Automotive Manufacturing Initiatives
Auburn University Lego Lab
Throughput by Cells

Throughput: Mass > Lean > Kaizen

Mass Production | Lean System | After Kaizen

Cell-1 | Cell-2 | Cell-3 | Target
Auburn University
Lego Lab
Average Defects by Cell

Throughput: Mass > Lean > Kaizen
WAR EAGLE INC
Manufacturing Cell
## Process Capacity Chart

<table>
<thead>
<tr>
<th>Step</th>
<th>Process Name</th>
<th>Machine Number</th>
<th>Manual Time (sec)</th>
<th>Walk Time</th>
<th>Auto Time (sec)</th>
<th>Total CT (sec)</th>
<th>No. of Pcs./Change</th>
<th>Time to change (sec)</th>
<th>Time/pc. (sec)</th>
<th>Shift Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turning</td>
<td>L1</td>
<td>69.44</td>
<td>3.2</td>
<td>138</td>
<td>207.44</td>
<td>1</td>
<td>69.44</td>
<td>69.44</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>L2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Drilling</td>
<td>M1</td>
<td>44.65</td>
<td>4.33</td>
<td>8.4</td>
<td>53.05</td>
<td>1</td>
<td>44.65</td>
<td>44.65</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>Cutting</td>
<td>Saw</td>
<td>4.33</td>
<td>0</td>
<td>0</td>
<td>4.33</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>Drilling</td>
<td>M2</td>
<td>44.65</td>
<td>3.88</td>
<td>62.4</td>
<td>107.05</td>
<td>1</td>
<td>4.33</td>
<td>4.33</td>
<td>415</td>
</tr>
</tbody>
</table>

**Group:** Manufacturing Cell Design  
**Product:** Headlight (part B)  
**Line:**  
**Created by:** Arvind
<table>
<thead>
<tr>
<th>Description of Operation Step</th>
<th>Time (sec.)</th>
<th>Manual</th>
<th>Automatic</th>
<th>Walk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 L1</td>
<td>69.44</td>
<td>138</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td>2 L2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>3 M1</td>
<td>44.65</td>
<td>8.4</td>
<td>4.33</td>
<td></td>
</tr>
<tr>
<td>4 Saw</td>
<td>4.33</td>
<td>0</td>
<td>3.47</td>
<td></td>
</tr>
<tr>
<td>5 M2</td>
<td>44.65</td>
<td>62.4</td>
<td>3.88</td>
<td></td>
</tr>
</tbody>
</table>

**Time (draw solid line vertically at takt time):**

- **TPT = 236.47 Sec**
- **TT = 270 Sec**

**OEE**

**CT = 177.95 Sec**
**WAR EAGLE INC.**

**Manufacturing Cell**

**Standard Work Chart**

**WAR EAGLE INC.**

### Standardized Work Combination Table

<table>
<thead>
<tr>
<th>No.</th>
<th>MAJOR STEPS</th>
<th>MAN TIME</th>
<th>AUTO TIME</th>
<th>WAIT TIME</th>
<th>WALK TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pick up raw material</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Load/Unload part and start L1</td>
<td>69.44</td>
<td>138</td>
<td>0</td>
<td>3.2</td>
</tr>
<tr>
<td>3</td>
<td>Load/Unload part and start M1</td>
<td>44.65</td>
<td>8.4</td>
<td>0</td>
<td>4.33</td>
</tr>
<tr>
<td>4</td>
<td>Load/Unload part and start S1</td>
<td>4.33</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Load/Unload part and start M2</td>
<td>44.65</td>
<td>62.4</td>
<td>0</td>
<td>3.88</td>
</tr>
</tbody>
</table>

**Time**

- 164.1
- 208.8
- 0
- 13.41

**TOTAL CYCLE TIME (Manual+Walk)**

- 177.48

**Diagram**

- Working Sequence
- Walking

**Notes**

- Return to Start

**Additional Information**

- **Plant:** WAR EAGLE INC.
- **Product:** Part 2 - SPEEDSTER HL
- **Op.:** _1_of_ _1_
- **Area:** Shelby Center
- **Process:** Production

**Takt Time:** 60 sec

**Cycle Time:** 177.48
A3 PROCESS UTILIZED TO CREATE
WAR EAGLE INC

THEME:
Designing Machine Cell based on Pull System

BACKGROUND:
To design a sub assembly cell at 'War Eagle Inc.' to be synchronized to the TIGER MOTORS using Kanban signals so as to demonstrate Lean Manufacturing Practices, and be a part of the experiential learning experience at Auburn U which aims to bring lectures to life by developing a system to enhance the knowledge and understanding of future students with specific goals of providing students with 10 years of manufacturing experience and to embarrass local manufacturers.

