Designing and Deploying Lean Healthcare Curriculum

Earll M. Murman
Jackie Candido
LAI Knowledge Exchange Event
April 21, 2011
Meet the Speakers

Earll Murman
MIT Ford Professor of Engineering Emeritus
Director of the LAI Educational Network
PhD in Aerospace Engineering
Interests: Lean Six Sigma; STEM education, healthcare, systems & aerospace engineering

Jackie Candido
Associate Director of the LAI Educational Network for Educational Initiatives
PhD in Educational Leadership and Learning Technology
Interests: Curriculum design; distance learning; instructional technology for vision impaired learners.

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Session Objectives

At the end of this session, you will be able to:

• Identify the Lean Advancement Initiative, its Educational Network and the LAI Lean Academy courses
• Use or adapt the VALUE PIL methodology for self assessment of student proficiency
• Describe the importance of aligning course content with learning objectives
• Report on one instance of lean healthcare curriculum development and deployment
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Audience Geographic Profile

Select the letter that represents your geographic location and enter it in the poll

A. United States or Canada
B. Mexico or Central or South America
C. Europe
D. Africa
E. Asia
F. Australia or New Zealand
In the poll on the right, check one or more of the following choices that represent your professional occupation:

A. Healthcare professional (MD, RN, ….)
B. Healthcare administrator
C. Process improvement professional
D. Faculty member
E. Student
F. Other
Audience Curriculum Interests

In the poll on the right, check all the choices that represent your curriculum interest

A. Awareness training – a few hours to a day
B. Readiness training – 3 to 5 days
C. Expert training – 6 mo. or more with project
D. Curriculum in degree granting program
E. Certificate program
F. Other
Agenda

• Background – 15 min
  • Audience profile
  • LAI, EdNet, LAI Lean Academy
  • Questions and discussion

• Lean Healthcare curriculum – 40 min
  • Beginnings
  • VALUE PIL assessment tool
  • Voice of Customer survey
  • Learning objectives
  • Course offerings & experiences
  • Questions and Discussion

• Wrap up – 5 min
About LAI

The Lean Advancement Initiative (LAI) at MIT, together with its international Educational Network (EdNet), offers organizational members from industry, government, and academia the newest thinking, products, and tools related to lean enterprise transformation. LAI is a unique research consortium that provides a forum for sharing research findings, lessons learned, and best practices.

LAI offers:

- unique opportunities to engage with customers, suppliers, and partners to solve problems and share organizational transformation experiences
- a portfolio of thought-provoking knowledge exchange events and meetings
- innovative enterprise transformation products, tools, and methodologies

LAI researches, develops, and promotes practices, tools, and knowledge that enable and accelerate enterprise transformation. LAI accelerates lean deployment through identified best practices, shared communication, common goals, and strategic and implementation tools honed from collaborative experience. LAI also promotes cooperation at all levels and facets of an enterprise to eliminate traditional barriers to improving industry and government teamwork.
LAI Educational Network

Integrating lean into education

Research results and practitioner knowledge

Curriculum Materials
Major EdNet Activities

Co-host Annual Lean Educator Conference

Keynote speakers, contributed presentations, workshops, plant tours

Collaborative Curriculum Development

Creating shareable curriculum and deploying in multiple venues

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LAI Lean Academy® Course

Three day short course for Lean Enterprise fundamentals

Over 88,000 video views
Lean Six Sigma Concepts Covered in LAI Lean Academy Course

- Processes
- Value
- Value stream
- 7 types of waste
- 5 S
- Flow
- Cycle time
- Takt time
- Balanced work
- Single piece flow
- Standard work
- Kitting
- Pull System
- Kanban
- Visual control
- Mistake proofing
- Three elements of collaboration
- Andon
- VSM
- Lean supply chains
- IPTs
- A3 charts
- SPC
- Six Sigma
- DFSS
- Process quality
- Kaizen
- Product quality
- Enterprises
- Stakeholders
- Internal customers
- External customers
- Process maps
- Leadership and management
- Price vs cost
- DFMA
- IPPD
- Hybrid supply chain
- Key characteristics
- DPMO
- 5 whys
- DMAIC
- Cp vs. Cpk
- Histograms
- Scatter Diagram
- Pareto chart
- PICK charts
- Product lifecycle
- Value added time
- And more…..
Outcomes

