Overview of the LAI Whitepaper Series on Lean Product Development

Oehmen, Josef

Publication date: 2011

Citation (APA):
Lean Enterprise Product Development: 15 years of Innovation at LAI
- Overview of the Whitepaper Series -

LAI Web Knowledge Exchange Event

Dr. Josef Oehmen
Dr. Eric Rebentisch
March 31, 2011

We Share A Common Goal: Enterprise Excellence
Upcoming Knowledge Exchange Events

April 21, 2011
Designing and Deploying Lean Healthcare Curriculum
Prof. Earll Murman and Jackie Candido, Ph.D.

April 14, 2011
Enhancing Cost Realism Through Risk-Driven Contracting
Maj. Sean Dorey

May 17, 2011
Beta Release of LESAT 2.0
LESAT Team

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

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

July 18-20 or July 18-22, 2011
LAI Lean Academies: Enterprise, Healthcare, and Product Development
Prof. Earll Murman

Summertime Enterprise Thinking

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

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

July 18-20 or July 18-22, 2011
LAI Lean Academies: Enterprise, Healthcare, and Product Development
Prof. Earll Murman
Overview

• Introduction to past Lean Enterprise Product Development work at LAI
• Overview of all planned whitepapers
• Current whitepapers:
  – Risk Management
  – Waste in Lean Enterprise Product Development
  – Lean Program Management (beta)
• Next whitepapers:
  – Product Development Self Assessment Tool
  – Lean Product Development Practices

Brief look at my CV

• Education and Research
  – M.Sc.Eng. from Technical University of Munich
  – Master thesis at LAI on Risk Management in PD
  – MBA at Collège des Ingénieurs in Paris
  – PhD at ETH Zurich (Swiss Federal Institute of Technology)
  – Research in the areas of Supply Chain Risk Management
• Today
  – Research Scientist with LAI and KFUPM cooperation project
  – Risk management along the engineering value chain
  – Lean program management
• Work experience
  – Assistant of the CTO of a Swiss company, projects in technology and innovation management (2005/2006)
  – Consultant in different areas of risk management for many years
  – Scientific advisor to risk management consultancy
  – Member of the supervisory board for a technology and project development company in the field of sustainable technologies for developing countries
Introduction to the past 15 years

RESEARCH ON LEAN PD AT LAI

Lean PD Research at LAI

• Overview of 15 years of research in lean product development
• Goal:
  – Tie together different pieces of research from different points in time
  – Present the “bigger picture” of the relationships within PD and LAIs research
  – Develop a series of reports for LAI members that present an integrated view on the main topics of Lean PD
  – (Develop publications and / or a book from these reports)
How do you eat an elephant?

Slice by slice!

Pre-selection: >500 → 175 papers

Overview: Empirical basis vs. Fit to field

Base sample: 102 papers

Extended sample: +73 papers
How easy / hard is it to fit 15 years of research into a common framework?

- Should be easy. It is all related to Lean product development, is it not?
- Might be hard. They covered a lot of ground.
- I now know that for all practical purposes, it is impossible!

Possible Structure – Alternative 27

Dr. Josef Oehmen - oehmen@mit.edu

Framework for PD Research

<table>
<thead>
<tr>
<th>Type of process</th>
<th>Processes for Value-orientation</th>
<th>Processes for Enterprise Integration</th>
<th>Processes for efficient execution</th>
</tr>
</thead>
</table>
Whitepapers we will discuss today

1. Risk Management in Lean PD
2. Waste in Lean Product Development
3. Lean Program Management (beta)
4. Lean PD Performance Measurement and Self Assessment
5. Lean Product Development Practices
RISK MANAGEMENT IN LEAN PD

Risk Management: A very old topic

“Prudent princes [should] regard not only present troubles, but also future ones, for which they must prepare with every energy, because, when foreseen, it is easy to remedy them.”

- Niccolò Machiavelli
  The Prince (1513)
Risk Management – Why?

![Diagram showing the relationship between total cost, risk, and risk mitigation intensity.]

The new ISO 31000 Process

- Example of “external” risk management process in PD
- A variety processes exist:
  - DoD
  - INCOSE
  - NASA
  - PMI
  - PRINCE2
  - ...
LAI’s past research

- Risk management processes and methods
- Management of uncertainty in PD
- Application of real options theory
- Portfolio-level PD risk management

The Four Principles of Risk-Driven Design:
Integrating “Risk Thinking” into Development Processes to Create Resilience

**Principle 1**
Creating Transparency Regarding Design Risks
- Explore and identify knowable uncertainties
- Quantify resulting risks

**Principle 2**
Making Risk-Driven Decisions
- Resource allocation to retire biggest risks first
- Objective setting associated with risk assessment
- Entrepreneurial decision making based on risk-return analyses

**Principle 3**
Minimizing Uncertainty in Design
- Reduction of external uncertainty
- Reduction of internal uncertainty

**Principle 4**
Creating Resilience in the Design System
- Create agile design system: swiftness, cost efficiency, flexibility and versatility
- Create critical buffers in the design system
WASTE IN LEAN PRODUCT DEVELOPMENT

Why is Lean Product Development Important?