CURRENT CONDITION:
1. Received last set of machine codes from the Product Design Team.
2. All machines are set in proper positions and work is aligned to each workstation. Since one of the lathes (L1) is down, line balancing could not be achieved.
3. Cutting tools & Holding fixture were received.
4. A KANBAN system has been implemented by making use of University's intranetwork.
5. Process capacity chart, Standardized work combination table and Standardized work chart have been developed.
6. Delay in handover of CNC codes led to absence of our participation in Final Production run.

IMPLEMENTATION PLAN:

<table>
<thead>
<tr>
<th>Issue</th>
<th>Corrective Action</th>
<th>Open Date</th>
<th>Target Date</th>
<th>Close Date</th>
<th>Responsibility</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>All machining centres to be shifted to other location inside the same facility</td>
<td>To be discussed with SS team and machines have to be shifted</td>
<td>10/6/16</td>
<td>10/31/16</td>
<td>11/11/16</td>
<td>Akshay</td>
<td>Green</td>
</tr>
<tr>
<td>Product Design has been finalized and codes provided</td>
<td>Alterations to be done in codes making it conform to the design specifications</td>
<td>11/08/16</td>
<td>11/13/16</td>
<td>11/18/16</td>
<td>Samrat</td>
<td>Green</td>
</tr>
<tr>
<td>Holding Fixtures to be finalized</td>
<td>To be finalized from the shortlisted ones</td>
<td>10/6/16</td>
<td>11/11/16</td>
<td>11/11/16</td>
<td>Charles</td>
<td>Green</td>
</tr>
<tr>
<td>Type of KANBAN system for signalling to be implemented</td>
<td>Shortlisted to two types. Have to talk to DIT before finalizing on the type to be implemented</td>
<td>10/25/16</td>
<td>11/11/16</td>
<td>11/26/16</td>
<td>Charles</td>
<td>Green</td>
</tr>
<tr>
<td>Labeling of machines for identification</td>
<td>Lathes to be labelled as L1 &amp; L2. Mills as M1 &amp; M2</td>
<td>11/10/16</td>
<td>11/17/16</td>
<td>11/15/16</td>
<td>Anjan</td>
<td>Green</td>
</tr>
</tbody>
</table>

GOAL:
1. To design and implement a manufacturing cell which incorporates Lathes and Mills to manufacture a part for a Speedster and an SUV using a 'PULL' based system synchronized to the 'Tiger Motors' assembly line that feeds the instrument panel in sequential order.
2. To specifically build & order according to the vehicle type using 'First in First Out' sequence based on Kanban.
3. To develop and display Process capacity chart, Standardized work combination table and Standardized work chart.
4. Abstract on how to get the lathe (L2) working to be conveyed.

NOTES:
- Feedback/comments on the project work to be provided along with steps to be taken to improve the process.
- Set of Ideas to improve the KANBAN system to be handed over.
- Process capacity chart, Standardized work combination table and Standardized work chart to be displayed as a learning instrument for future students.
- Abstract on how to get the lathe (L2) working to be conveyed.
This particular A3 is important to us
This part is supposed to function as a **HIGH INTENSITY LIGHT BEAM DEVICE**
On the roof of the car
This part is supposed to function as a **WINCH** for the SUV

A *winch* is a mechanical device that is used to pull in (wind up) or let out (wind out) or otherwise adjust the "tension" of a rope or wire rope (also called "cable" or "wire cable"). - Wikipedia
Tiger Motors
JT Black - Lean Engineering
Student of the Year

Nick Simmons
Lean Engineering Six Sigma Green Belt Auburn Certification

- INSY 5800/6800 Lean Mfg. Elective
- INSY 5330/6330 Six Sigma Elective

INSY 4800 Senior Design Required

B Average

Lean/Six Sigma - Engineering Green Belt Certification (230 awarded over the last five years)
Senior Design
Six Sigma DMAIC Structure

M

D

A

I

C

DEFINE

MEASURE

ANALYZE

IMPROVE

CONTROL
Expansion of the manufacturing Cell
  • Lathe, Grinder and Router added
  • New product designs and cell programming by Mechanical Engineering SD team

Augmented Reality Workstation

New SCARA Robot with vision inspection tied to PLC

Andon summary screens for real time throughput/Quality to target
We’ll hold questions until the end

