Lean Enablers for Managing Engineering Programs

PMI Professional Development Day Nov 1, 2014
Used with permission from Dr. Josef Oehman & Dr. Eric Rebentisch, presented by Deb Secor
Deb Secor Bio

"NOTE: This presentation does not contain Rockwell Collins developed information and does not necessarily represent or reflect the views of Rockwell Collins."

- Deb Secor is a principal project manager and Lean Master in the Engineering & Technology organization at Rockwell Collins. Deb provides enterprise Lean Electronics(SM) mentoring, training and implementation for Rockwell Collins; an initiative recognized throughout the aerospace industry. She is the Engineering & Technology lead for the Rockwell Collins Lean Advisory Council. Deb developed a new approach to program planning for Rockwell Collins, Lean Enabled Accelerated Planning (LEAP). She has been the principal project manager for many enterprise transformations, including the Design & Development Cycle Time Reduction initiative. Deb works with program teams throughout the life-cycle, from pursuit through service and support.

- Deb also serves as a Co-Chair of the INCOSE Lean Systems Engineering Working Group, recognized for Best Product Award in 2009 and the Shingo Prize for Research and Publications in 2011 & 2013. Deb has presented Lean Product Development and Knowledge Management Strategies papers at various PMI, MIT, INCOSE, AME and AIAA conferences. Areas of specialization include Lean continuous improvement, Lean Product Development, Lean Systems Engineering, Enterprise Value Stream Mapping, Business Integration and Process Improvement, Knowledge Management, Lean Project Management, and Change Management. Deb studied Business Administration at Mount Mercy University.

- Rockwell Collins is a pioneer in the design, production and support of innovative solutions for our customers in aerospace and defense. Our expertise in flight-deck avionics, cabin electronics, mission communications, information management and simulation and training is strengthened by our global service and support network spanning 27 countries. Working together, our global team of nearly 20,000 employees shares a vision to create the most trusted source of communication and aviation electronics solutions.
Lean? Wait a minute…

Carol, schedule a staff meeting.

What’s the topic?

I plan to fuse Six Sigma with Lean methods to eliminate the gap between our strategy and our objectives.

I’ll just say “waste of time.”

Source: dilbert.com
OVERVIEW OF THE LEAN ENABLERS STUDY
Project Management Institute (PMI)

- World’s leading not-for-profit membership association for the project management profession
- More than 600,000 members and credential holders in more than 185 countries.
- “Products”:
  - globally-recognized standards,
  - credentials, and
  - professional development opportunities
- Standards
  - Guide to the Project Management Body of Knowledge
  - Standard for Program Management
  - Standard for Portfolio Management
  - Organizational Project Management Maturity Model (OPM3)
  - Various practice standards, frameworks and standards extensions
The LAI/CEPE Operating Model

Consortium Members
- Executive Board
- Champions
- Membership fee

Sponsored Research Programs
- Focused research
- By members and non-members

- LAI Faculty and Researchers
- LAI Students
- LAI Research Project Portfolio
- LAI Educational Network
UPDATE
MIT’s Consortium for Engineering Program Excellence

New Partners

Focus on Lean Management of Engineering Programs
International Council on Systems Engineering (INCOSE)

- Not-for-profit membership organization
- 8000+ members

- Develop and disseminate the interdisciplinary principles and practices that enable the realization of successful systems
- Share, promote and advance the best of systems engineering from across the globe for the benefit of humanity and the planet.