What we Learned

- Audience proficiency reaches READY to CAPABLE after 3 day curriculum
- Curriculum fits multiple audiences
- 50/50 mix of active learning and lecture is effective
- Collaborative development and delivery worked well
- Over 30 instructors
- Adopted in toto or in fragments at about 15 schools

A Core Curriculum for Multiple Deployments
Questions and Discussion on Background Topics
• Spring 08 – Early thinking about 3 day healthcare course modeled on LAI Lean Academy

• August 09 – Conceptualized course during summer workshop at Purdue
  • Target Audience: Multifunctional Healthcare Teams

• Fall 09 – Instructor team formed & benchmarking

• Winter 09 – Conducted Voice of Customer survey, set course learning objectives, designed content

• Spring 09 – Developed curriculum

• June 09 – First offering: VA VISN1
  • 38 participants spanning MD, RN, Process Improvement, Administration
Multifunctional Instructor Team

Earll Murman, PhD  
Prof. Emeritus  
MIT Engineering

Deanna Willis, MD, MBA  
Assistant Prof.  
Indiana University School of Medicine

Barrett Thomas, PhD  
Assistant Prof.  
Univ. of Iowa College of Business

Whitney Walters, MSE  
Lean Coach  
Univ. of Michigan Health System

Steve Shade, MS  
Mg. Dir., Center for Advanced Manufact.  
School of Medicine

Team

Hugh McManus, PhD  
Sr. Project Eng.  
Metis Design

Annalisa Weigel, PhD  
Assistant Prof.  
MIT Engineering

Jackie Candido, PhD  
Assoc EdNet Director for Educational Initiatives

Simulation Team

Coordinator & Educational Specialist

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VALUE PIL Assessment Tool

LAI Lean Academy Self-Assessment Scale

0  Unaware  To have no exposure to or knowledge of...
1  Aware  To have experienced or been exposed to...
2  Ready  To be able to participate in and contribute to...
3  Capable  To be able to understand and explain...
4  Skilled  To be skilled in the practice or implementation of...
5  Expert  To be able to lead or innovate...

...Lean Healthcare Knowledge Areas

1  Context for Lean Healthcare
2  Healthcare enterprises
3  Lean Six Sigma fundamentals
4  Process and value stream fundamentals
5  Fundamental principles of Lean Thinking
6  Lean six sigma methods
7  Lean six sigma tools
8  Lean six sigma applications in healthcare
9  People and organizations in healthcare
10  Implementing lean in healthcare

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VALUE PIL Assessment Worksheet

- Structured tool for the audience to self assess their lean proficiency
- Administered before and after the course
- Also used to design the course
# Lean Concepts, Terms and Tools Introduced in LAI Lean Healthcare Academy

- 5 Whys
- 6S
- 8 wastes
- A3 thinking and tool
- Andon
- Balanced scorecard
- Balanced work
- $C_p$, $C_{pk}$
- Capacity, throughput, queuing, bottleneck
- Cause and effect diagrams
- Check lists/sheets
- Current state
- Customers (external & internal)
- Cycle time
- DMAIC
- Enterprise stakeholders
- Enterprises
- Flow
- Future state
- Gemba (Genba)
- Genchi Genbutsu
- Integrated teams
- Kanban
- Kitting
- Lean is a journey
- Lean is a way of thinking
- Little’s law
- Mistake proofing
- Muda, muri, mura
- Non value-added time
- Pareto charts
- PICK charts
- Plan-do-study-act (PDSA)
- Policy deployment
- Process maps
- Processing time
- Pull
- Relational coordination
- RPIW
- Single piece flow
- Spaghetti diagrams
- Stakeholder value
- Standard work
- Takt time
- Three actuals
- Time value charts
- UCL, LCL
- USL, LSL
- Value added, non-value added, waste
- Value streams
- Value stream mapping and analysis (VSMA)
- Variation impact
- Visual control
- Voice of the customer
- Wait time
- ….. and more
Audience Proficiency Poll

LEVEL 2 PROFICIENCY - READY:
To be able to participate in and contribute to...

RUBRICS
• Do I know enough about these topics that I can comprehend what other people mean?
• Can I participate in give-and-take dialog on these topics?
• Have I ever participated in an event when this topic was used?
• Did I contribute to the discussion or action surrounding this topic?