Tom Devall
devall@auburn.edu
(334) 740-3905

https://www.youtube.com/watch?v=ttL1QzWc7gQ
As virtualization becomes a broader and longer reality, we have to get great at teaching virtually. Fraught with nuance and challenge, there are methods and tools to teach lean in this new normal that are effective.
Old vs. New Workshop Offerings – Impact of Covid-19

Three Old Foundational Offerings (Often Sequential)
1. Strategy Creation Sessions
2. Operating Plan Creation Sessions
3. Culture Bootcamps
4. Forms of Lean Training (Sticklebrick)

Three New Offerings
1. Virtual Strategy Creation Sessions
2. Virtual Operating Plan Sessions
3. Virtual “InBox” Lean Training
InBox – Overview 1

WHAT IS INBOX?

InBox is a Lean office simulation played in a classroom. It recreates an invisible workflow that is managed through email – similar to most transactional workplaces.

BENEFITS

- Low-cost training solution for initiatives of all sizes
- Designed to realistically replicate back-office processes
- Immersive experience that allows participants to apply Lean Six Sigma concepts to an office process problem
- Students can complete an entire project in less than a day
- Online simulation means no new hardware or software

InBox®, Lean office simulation, provides a live, participant-driven simulation that teaches how to apply Lean concepts to transactional processes.

With InBox, students of all levels can practice the tools of Lean and Six Sigma in a risk-free setting. This kind of practice builds capability. InBox is unique: it employs an email-based work process, providing first-hand experience with Lean Office concepts where the work flow is essentially invisible.

TOP FEATURES

- Easy online access
- Project employs an email-based work process relevant to the office
- Hands-on simulation illustrates Lean Office principles
- Can be played by 15-20 individuals at one time
- Facilitator support materials include scoreboards and other gadgets to help monitor cycle and process times

The SigmaSim Suite

MoreSteam’s SigmaSims are individual DMAIC and Lean online simulation games that provide the practice necessary to move students from competence to confidence.

A True Simulation for the Office Environment

Until now, Lean simulations have focused solely on manufacturing-type processes, such as assembling parts or shuffling papers. These games fail to resonate with employees who rely on communication technologies.

InBox is the first Lean Six Sigma simulation built around an electronic workflow – the type of work environment that actually exists in service businesses or in the support functions of a manufacturing enterprise.

A Focus on Lean Office Tools

By using an email-based platform, participants assume work roles in an invisible (and very confusing) process. With help from the facilitator, students learn and practice Value Stream Mapping, identifying Non-Value-Added Activities (Waste), Takt Time, WIP, and Bottlenecks in a service process where there is no tangible work product.

Catered to a competitive 2-4 team set (normally 2 teams of 15), to augment in-person learning and to show transactional Lean Sigma where the process is not a manufacturing line or visible (email-based)
InBox Overview 2

**Teach Tools and Methods in a Risk-free Environment**

Project experience is invaluable to Belts success. Build more practice opportunities in your training with InBox, where mistakes and questions are welcome! Completed in a few hours, the InBox simulated project requires using simple process mapping and data analysis to make improvements—just like in the real world.

**Learn Continuous Improvement over Multiple Simulation Runs**

Show participants the effect of Lean on the InBox process by using the cycle time scoreboard. From this view, facilitators can help identify bottlenecks, flow, and even capture cycle time. Students can see the impact of Lean on the process immediately.

**Students Work Alone, But Decide as a Team**

Using work instructions written specifically for their roles, participants “work” on tasks that arrive in their “InBox.” Several minutes of play make it clear that the InBox process needs the help of Lean thinkers. After a run of the process, students discuss and apply concepts such as value stream mapping, error-proofing, and standardized work—among many other Lean lessons.

Every production run automatically generates the “scorecard” and downloadable data for the participants to analyze in their Zoom breakout room.

There is a lean and quality element (i.e., speed of workflow and creation of defects).