- Systems Engineering Handbook v. 3.2.2, consistent with ISO/IEC 15288:2008

- January: International Workshops
- July: International Symposia
- www.incose.org
From 0 to …

180+ current members representing 50+ organizations
Engaging in the PMI-MIT-INCOSE Partnership

Key actions:

• Aligned Program Management and Lean/SE viewpoints with global practice and the “to be” publication

• Correlated and linked “Lean Thinking”, SE challenges and lean enablers to program management performance domains rather than (project or program management) life cycle processes

• Focused on lean program management, not project management
Motivation/Case for Change - Management of Large-Scale Engineering Programs: The US Department of Defense Example

- Total cost growth: $296 billion
- Average schedule overrun: 22 months
- Similar situation in other industries

Sources: GAO 06-368, Bloomberg, GAO 10-374T
Study Design: Innovation by Bridging Knowledge Domains

Lean Management + Systems Engineering + Program Management = Unique, Relevant and Actionable Advice

Unique
- Three world-class organizations and thought leaders joined forces
- Industry, government and academia participation

Relevant
- Massive challenges in program execution: Cost and schedule overruns
- Integration of knowledge and professional domains
- Extensively validated

Actionable
- Concrete advice
- Mapped to known challenges and existing standards
- Guidance for implementation

2 Core Results:
- 160 Program Management Challenges in 10 Themes
- 300 Lean Enablers (= Management Best Practices) in 40 areas
Lean in Program Management
Community of Practice – Who we are

- January 2011 – March 2012
- Conduct a study within 1 year, that
  - Identifies the key challenges in managing engineering programs and
  - Identifies and documents best practices to overcome these challenges
- Ensure highest possible degree of applicability and practicality by
  - Focusing on needs of program managers from industry and government,
  - Develop the results through a group of subject matter experts and
  - Validate the results extensively.
Core Team Members

- Josef Oehmen, Bohdan “Bo” W. Oppenheim, Deborah Secor, Eric Norman, Eric Rebentisch, Joseph A. Sopko, Marc Steuber, Rick Dove, Kambiz Moghaddam, Steve McNeal, Mark Bowie, Mohamed Ben-Daya, Wolf Altman and John Driessnack

- Examples of some of the credentials
  - Eric Norman: Norman & Norman Consulting; Chair of PMI Standard for Program Management – Third Edition
  - Josef Oehmen: Research Scientist, MIT’s Lean Advancement Initiative
  - Bo Oppenheim: Professor, Loyola Marymount University
  - Eric Rebentisch: Research Scientist, MIT’s Lean Advancement Initiative
  - Joe Sopko: Senior Consultant, Siemens Corporate Research
  - Stephen Townsend: Director, Global Alliances & Networks, PMI
Development Process

- Based on **concrete challenges**, not thin air
- Incorporates **start-of-the-art knowledge** from literature
- Developed by group of 15 **subject matter experts** through year-long, weekly meetings
- Feedback through wider **community of practice** (100+ members)
- Discussed at **4 large and very successful workshops**, involving both PMI and INCOSE members
- Backed-up by **two validation surveys**
- Validated by **content analysis** management practices of highly successful programs
Goal: Supporting Existing Standards in Program Management and Systems Engineering

How Standards Proliferate:
(See: A/C chargers, character encodings, instant messaging, etc.)

SITUATION:
There are 14 competing standards.

14?! Ridiculous!
We need to develop one universal standard that covers everyone’s use cases.

\{\text{Yeah!}\}

SITUATION:
There are 15 competing standards.

Source: Randall Munroe, www.xkcd.com
## Prioritization and consolidation of 160+ challenges into 10 major themes