Time share of different types of activities in PD

- Waste (Activity idle) 62%
- Activity Executed 38%
- Waste 15%
- Necessary waste 11%
- Value added 12%

Source: McManus, 2005, Oppenheim, 2004
8 Types of Waste in Lean PD

1. Over production of information
2. Over processing of information
3. Miscommunication of information
4. Stockpiling of information
5. Generating defective information
6. Correcting information
7. Waiting of people
8. Unnecessary movement of people

Relationship of Waste Types
The Vicious Circle of Information in Inventory

- Information in Inventory
- Information rot (11%/month)
- Rework required (54% of initial work for "rotten" items)
- PD process is destabilized and out of sync
- Unplanned rework, firefighting re-allocates resources to solve problem
- Tasks are interrupted, more information is stored (and defect rate increased, increasing rework)

The Impact of Information in Inventory on “Rot” and “Rework”

- About 0.54% of information in inventory is affected by “information rot”: Obsolescence through changing requirements, rework of related components etc.
- Of the affected information, the average rework ratio is 53%, meaning that about half of the `rotten` information must be reworked

Source: Kato 2005
Example: Time wasted by different types of PD waste

Wasted engineering hours per 50 engineering weeks (average of three projects)

Source: Kato 2005

Example: Rework and Information Inventory

Average time wasted on 'correcting information' (engineering hours/period)

Average Information Inventory Time (engineering days) by Root Cause

Source: Kato 2005
LEAN PROGRAM MANAGEMENT (BETA)

Dr. Josef Oehmen - oehmen@mit.edu

LAI’s Take on Program Management (under construction)

Stakeholder Needs  Technology  Competitors

Program Management

Program Organization and Enterprise Management

Scoping, Planning & Contracting  Technology Integration  Product Design

Production, Use, Service, Decommissioning

Processes  Organization  Skills  Manpower  Budget  Regulations

Operational System
Detail: Program Organization & Enterprise Management

Program Organization and Enterprise Management

- Integrating and leading the program organization
- Stakeholder management
- Progress monitoring and management (EVM)
- Risk management
- Project management
- Multi-project coordination
- Developing Intellectual Capital
- Building the Program Enterprise
- Understanding the Enterprise
- Optimizing the Program Enterprise
- Learning to Learn in the Enterprise
- Improving the Enterprise

Scoping, Planning & Contracting -> Technology Integration -> Product Design

Produced, Use, Service, Decommissioning

Detail: Planning to Design

Program Organization and Enterprise Management

- Needs & requirements definition
- Specification definition
- Trade-offs
- Cost estimation & Life Cycle Costing
- Incentive alignment, contract negotiation & conclusion
- Technology scouting and selection
- Technology maturation monitoring
- Coordination of Technology Development
- Technology transition management
- PD team organization
- Monitoring Systems Engineering
- Leading Indicators
- Integrated Product and Process Development
- Product architecting
- Value stream optimization
- Testing & prototyping

Scoping, Planning & Contracting -> Technology Integration -> Product Design

Produced, Use, Service, Decommissioning
Lean Program Management Community of Practice
Project Activities and Time Line

1. Start up phase
   - Build consortium membership (industry, government, professional organizations, academia)
   - Manage, support, and fund the program management community
   - Example and review preliminary lists (literature-based) on lean enablers and pitfalls (alpha review)

   Phase 0: Mar 2011

2. Collect program management challenges (beta)
   - Create group of “experts” to collect program management challenges
   - Collect examples of program management enablers and pitfalls
   - Plan review & revision through group feedback

   Phase 1: Apr - Jun 2011

3. Describe & validate program management challenges (gamma)
   - Prepare online survey to complete and describe program management pitfalls
   - Test & revise online survey with CoP members
   - Disseminate survey through CoP members to their organizations
   - Consolidate results and approve through CoP members

   Phase 2: Jul – Sept 2011 INCOSE Symposium

4. Collect lean program management enablers (beta)
   - Create group of “experts” to collect lean program management enablers
   - Complete collection of preliminary lean program management enablers
   - Plan review & revision through group feedback