Examples of improvements may be standard work, single piece flow, reduction of financial approvals, etc.
Case Study – Mettler Toledo – Teams + Mural

We will use a combination of Microsoft Teams and a Virtual Whiteboard, called “Mural”

- **Microsoft Teams**: This will be our primary workspace together, virtually, via videoconference. There will be 3 meetings setup in total, please find corresponding Teams Links in your Outlook Invitation and on Slide 15 or 16:
  - **Meeting 1** – Master plenary session, for all, to kickoff the session, debrief
  - **Meeting 2** – Break out session for Team Blue Only
  - **Meeting 3** – Break out session for Team Green Only

- **Mural Whiteboard**: This will be where we work together and create, individually as teams. Your team leads will have access to this whiteboard and can invite all or some of the team members to collaborate

*Please click on the MURAL Logo left and watch the short intro video to the tool*
Case Study – Mettler Toledo – Teams + Mural

• Both Green and Blue teams will be head-to-head to meet the 4 core business objectives. There can only be 1 overall winner, no ties, however there are multiple ways to win.
Case Study – Mettler Toledo – Teams + Mural

Based on your role allocation, please click and read your detailed role instruction below (PDF):

<table>
<thead>
<tr>
<th>Job Title</th>
<th>Pre-read</th>
<th>Green Team</th>
<th>Blue Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Research</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Site Research</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Site Selection</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Site Committee</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Feasibility</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Local Government</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Finance Proposal</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Finance Approver</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Landlord A</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Landlord B</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Landlord C</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Legal 1</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Legal 2</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Operations</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Reporting</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Example – Miro Digital Whiteboard

Digital Product Lifecycle Management Platform

Objectives: With your expertise, identify gaps within Product Lifecycle management analysis at an enterprise level. From business actual performance capability to a desired performance capability.

Agenda (2 Hrs):
1. Introduction and Opening Remarks
   a. One-Minute Digital Transformation
   b. Stephen’s Focused Trend Navigator
   (10 mins)
2. Industry Perspectives: Summary of Previous Workshops/Current State Systems
   a. Industry Summary
   b. Canadian Circulation
   c. R&D Products
   (20 mins)
3. Product Launch
   a. Custom Products
   b. R&D Products
   c. Warehousing
   (20 mins)
4. Closing Remarks
   a. Stephen’s Focused Trend Navigator
   b. Canadian Circulation
   c. R&D Products
   d. Warehousing
   (30 mins)
Thank You!

Contact me for More Info:

Jared Frederici

- https://www.linkedin.com/in/jaredfrederici/
- https://www.thepoiriergroup.com/
  https://www.moresteam.com/simulations/sigmabrew-inbox.cfm
Sticklebrick (ProdSim concept) Simulation

- First exposure in 2005 with BMGi at MDS
- 75 Trainings with it, my go to simulation because it is so robust
- A Physical Simulation AND very portable
- Relatively easy and inexpensive to create and use
- Does involve a little set-up and tear down time
- I delivered this as a Saturday, 9-4 Lab at OSU, the students hated having to do a Sat but at end of day said it was great, they loved it
- Robust in that the leader has the ability to teach so many principles and methods/tools associated with ISE and ILSS—e.g. we integrated Process Playground Simulation with it in the 2nd Improvement Cycle.

- Would be a good way for you to play around with what Tom has shared
BLOOM’S REVISED TAXONOMY

Creating
Generating new ideas, products, or ways of viewing things
Designing, constructing, planning, producing, inventing.

Evaluating
Justifying a decision or course of action
Checking, hypothesising, critiquing, experimenting, judging

Analysing
Breaking information into parts to explore understandings and relationships
Comparing, organising, deconstructing, interrogating, finding

Applying
Using information in another familiar situation
Implementing, carrying out, using, executing

Understanding
Explaining ideas or concepts
Interpreting, summarising, paraphrasing, classifying, explaining

Remembering
Recalling information
Recognising, listing, describing, retrieving, naming, finding
“Product” or “Service”--Deliverable

Operator 1

Operator 2

Operator 3

Operator 4
The Initial State is set up with lots of waste but also typical of current state in many non-lean operations.

Metaphorically, this lab is a scaled down version of what you will see in the real world. Lots of waste, poor flow, little/poor data, un-rationalized work flow, disorganization, lots of failure modes, etc.
# Hokies.com Key Roles