<table>
<thead>
<tr>
<th>#</th>
<th>Theme</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reactive Program Execution</td>
<td>Program is executed in a reactive mode towards outside influences, instead of proactively managing and coordinating stakeholders, risks and issues.</td>
</tr>
<tr>
<td>2</td>
<td>Lack of stability, clarity and completeness of requirements</td>
<td>Changing, unclear and incomplete requirements from customers and other stakeholders seriously affect the efficient and effective execution of the program.</td>
</tr>
<tr>
<td>3</td>
<td>Insufficient alignment and coordination of the extended enterprise</td>
<td>The complex network of organizations and departments involved in delivering the program value is not aligned in their priorities. This includes the alignment and optimization of strategic priorities and portfolios.</td>
</tr>
<tr>
<td>4</td>
<td>Value stream not optimized throughout the entire enterprise</td>
<td>The value stream is only locally optimized. There is a lack of visibility of the value stream, and / or barriers between organizational units to implement a seamless flow. There are insufficient trade-offs between organizations to reach overall optimum.</td>
</tr>
<tr>
<td>5</td>
<td>Unclear roles, responsibilities and accountability</td>
<td>The roles, responsibilities and accountability of individuals, teams, project, staff organization and organizations are not clearly defined.</td>
</tr>
<tr>
<td>6</td>
<td>Mismanagement of team competency and knowledge</td>
<td>The expertise and knowledge of individuals, teams and the organization is insufficient, not transferred sufficiently, or not applied appropriately during the program.</td>
</tr>
<tr>
<td>7</td>
<td>Insufficient Program Planning</td>
<td>The program planning is inaccurate and / or unable to accommodate uncertainties, leading to unrealistic expectations and base plans.</td>
</tr>
<tr>
<td>8</td>
<td>Improper Metrics, Metric Systems and KPIs</td>
<td>The metrics and KPIs used during the program do not capture the intended performance attribute, incentivize the wrong behavior, or are lagging instead of predictive.</td>
</tr>
<tr>
<td>9</td>
<td>Lack of Active Program Risk Management</td>
<td>Budgetary and time constraints force limited or no risk management activity to be undertaken by the program team. The program team attempts to function without clear off-ramps and mitigation approaches. Ownership of risks is ill-defined.</td>
</tr>
<tr>
<td>10</td>
<td>Poor Program Acquisition and Contracting Practices</td>
<td>Time constraints force inadequate quality of the Request for Proposal (RFP) or contract bid. Improper incentives, improper management of low-TRL-technologies, insufficient leadership and interference of laws and regulations all exacerbate this challenge.</td>
</tr>
</tbody>
</table>
Improvement opportunity: Better integrate Systems Engineering and Program Management through Lean Thinking

- Based on 15-month research project
- Identified 10 core engineering program challenges
- Describes 43 best practices in 6 areas
- Download e-book & sign up for mailing list at www.lean-program-management.org
LEAN MANAGEMENT AND BENEFITS REALIZATION IN PROGRAMS
**What is a Program?**

- “… a temporary, flexible organization created to coordinate, direct and oversee the implementation of a set of related projects and activities in order to deliver outcomes and benefits related to the organization's strategic objectives.”
  - UK Cabinet Office *Managing Successful Programmes (MSP)* – 2011

- “A group of related projects, subprograms, and program activities that are managed in a coordinated way to obtain benefits not available from managing them individually.”
  - PMI *Lexicon of Project Management Terms* – 2012
Programs versus Projects

- Programs deliver benefits (business case: cost vs. benefits)
  - Clear vision, but not the path to get there
  - Scope is business need or market driven (benefit focused)
  - Program phase outcomes often determine the path
  - Business change management is a critical competency
  - Some project business cases are only viable at the program level (i.e. enablers, not profit centers)
  - Programs continue as long as they deliver benefits (e.g. product life-cycle, business improvement programs)
Application of Lean Enablers in “Best Practice Programs” –
The more detailed the reports, the more Enablers we found

- Deepwater (GAO-06-546): 74%
- 2011 Prairie Waters: 65%
- 2010 Dallas Cowboys Stadium: 60%
- 2009 Flour Power Plant: 37%
- 2009 BAA Heathrow: 19%
- 2008 QIT - Fer et Titane: 23%
- 2007 Nuclear Cleanup: 35%
- 2006 Rocky Flats Plant: 26%
- 2005 Quartier International de: 26%
- 2004 Haradh Gas Plant: 37%
- 2003 Winter Olympics: 42%
- 2002 Hawiyah Gas Plant: 42%
- 2001 River of Aluminum: 35%
- 2000 The Troja Reactor: 35%