5. Collect lean program management enablers (gamma)
   - Create group of “experts” to collect lean program management enablers
   - Complete collection of preliminary lean program management enablers
   - Plan review & revision through group feedback

6. Map lean program management enablers to challenges (delta)
   - Create group of “experts” to collect lean program management enablers
   - Complete collection of preliminary lean program management enablers
   - Plan review & revision through group feedback

7. Collect illustrating examples
   - Obtain and collect illustrative examples (public knowledge high profile cases or generic examples)
   - Consolidate results, review and approve through CoP members

8. Codify knowledge and write report
   - Summarize results on CoP findings
   - Review of report through CoP members


Lean Program Management Enablers Strongly Support Carter Initiative

- Program Management Challenges (100+)
- Corresponding Lean Program Management Enablers (100+)
- Actionable Program Management Improvements

Affordability
- Increase affordability by using program management best practices in the areas of:
  - Program execution
  - Enterprise management
  - Planning & Contracting
  - Technology Integration
  - Development & Systems Engineering

Tradecraft
- Improve acquisition tradecraft by improving training for program managers
  - Close collaboration with Defense Acquisition University
  - Translation of results into improved or new course material

Value
- Utilize power of Lean Management to eliminate waste regarding:
  - Low-value statutory processes
  - Internal reports
  - Overhead imposed on industry
Current Members: 40

PRODUCT DEVELOPMENT SELF-ASSESSMENT TOOL

Forthcoming Whitepaper
The $1 Million (or Billion) Question:

What are the 3 most important things I need to do right to succeed in Product Development?

The Bad News
The Main Differentiators between Top and Bottom Performers

1. High level of upfront project preparation
   – Scoping of project
   – Staffing of project
   – Handling of “Fuzzy Front End”

2. Focus on project team
   – Emphasize on Project Organization over Line Organization
   – Strong project leadership

3. Keep eyes on the ball
   – Exploration of customer needs at each step of the project
   – Close customer integration, constant feedback loops

Where does that leave us?

• There is no silver bullet, but:
• Collection of LAI PD Best Practices
• Have to be part of enterprise transformation process
• Specific recommendations for PD Change Management and how to integrate
LAI PD Self-Assessment Tool

Goal: Developing a self-assessment tool that covers not only "best PD practices" but also „best practices“ for achieving sustainable organizational change.

Part 1:
PD Self-Assessment Process

- What is the role of PD self-assessment in organizational change?
- How to implement the PD Self-Assessment Tool as part of existing company-wide business improvement processes?
- Based on a summary of the literature on organizational change relevant to this topic

Part 2:
PD Self-Assessment Questionnaire

PD best practices
- Based on previous tools (PERFORM, Lean factors, LESAT etc.)
- Based on the literature at LAI/MIT
- Based on the literature on PD practices

Change management best practices
- Based on existing literature on OC
- Based on the experience of industry partners

PD Self-Assessment Execution Process

1. Define purpose (WHY) and goals (WHAT) of self-assessment
2. Define organizational integration of SA-tool (WHERE)
3. Define roles and responsibility of self assessment (WHO)
4. Create and customize self-assessment tool (HOW)
5. Pretest and improve the self-assessment instrument
6. Prepare the self-assessment implementation
7. Execute Self-Assessment
8. Identify and communicate opportunities for improvement
9. Take Action

10. Integration into company-wide change management processes
11. Alignment with overall business goals
12. Select facilitator
13. Change questions (add, delete, rephrase)
14. Determine which group has to answer which questions
15. Create a sense of urgency
16. Motivate people
17. Introductory statement - inform employees about purpose of self-assessment
PD Self-Assessment Questionnaire

**PD Competencies** (44 metrics)
are defined as the firm’s proficiency to combine different resources in order to successfully create value by developing products and services.

**PD Dynamic Capabilities** (24 metrics)
are defined as the firm’s ability to match and even create organizational change, i.e. the capabilities to build, extend, integrate or reconfigure core PD competences to address rapidly changing environments.