**Assoc Coach**—Matt Haight  
**Asst Coach**—Davis Williams

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations Manager</td>
<td>John Healy</td>
<td>Tori Aber</td>
</tr>
<tr>
<td>Material Handler 1</td>
<td>Spencer Sheehan</td>
<td>Kritagya Arora</td>
</tr>
<tr>
<td>Operator 1</td>
<td>Max Hubert</td>
<td>Keegan Lahm</td>
</tr>
<tr>
<td>Operator 3</td>
<td>Lily Andualem</td>
<td>Sara Neumeister</td>
</tr>
<tr>
<td>QC 1</td>
<td>Shawn Richards</td>
<td>Bilbal Alabbood</td>
</tr>
<tr>
<td>Stores Mgr</td>
<td>Jack Curran</td>
<td>Zepeng Shi</td>
</tr>
<tr>
<td>Transporter 1</td>
<td>Grace Luther</td>
<td>Kelley Meadenb</td>
</tr>
<tr>
<td>QC 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1—Kelly Meaden  
2—Tori Aber  
3—Kritagya Arora  
4—Zepeng Shi  
5—Bilbal Alabbood  
6—Spencer Sheehan  
7—Netsanet Andualem  
8—Shawn Richards  
9—Jack Curran  
10—Sara Neumeister  
11—Grace Luther  
12—John Healy  
13—Keegan Lahm  
14—Max Hubert
You can use whatever space you have by being innovative, we had imperfect classroom space, layout wise, for 2-3 teams of 16 each but made it work (Robustness)
Level 1 view of DMAIC
DMAIC Roadmap Drives Creation of Value
Need to develop agility and flexibility—right method for right situation
Resources you should utilize, take advantage of

- MoreSteam
- Lean Six Sigma Pocket Toolbook
- Learning to See
- Minitab® 19
Dm Stage

- Picking the right project
- Charter
- Project Plan (IMP)
- Stakeholder Identification, Analysis and Core Team development
- DONE and then Requirements for Success to get to DONE
Dm Stage

4: Define II – Voice of the Customer
1 Voice of The Customer
2 Focus on The Customer
3 Understanding Customer Requirements
4 Where to Go For Customer Requirements
5 Conducting Surveys
6 Survey Considerations
7 Surveys – Sampling Frame
8 Structuring Survey Questions
9 The Degree of Uncertainty in Sampling
10 Guideline for Margin of Error
11 Affinity Diagram Toolset
12 CTQC Tree Diagram Toolset
13 Operational Definition Toolset
14 Voice Of The Customer As Specifications
15 QFD Toolset
16 Exercises and Quiz

5: Define III – Mapping the Process
1 Drawing a Process Picture
2 Process Thinking
3 The Source of Value
4 Value Stream Leverage
5 Process Mapping – Overview
6 Process Mapping (SIPOC) Toolset
7 Process Flow Charts and Swim Lanes
8 Value-Added Flow Charts
9 Spaghetti Charts
10 Takt Time
11 Value Stream Mapping Toolset
12 Define Tollgate – Progress Review
13 Exercises and Quiz

• Current State:
  • VoC, VoB, VoE and VoP
  • Structuring VoC and Requirements for Success (QFD)
  • How does it Perform? (little M)
  • High level why?
  • How does it work?
• Size of Prize, v1.0 business case
• DEFINEmeasure Stage Gate Deck Meeting
Measurement is a huge component of Lab I

- Session 6 is refresh from you stat class
- Session 7 is crucial and we’ll practice in Lab I and II and is all about the quality and integrity of your measurement system and data
Key Area of Practice!!

- You are going to be practicing what I call the ‘trilogy’ (run chart, control charts, and process capability analysis) in your post-work assignment and during the lab.
We’ll practice ‘light’ RCA with more focus on ECR

You’re going to do 2 rounds of A to I transition

Round 1, left to your own devices

Round 2, you’ll have “ISE/GB’s” to guide/facilitate for you

<table>
<thead>
<tr>
<th>9: Analyze 1 – Identifying Potential Root Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>13</td>
</tr>
<tr>
<td>14</td>
</tr>
</tbody>
</table>
And you’ll have two rounds of Improve to manage.

<table>
<thead>
<tr>
<th>12: Improve</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Improve</td>
</tr>
<tr>
<td>2 Benchmarking</td>
</tr>
<tr>
<td>3 Brainstorming</td>
</tr>
<tr>
<td>4 Narrowing Down The List of Ideas</td>
</tr>
<tr>
<td>5 FMEA Toolset</td>
</tr>
<tr>
<td>6 Error-proofing</td>
</tr>
<tr>
<td>7 Prioritizing and Selecting a Solution</td>
</tr>
<tr>
<td>8 The A3 One-Page Report</td>
</tr>
<tr>
<td>9 Continuous Flow Toolset</td>
</tr>
<tr>
<td>10 Quick Changeover Toolset</td>
</tr>
<tr>
<td>11 Cellular Processing Toolset</td>
</tr>
<tr>
<td>12 Balancing Capacity with Demand</td>
</tr>
<tr>
<td>13 The Theory of Constraints (TOC) Toolset</td>
</tr>
<tr>
<td>14 Pull System Overview</td>
</tr>
<tr>
<td>15 Pull Scheduling</td>
</tr>
<tr>
<td>16 Pull Systems</td>
</tr>
<tr>
<td>17 Core Process Pull Toolset</td>
</tr>
<tr>
<td>18 Corrective Action Matrix</td>
</tr>
<tr>
<td>19 Piloting a Solution</td>
</tr>
<tr>
<td>20 Improve Tollgate – Progress Review</td>
</tr>
<tr>
<td>21 Exercises and Quiz</td>
</tr>
</tbody>
</table>
Control will be something you have to think about in Ic stage