Count the number of items on the previous slide for which you can answer YES to one of the above rubrics.
Examples of Class Progression

MIT Students
Jan 2011
Voice of Customer Survey

• Instructor team scoped potential course content into 10 Knowledge Areas comprising 99 possible topics

• Subject matter experts asked for their desired level of proficiency in these areas and topics for a graduate of a three day introductory course
  • Used LAI Lean Academy Proficiency Scale: UNAWARE ... EXPERT

• Electronic survey distributed via networking

• 48 completed responses received
Proficiency of Respondents

Two major subgroups – Pros and Newbies

- **Proficient-in-Learn (36)**
  - Avg = 3.40
- **New-to-Learn (12)**
  - Avg = 0.74

**EXPERT** 5

**SKILLED** 4

**CAPABLE** 3

**READY** 2

**AWARE** 1

**UNAWARE** 0
Respondent’s Domain Expertise

- Med Staff (MD, RN) dominated by Newbies
- Three comparably sized groups of Pros

New-to-Lean vs. Proficient-in-Lean
Desired Knowledge Area Proficiencies
(Averaged over respondents, but significant variation)

- Pros desire greater proficiency than Newbies
- Pros emphasize Fundamentals over Methods, Tools, and Applications
- Newbies and Pros desire proficiency in People & Organizations
VOC on Specific Topics

Pro's Desired Proficiency of 99 Topics

No demarcation between most & least important topics
Cannot cover all topics in 3 day course

VOC survey was helpful guide for course developers
Learning Objectives (LOs)

- LOs developed for entire course and each module
- LOs should match desired level of proficiency
- Bloom’s Taxonomy used as a guide
- LOs evolve iteratively with course & module content

### Bloom’s Taxonomy of Educational Objectives

<table>
<thead>
<tr>
<th>Description</th>
<th>Sample verbs to use when writing learning objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>identify, record, list, repeat</td>
</tr>
<tr>
<td>Comprehension</td>
<td>discuss, summarize, tell, express, reproduce</td>
</tr>
<tr>
<td>Application</td>
<td>demonstrate, apply, schedule, illustrate</td>
</tr>
<tr>
<td>Analysis</td>
<td>authenticate, decipher, distinguish, analyze, describe, differentiate, approach, calculate, experiment, solve, compare, contrast, criticize, critique, classify, categorize, organize, create, manage, assemble, plan, prepare, formulate, arrange, judge, evaluate, rate, compare, assess, choose</td>
</tr>
</tbody>
</table>

Learning Objectives Example

At the end of this module, you should be able to:

• Recognize PDSA and A3 Thinking as effective process improvement approaches
• Use a Continuous Process Improvement Framework for structured problem solving
• Apply VSM and basic lean tools to improve flow
• Utilize root cause analysis methods
• Describe the value of an A3 chart

Class Poll – How many of these LOs are targeted at Bloom’s Application level of learning?
Curriculum Design Principles

• Match content coverage and exercises with LOs and Bloom’s levels of learning, e.g.
  - Knowledge – Single slide could be adequate
  - Comprehension – More slides & simple active learning exercise
  - Application – Directed 20 to 30 min active learning exercise
  - Analysis – Opened ended extensive exercise

• Revisit topic multiple times to achieve higher levels of learning, e.g. Value Stream Mapping
  - Day 1 – Directed introductory active learning exercise
  - Day 2 – Opened ended application to Lego simulation
  - Day 3 – Accounts Payable case study with homework

• Use actual exhibits for illustrations

• Make it fun!
Overview

Day 1
Clinical Context
- Lean Fundamentals & Healthcare Context
- Seeing Process
- Guest Speaker
- Defining Value and Finding Waste
- Finding Bottlenecks & Enabling Flow
- Respect for People
- A3 Thinking & Exercise

Day 2
Patient VS Context
- Value: Patient Satisfaction & More
- VSMA Fundamentals and Application
- Variability and Six Sigma Basics
- Safety Tools & Topics
- Effective Communication
- A3 Thinking & Exercise

Day 3
Med Center Context
- Planning, Prioritizing, Justifying & Achieving the Future State
- A3 Exercise Wrap Up
- High Performance Healthcare
- Lean Healthcare Implementation
- Enterprise Guest Speaker

Course Cutting Integration Elements
Patient Flow Simulation Spanning Clinic to Med Center Context
Developing an A3 Plan for Student Contributed Improvement Target

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Day 1 – Clinical Context

“The exercise and the ability to modify the parameters was very instructive”
Day 2 – Patient Value Stream

Context

“Exercises seemed to be valuable – good active participation.”