Based on application documents & GAO report

Based on brief reports
Top-down success stories in the Guide to Lean Enablers

19 successful programs analyzed for the Lean Enablers used

- Prairie Waters
- Dallas Cowboys Stadium
- Fluor – Newmont TS Power Plant
- BAA Heathrow Airport Terminal 1 Overhaul
- Hatch Ltd. – QIT Fer et Titane
- Fernald Feeds Materials Production Center Nuclear Cleanup
- Rocky Flats Plant
- Quartier International de Montreal
- Coast Guard Deepwater
- Haradh Gas Plant
- Salt Lake City, Utah Winter Olympics
- Hawiyah Gas Plant
- 4 large governmental IT acquisition programs
- Mozel Smelter
- Trojan Reactor Vessel
- Siemens Industry, Industry Automation
- Toyota
- Ford

We want to have more!
Survey. Lean Enabler for Managing Engineering Programs by Lean Principles

Use of Lean Enablers in Successful and Unsuccessful Programs:
Level of Agreement of Respondents

- LE 1.x: Respect
- LE 2.x: Value
- LE 3.x: Value Stream
- LE 4.x: Flow
- LE 5.x: Pull
- LE 6.x: Perfection

Disagree that Lean Enablers was used
Neither agree, nor disagree that Lean Enablers were used
Agree that Lean Enablers were used

average N: 63 programs per category; all differences are statistically significant
Some high-profile examples of large-scale engineering programs

- **Tunnel:** Boston Big Dig – 300% ($18 billion total overrun)
- **Energy:** Hydro in India – 50% - 150% (€2 billion total overrun)
- **Energy:** Nuclear in Finland – 70% (€2.7 billion total overrun)
- **Engineering:** F-35 Program – 75% ($175 million / plane)
- **Energy:** Offshore Wind Germany – €500 million for grid connection (20% so far of €2.5 billion contract, 40% of Siemens share I believe)

Awards

- **INCOSE 2009 Best Product Award** for Lean Enablers for Systems Engineering
  Deb Secor, Bo Oppenheim and Earll Murman receive the award for Best Product 2009 from Pat Hale, INCOSE President
  
  Citation: Awarded to the Lean Systems Engineering Working Group (LSE WG) for developing the new body of knowledge called Lean Systems Engineering, and a major enabling product called Lean Enablers for Systems Engineering [LEfSE], created to strengthen the practice of Systems Engineering with the wisdom of Lean Thinking. Special recognition to Bo Oppenheim, Earll Murman, and Deb Secor for leadership and coordination of the WG work with international cooperation.

- **2011 Shingo Research Prize** “for Best Research and Publication” for the Lean Enablers for Systems Engineering

- **INCOSE 2011 Working Group Award** for collaboration through the Joint PMI-INCOSE-MIT Community of Practice on Lean in Program Management to develop the Lean Enablers for Managing Engineering Programs

- **INCOSE 2012 Working Group Award** for our collaboration with PMI and the joint publication of the “Guide to Lean Enablers for Managing Engineering Programs”

AND
The guide provides the findings of the Joint MIT-PMI-INCOSE Lean in Program Management Community of Practice that are based on a 1-year project executed during 2011 and 2012. The community was made up of selected subject matter experts from industry, government, and academia. The findings reported in this guide are based on known best practices from the literature, program experience of the subject matter experts, and input from an extensive community of professionals.

The findings of the Joint Community of Practice were extensively validated through community and practitioner feedback, multiple workshops at INCOSE and PMI conferences, LAI-hosted web-based meetings, and surveys of the extended professional community. The survey results clearly show that programs that use the Lean Enablers show a significantly stronger performance in all dimensions—from cost, to schedule and quality, as well as stakeholder satisfaction.