<table>
<thead>
<tr>
<th>13: Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Control</td>
</tr>
<tr>
<td>2  Control Charts Revisited</td>
</tr>
<tr>
<td>3  The Process Control Plan</td>
</tr>
<tr>
<td>4  More On FMEA</td>
</tr>
<tr>
<td>5  Visual Control</td>
</tr>
<tr>
<td>6  5-S Approach</td>
</tr>
<tr>
<td>7  CHECK Process</td>
</tr>
<tr>
<td>8  Total Productive Maintenance</td>
</tr>
<tr>
<td>9  TPM Objectives &amp; Benefits</td>
</tr>
<tr>
<td>10 TPM Metrics</td>
</tr>
<tr>
<td>11 TPM Core Elements</td>
</tr>
<tr>
<td>12 TPM Maintenance Activities</td>
</tr>
<tr>
<td>13 Best Practices and Lessons Learned</td>
</tr>
<tr>
<td>14 Standardized Work – Documenting Process Changes</td>
</tr>
<tr>
<td>15 Ending the Project</td>
</tr>
<tr>
<td>16 Control Tollgate – Progress Review</td>
</tr>
<tr>
<td>17 Exercises and Quiz</td>
</tr>
<tr>
<td>18 Course Completion</td>
</tr>
<tr>
<td>19 The Lean Six Sigma Journey</td>
</tr>
</tbody>
</table>
100% On Time Deliveries and Defect Free (e.g. Service Level = 100%)

- On time = our ‘order’ for multiple and different mixes of types of deliverables is received within one minute of our request AND

- Defect Free = Zero defects (no deliverable unit in an order can be defective) Defective order = 1 or more defective deliverables in order!
Voice of the Business (supplier(s)) in the Simulation

**Super ordinate:** Survive and Thrive (grow our franchise value in a sustainable fashion).

I--Meet our Customers Requirement of 100% On Time Deliveries and Defect Free

- On time = Customer has received order within one minute of placement of the order. An order contains multiple deliverables of four different types of deliverables.
- Defect Free = Zero defects in the order. (e.g. if any one deliverable in the order is defective, then the order is rejected.)

II—Improve our Process Maturity and our Value Stream Capability

III—Improve our organization/team ability to continue to improve performance over time.
Simulation: Updated and Rough Sequence of Events

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tee-up the Course &amp; Simulation</td>
<td>:30</td>
</tr>
<tr>
<td>2. Time to get ready to run production cycle 1</td>
<td>:30</td>
</tr>
<tr>
<td>3. Run Production Cycle 1 (current state)</td>
<td>:11</td>
</tr>
<tr>
<td>4. Complete Scorecard and Debrief</td>
<td>:30</td>
</tr>
<tr>
<td>5. Improvement Cycle I--Study, Plan, Adjust I</td>
<td>:75</td>
</tr>
<tr>
<td>• Mai TG’s, get ‘adjustments’ approved</td>
<td>10:15</td>
</tr>
<tr>
<td>• Working Lunch in here at 11:30 time frame and Process Playground Overview</td>
<td>11:00</td>
</tr>
<tr>
<td>6. Run Production Cycle 2</td>
<td>:TBD</td>
</tr>
<tr>
<td>7. Update Scorecard and Debrief</td>
<td>:30</td>
</tr>
<tr>
<td>8. Study, Analyze/Develop, Adjust: Teach Tools and small group breakouts to apply tools followed by team plenary to integrate and Agree to SOLUTION (GB assistance)</td>
<td>:90</td>
</tr>
<tr>
<td>9. Run Production Cycle 3 and then update Scorecards</td>
<td>:TBD</td>
</tr>
<tr>
<td>10. Final Debrief, Takeaways, HW assignment, adjourn</td>
<td>:30</td>
</tr>
<tr>
<td>11. Ready kits for next year and put-away (asst coaches)</td>
<td>~16:00</td>
</tr>
</tbody>
</table>
The Steps in the DMAIC Process that you will experience in this Experiment