Patients ready for admission

“Getting to the point of ‘drinking from a fire hose’ - info coming fast and furious.”
Day 3 – Med Center Context

“I was very surprised that the sim worked out as well as it did.”

“Good examples of lean healthcare implementation.”
Before and After VALUE PIL

Average Student Proficiency Gain

Participants went from READY to CAPABLE
VALUE PIL Distributions

Before VALUE PIL (Avg = 1.8)

After VALUE PIL (Avg = 3.2)

Individual VALUE PIL proficiencies sorted from highest to lowest. Everyone improved!
Other 2009-2010 Deployments

- Offered through MIT’s summer CE program
- Enrollment insufficient to support full sim
- Combined with traditional LAI Lean Academy

We learned a combined class was feasible
Needed to be re-architected for synergistic fit
Course Revision

Version 2 of course has been developed & tested

- Less emphasis on people & organization topics
- Less emphasis on safety tools
- More emphasis on A3 Thinking and Tool
- More emphasis on Six Sigma Basics
- Designed to fit together with LAI Lean Academy for greater deployment flexibility
  - Meet together 50% of time – mostly fundamentals
  - Meet separately 50% for Lego simulation, six sigma basics implementation, people & organization
  - Includes plant tour

Tested on MIT students in January 2011

- Revisions worked well
**Day 1**

**Fundamentals**
- The Start of Your Lean Journey, 6S
- Lean Thinking: Process, 5 Lean Fundamentals, Waste and Value, Value Stream Mapping, 5 Whys, Mistake Proofing, Genchi Genbutsu, ...
- Plant tour

**Day 2**

**Lego Clinic Simulation**
- Application of Day 1 fundamentals, plus
  - Structured PDSA problem solving framework involving A3 thinking and root cause analysis
  - RPIW
  - DMS

**Day 3**

**Advanced Topics**
- Accounts payable case study
- Variation & Six Sigma basics
- High Performance Healthcare
- Implementation
- Enterprise Speaker

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**CEUs:** 2.1 Continuing Education Units  
**CMEs:** 19 AMA PRA Category 1 Credits™
Upcoming Offerings

MIT’s Professional Education Program

- July 19 – 21 Open enrollment
- Update of version tested in January

1 day introductory course - NEW

- June 9 to VA Fellows
- Clinic simulation and lean fundamentals

http://web.mit.edu/professional/short-programs/
Select: Courses by Topic
Select: Lean Enterprise
Questions and Discussion
Summertime Enterprise Thinking

June 9-10, 2011
Epoch-Based Thinking: Anticipating System and Enterprise Strategies for Dynamic Futures
Donna Rhodes, Ph.D.  Adam Ross, Ph.D.

June 13-14, 2011
Architecting the Future Enterprise
Prof. Debbie Nightingale  Donna Rhodes, Ph.D.

June 20-21, 2011
Principles of Enterprise Transformation
Prof. Debbie Nightingale  Jayakanth Srinivasan, Ph.D.

June 6-8, 2011
Value-Driven Tradespace Exploration for System Design Future Enterprise
Donna Rhodes, Ph.D.  Adam Ross, Ph.D.

June 20-21, 2011
Principles of Enterprise Transformation
Prof. Debbie Nightingale  Jayakanth Srinivasan, Ph.D.

July 18-20 or July 18-22, 2011
LAI Lean Academies: Enterprise, Healthcare, and Product Development
Enterprise Track  July 18-20
Healthcare Track  July 18-20
PD Track  July 21-22

Eric Dickson, M.D.  Hugh McManus, Ph.D.  Prof. Earll Murman
Eric Rebentisch, Ph.D.  Julie Vannerson, M.D.  Prof. Annalisa Weigel
Audience Feedback

Overall, this session
A. Exceeded
B. Met
C. Fell short of my expectations

Submit your answer to the online poll lean.mit.edu/ednet
Thank you!

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