The core of this document contains (1) the 10 themes for major engineering program management challenges, and (2) the 43 Lean Enablers with 286 subenablers to overcome these challenges, better integrate program management and systems engineering, and lead engineering programs to excellence.
## Success Story of Lean Engineering Accelerated Planning (LEAP) at Rockwell Collins – a front-loading approach mapped to the Lean Enablers

<table>
<thead>
<tr>
<th>Degree of addressed subenablers</th>
<th>LE</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>75%</td>
<td>1.6.</td>
<td>Encourage personal networks and interactions</td>
</tr>
<tr>
<td>73%</td>
<td>3.5.</td>
<td>Front-load and integrate the program</td>
</tr>
<tr>
<td>50%</td>
<td>3.1.</td>
<td>Map the management and engineering value streams and eliminate non-value added elements</td>
</tr>
<tr>
<td>50%</td>
<td>3.11.</td>
<td>Develop a Communications Plan</td>
</tr>
<tr>
<td>50%</td>
<td>4.6.</td>
<td>Integrate all Program Elements and Functions through Program Governance</td>
</tr>
<tr>
<td>45%</td>
<td>2.3.</td>
<td>Frequently engage the stakeholders throughout the program lifecycle</td>
</tr>
<tr>
<td>43%</td>
<td>3.9.</td>
<td>Develop an Integrated Program Schedule at the level of detail for which you have dependable information</td>
</tr>
<tr>
<td>40%</td>
<td>2.1.</td>
<td>Establish the value and benefit of the program to the stakeholders</td>
</tr>
<tr>
<td>33%</td>
<td>4.7.</td>
<td>Use efficient and effective communication and coordination with program team</td>
</tr>
<tr>
<td>30%</td>
<td>6.6.</td>
<td>Proactively manage uncertainty and risk to maximize program benefit</td>
</tr>
</tbody>
</table>
## Summary

<table>
<thead>
<tr>
<th>What we are working on</th>
<th>How you can engage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prioritization of Lean Enablers</td>
<td>Free Online Workshop</td>
</tr>
<tr>
<td></td>
<td>Survey on Implementation Effort</td>
</tr>
<tr>
<td>Development of Implementation Workshops</td>
<td>Description of games &amp; simulations you use</td>
</tr>
<tr>
<td>Documentation of Success Stories</td>
<td>Share your story with us in an interview</td>
</tr>
<tr>
<td>Using Lean Enablers to Frontload Programs</td>
<td>Provide input on your successes, as well as barriers to, frontloading</td>
</tr>
<tr>
<td>Encyclopedia of Lean Enablers &amp; Website</td>
<td>Check it out at <a href="http://cepe.mit.edu">http://cepe.mit.edu</a></td>
</tr>
<tr>
<td></td>
<td>Help us improve the Encyclopedia</td>
</tr>
</tbody>
</table>
Next steps (ADKAR Prosci® Model)

- **A**wareness of this guide
- **D**esire to improve program execution
- **K**nowledge of how and when to apply specific enabler(s)
- **A**bility to implement the desired change
- **R**einforcement and continuous improvement – continue to work the challenges and enact the enablers

Questions?
Back-up and Reference Materials
Our new website: http://cepe.mit.edu

The Consortium for Engineering Program Excellence website

• New homepage offers
  – News
  – Information about CEPE
  – Lean Program Management
  – Resources for Practitioners
    • Key documents & Resources (Guide, Link to Encyclopedia, etc.)
    • Presentations & Reports
    • Tools & Methods
    • Case Studies & Publications
E-Book
http://dspace.mit.edu/handle/1721.1/70495

Wiki http://www.lean-program-management.org/encyclopedia/
Recent Key Achievements

IN THE JUNE ISSUE, AVAILABLE TO MEMBERS:

Lean Into Savings
In a world of big-budget programs, applying lean principles can yield huge bottom-line results.

Strength in Numbers
The age range on project teams has never been broader. Follow these tips to get the most from a multi-generational team.
The Encyclopedia for Lean Enablers

43 Lean Enablers for Managing Engineering Programs

• For every Lean Enabler you will find:
  – A detailed description
  – Corresponding Sub enablers
  – Implementation suggestions
  – Concrete examples and success stories
  – Metrics to measure:
    • Degree of implementation
    • Effect
  – Additional reading
How we worked

The Encyclopedia embodies knowledge from MIT, industry experts and literature research

- Expertise in Lean Product Development
- Body of Knowledge:
  - Workshop material
  - Tools & methods
  - Executive trainings

- MIT knowledge
- Literature Research
- Industry Experts

- Program Management
- Systems Engineering (B. W. Oppenheim)
- Lean Product Development

- Program Managers
- SMEs (Co-Authors)
- Conferences (collection of Success stories)
Stay tuned for more about the integration of PM and SE...