Define
- Opportunity Definition, Scoping
- Charter
- Problem and Objective Statement and Initial KPI’s
- Change Management Plan
- Definition Document Complete

Measure
- Develop Measurement Plan
- VS & Process Maps
- C&E Analysis
- Measurement System Analysis: Measurement to Data
- Initial Analysis to Determine Current State Process Capability
- Current Process Capability Defined

Toll Gate

Analyze
- Future State Value Stream Map
- Waste and Variation Analysis
- C&E Analysis for Waste and Variation
- Experimentation, Piloting, Simulation as appropriate
- Root Causes of Waste and Variation Known

Toll Gate

Improve
- Design Solution w/ elements
- Confirm SE’s are focused on X’s
- Develop Solution(s)
- Build Implementation Plan
- Execute the Plan

Toll Gate

Control
- Optimize & Refine Solutions
- Control X’s & Monitor Y’s
- Close & Routinize
- Realization Tracking for 12 mos.

The Final Toll Gate
Parallel, Emulating/Simulating your 70 or 140 day Capstone Experience

- 8/26/2013 Launch
- 8/26/2013 - 12/6/2013 70 day project to get through Ai
- 12/13/2013 - 1/3/2014 Break Period
- 1/6/2014 - 2/8/2014 30 day project to get through Ic
- 2/10/2014 - 4/18/2014 40 day project to get through C (could extend)

8/26/2013

Dm Ma/C Ai/D Ic/O C/V

Squeeze in working lunch

A (CVA) = 45/390
B = 165/300 (BVA)
C = some of A and BVA
D = some of A and BVA
Illustration of what I want you to stay conscious about

- **Principle** = Customer Driven

- **Concept/Construct** = Voice of Customer Operational Definition

- **Method** = Quality Function Deployment/House of Quality

- **Tools** = Affinity diagrams, interview/listening, modeling

- **Applications** = reduction to practice, what are you practicing with and why. Using tools, linking tools, using methods, linking methods to get to DONE
### Results Sheet Scorecard:

#### MDS SIM SCORECARD

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Cycle</th>
<th>Cost/Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overdue Orders</td>
<td>1</td>
<td>$150</td>
</tr>
<tr>
<td>Lead Time</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Value Added Time:</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Operator 1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Operator 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operator 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operator 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transporter (only record time to travel to Customer)</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>% Value Add (=VAT/LT)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Quality

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Cycle</th>
<th>Cost/Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Defects</td>
<td>1</td>
<td>$50</td>
</tr>
<tr>
<td>External Defects</td>
<td>2</td>
<td>$100</td>
</tr>
</tbody>
</table>

#### Costs

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Cycle</th>
<th>Cost/Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw Materials</td>
<td>1</td>
<td>$2</td>
</tr>
<tr>
<td>WIP</td>
<td>2</td>
<td>$10</td>
</tr>
<tr>
<td>Finished Goods</td>
<td>3</td>
<td>$20</td>
</tr>
<tr>
<td>Space</td>
<td>4</td>
<td>$200</td>
</tr>
<tr>
<td>People</td>
<td>5</td>
<td>$100</td>
</tr>
<tr>
<td># On Time &amp; Defect Free Widgets Received</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Revenue: $ Received by Customer for On Time and Defect Free Widgets</td>
<td>7</td>
<td>$35/ widget</td>
</tr>
<tr>
<td>Total Costs: Sum of costs</td>
<td>8</td>
<td>-</td>
</tr>
<tr>
<td>Avg Cost/Widget: Total Costs/# On Time &amp; Defect Free Widgets Received</td>
<td>9</td>
<td>-</td>
</tr>
<tr>
<td>Profit/ Loss</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Customer Service % =# Total # On Time and Defect Free Widgets (Received / Total # Widgets Ordered)</td>
<td>11</td>
<td>-</td>
</tr>
</tbody>
</table>
Kaizen Process (Methodology)

The *Kaizen* Event Process

- **About 4 Weeks Prior to Event:** Plan Event and Create Charter
- **Day 1-2:** Train (if needed) & Process Walk
- **Day 2-3:** Root Cause Analysis & Future State Plan
- **Day 3-5:** Improve Process
- **After Event:** Sustain Process, Report Out, & Follow-Up

Files:
- ..\TG Illustrations\SLT PRESENTATION PSC NEWMARKET KAIZEN3 - .ppt
- ..\TG Illustrations\BRL Flow Kaizen - Rpt to SLT.ppt
Deliverables due at end of Improvement Cycle 2 (practice with principles and tools)

- **LEAN:** version 2.0 of A Value Stream Map and Choke Point Analysis
  - all data boxes complete
  - choke point analysis, Takt time, CT’s, buffer/queue analysis
  - AI—what does the VSM/A suggest we have to adjust in the first improvement cycle?

- **LEAN:** version 2.0 Waste MAI
  - describe the types of waste, prioritize them based on data collected, support with tool application (an example might be spaghetti diagram or methods/motion analysis or layout analysis, etc.)
  - do quick Analyze and Improve, why does the waste exist and how can you mitigate it, minimize it

- **Version 2.0 Business Case Development**
  - what is full potential performance?
  - what is current state business performance?
  - AI—what is causing the business to under perform and what adjustments should be made in IC 1 to address those gaps/issues?

- **Version 2.0 SixSigma/Quality:**
  - complete an FMEA left side and right side
  - Fill in the data boxes for Yield Loss in VSM
  - Where are the defects being caught/noticed? Where are they being created?
  - do AI on the defects and make appropriate adjustments
Lean Sigma Basics

Adhoc
As required, not defined, and success depends on individual effort & knowledge.
Highly variable, difficult to repeat.

Practice
Discipline is in place to repeat the process with some degree of success

Defined
Process is documented, standardized, and integrated.

Managed
Detailed measures (time, quality, etc.) are collected and are used to quantitatively understand and control the process.

Optimized
Continuous and proactive process improvement through quantitative feedback from the process, and from piloting innovative ideas and technologies

Process Maturity Levels: Improvement Cycle 1 more ad hoc, improvement cycle 2 more into level 4 relative to DMAIC
This ‘model’ is from a webinar you will be viewing next week and gives us more detail on types of buffers to be managed.
Roles and Responsibilities:

*Cycle Times and Lead Time Monitoring:* Determine and maintain cycle times and lead times for process (entire value stream) and report out for scorecard summary at end of production cycle. To include operators, transporters, material handlers, and QC.

*Quality:* Work with QC to ensure proper data capture and then reporting at end of production cycle to evaluate quality performance. Yield Loss, Defects.

*Cost:* Measure, track component and subassembly and final deliverables ‘in system’ at end of production cycle for scorecard report out on costs to include labor and other costs. This would include the IE’s measuring and inefficiencies and looking for ways to reduce costs.

*Waste:* Identify types of waste, document, get data.

**Rules:** They cannot do any other work.
In most organizations, in capstone as well as the ones you migrate to there will be IT Departments. At MDS we had Byte Belts on every project to help with the bottom half.

Data are most often not stored in a common place, and are often not trusted and not readily available available.

**Foundational data role**
- Select and gather data from many sources, preferably through automated extract, transfer, & load (ET&L) process
- Assure data are cleaned & ready for analysts to use – data quality monitors
- Assure data are integrated & can be joined with other data – think LEGOs
- Assure data storage is high reliability & user-friendly – SSAS cubes, databases

**“Above the line” analyst role**
- Extract features from data through statistical analyses
- Apply business acumen to data & analyses – create new knowledge
- Apply data visualization techniques to aid in telling the right story – as in life, so in business: the best story wins …

Adapted from S. Cunningham; Intel Corporation; 2013
Initial VSM and Measurement Plan--initial
Daily Production and Adjustment Process (DPAP): Improve the data capture/entry & enhance the DPR
Customer and Member Satisfaction and Feedback Survey

Teaching Lean

You can download the deck (handouts)
You will receive an e-mail tomorrow with link to recording.
You can go to this IISE link soon and get deck and recording.
IISE’s Annual Conference

Membership Has Privileges—Consider joining IISE?

https://www.iise.org/Details/?id=560
Disruptive Innovation in Distribution: From Weeks to Days to Hours
Rodolfo Portillo, Rafjiv Saxena, Bob Pudlo, Russ Meller
9 Dec 1-2 pm

Quarter 1 Webinar Program/Lineup is rapidly solidifying:

• Industry Benchmarking: Best ISE Practices in Small and Medium Sized Businesses
• Industry Benchmarking: Operational Excellence Best Practices
Thank You!

An e-mail tomorrow from Go2Webinar will provide a link to the recording and you can also access the presentation and recording on the IISE website.


Contact us for More Info or to provide feedback:

For IISE Webinar Sponsorship opportunities Trent Sexton:
  • tsexton@iise.org

For IISE Webinar Ideas, Suggestions, Feedback, Requests, Scott Sink:
  • https://www.linkedin.com/in/dscottsink/
  • ssink@jumpcurves.com