- On-going joint effort by MIT, PMI and INCOSE

- Results presented at INCOSE IS (June) and PMI Global Congress (October) 2013

- Download the white paper documenting the survey analysis at http://cepe.mit.edu/survey-results-pm-se/

- Follow-up interviews underway to understand factors for successful integration of PM and SE

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Next: Part 2-4

2 Prioritization and Customization

3 Implementation Workshops

4 Success Stories and Detailed Description of Lean Enablers
Prioritization and Customization
There is no „one size fits all“

Situation
• Even the most successful programs do not use all 43 Lean Enablers
• No company can implement all 43 Lean Enablers at the same time
• So, which ones are the most relevant for your program and organization?
Prioritization and Customization Tool

Future State: What it will do

User Input
- Likelihood of Occurrence of Challenges
- Impact in case of Occurrence of Challenges
- Current Degree of Lean Enabler Implementation
- Information about Company / Organization and its Program

Risk Profile

Matching to Lean Enablers

Prioritization

Overall Prioritization

Implementation Effort
Prioritization and Customization Tool
Current State: What it does

Assessment of Strengths and Weaknesses - Likelihood
Assessment of Strengths and Weaknesses - Impact
Assessment of Lean Enabler Maturity

Matching of Challenges to Lean Enablers
Relevance of Lean Enabler
Relevance of LE
Current Degree of Implementation

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Prioritization and Customization Tool

Current State: What it does II
Building an Implementation Workshop Development Framework

The Framework will connect the Lean Enablers with workshop elements to facilitate the workshop development.

**Problem**
- 43 Lean Enablers need to be implemented
- Many different topics and hierarchy levels are being addressed
- No standardized way for creating implementation workshops

**Solution**

**Framework**
- Defines
- Provides
- Matches

**Output**

- Fine-Tuning Workshop Plan
- Recruiting and Preparing Workshop Faculty
- Determining Locale and Workshop Budget
- Deciding on Marketing Strategies
- Finalizing Administrative Details
- Conducting the Workshop

**Done by Organization**
The assessment will identify, what elements need to be implemented on what hierarchy level.

1. Prioritization Tool for Lean Enablers
2. Lean Enablers are mapped to their Impact Areas
3. Assessment of Hierarchy level by experience
Presentation of Framework

Defines
- Workshop goals and objectives are predefined
- Topics of the workshops are suggested according to hierarchy

Provides
- Agenda
  - 8h Session 1
  - 8h Session 2
  - 4h Session 3
- Slide Deck
- Theoretical Content
- Evaluation survey

Matches
- Hierarchy level with techniques
- Lean Enablers with Simulations and Games

Goal: Implementation of identified, high potential Lean Enablers

<table>
<thead>
<tr>
<th>Facilitator</th>
<th>Cultural</th>
<th>Leadership</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Leadership</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Middle</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

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The Framework will connect the Lean Enablers with workshop elements to facilitate the workshop development

**Input**
- Hierarchy level
- Impact Areas
- Lean Enablers
- Available Time

**Output**
- Blueprint of workshop structure
- Workshop techniques
- Demo tools
- Content for theoretical part on LE

**Defines**
- Workshop goals and objectives
- Topics of the workshops

**Provides**
- Structure for Agenda
- Content for theoretical part on LE
- Evaluation survey

**Matches**
- Hierarchy level with workshop techniques
- Lean Enablers with Demo Tools
Next Steps

1. Populating the framework with further content
2. Documentation of approach and results
3. Presentation of framework at the PMI World Conference 2013
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