**PD Project Results** (24 metrics)
results of the projects from multiple dimensions

---

**PD Competencies (44 metrics)**

**Internally oriented**
- Product Definition and Planning Competence
- Product Concept and Design Competence
- Product Validation Competence
- Product Delivery Competence
- Schedule Management Competence
- Financial Management Competence
- Portfolio Management Competence
- Risk Management Competence
- Project Execution Competence
- PD Staff Competence
- Data Management Competence
- Technology Competence

**Externally oriented**
- Marketing Competence
- External Requirements Integration Competence
- Supplier Management and Integration Competence
- Customer Focus Competence
### Dynamic Capabilities and Results

**PD Dynamic Capabilities (24 metrics)**
- Communication and diffusion channels
- Vision, strategy & plans
- Corporate culture
- People for change
- Helping, training & education
- Human resources for product development
- Openness to improvements
- Learning

**PD Project Results (24 metrics)**
- Project Financial and Market Results
- Project Customer Satisfaction and Loyalty Results
- Organizational Effectiveness Results
- Product Results
- Project Benchmarking

---

**Forthcoming Whitepaper**

**LEAN PD PRACTICES**
Overview: Lean PD Practices

1. Workload leveling
2. Strong project manager
3. Specialist career path
4. Responsibility-based planning and control
5. Cross-project knowledge transfer
6. Simultaneous engineering
7. Supplier integration
8. Product variety management
9. Rapid prototyping, simulation and testing
10. Process standardization
11. Set-based engineering

Source: Hoppmann 2009

Average Implementation of Lean PD Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Not used</th>
<th>Used in about half of the projects</th>
<th>Used in every project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Standardization</td>
<td></td>
<td></td>
<td>3.62</td>
</tr>
<tr>
<td>Simultaneous Engineering</td>
<td></td>
<td></td>
<td>3.36</td>
</tr>
<tr>
<td>Strong Project Manager</td>
<td></td>
<td></td>
<td>3.34</td>
</tr>
<tr>
<td>Workload Leveling</td>
<td></td>
<td></td>
<td>3.33</td>
</tr>
<tr>
<td>Specialist Career Path</td>
<td></td>
<td></td>
<td>3.31</td>
</tr>
<tr>
<td>Product Variety Management</td>
<td></td>
<td></td>
<td>3.20</td>
</tr>
<tr>
<td>Supplier Integration</td>
<td></td>
<td></td>
<td>3.12</td>
</tr>
<tr>
<td>Rapid Prototyping, Testing and Simulation</td>
<td></td>
<td></td>
<td>3.05</td>
</tr>
<tr>
<td>Responsibility-based Planning and Control</td>
<td></td>
<td></td>
<td>3.02</td>
</tr>
<tr>
<td>Set-based Engineering</td>
<td></td>
<td></td>
<td>2.71</td>
</tr>
<tr>
<td>Cross-project Knowledge Transfer</td>
<td></td>
<td></td>
<td>2.46</td>
</tr>
</tbody>
</table>

n = 113
### Benefit vs. Ease of Implementation

1. Simultaneous Engineering
2. Process Standardization
3. Product Variety Management
4. Workload Leveling
5. Cross-project Knowledge Transfer
6. Supplier Integration
7. Strong Project Manager
8. Rapid Prototyping, Testing and Simulation
9. Set-based Engineering
10. Specialist Career Path
11. Responsibility-based Planning and Control

Source: Hoppmann 2009

---

### Lean PD Implementation Stages

<table>
<thead>
<tr>
<th>Planning Organization</th>
<th>Integrated Organization</th>
<th>Responsible Organization</th>
<th>Learning Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Standardization</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Workload Leveling</td>
<td>14</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Specialist Career Path</td>
<td>20</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>Strong Project Manager</td>
<td>11</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>Responsibility-based Planning and Control</td>
<td>35</td>
<td>34</td>
<td>33,36</td>
</tr>
<tr>
<td>Simultaneous Engineering</td>
<td>6</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Rapid Prototyping, Simulation and Testing</td>
<td>30</td>
<td>29</td>
<td>31</td>
</tr>
<tr>
<td>Supplier Integration</td>
<td>28</td>
<td>25</td>
<td>27</td>
</tr>
<tr>
<td>Product Variety Management</td>
<td>21</td>
<td>22,24,23</td>
<td></td>
</tr>
<tr>
<td>Set-based Engineering</td>
<td>39</td>
<td>37</td>
<td>40</td>
</tr>
<tr>
<td>Cross-project Knowledge Transfer</td>
<td>41</td>
<td>42</td>
<td>43</td>
</tr>
</tbody>
</table>

Source: Hoppmann 2009
Summary

- 15 years of research
- 100+ core publications
- Expected total number of whitepapers: About 10
- Published today:
  - Risk management
  - Waste
  - Program Management (beta)
- In pipeline
  - PD Self Assessment / Performance measurement
  - Lean PD practices

Your feedback: Next whitepapers?

**Candidate whitepaper**

- Stakeholder needs generation
- Trade space exploration & decision making
- Product architecture & commonality management
- IT systems in PD
- HR development & intellectual capital
- Teams in PD
- Core PD process principles

**Status**

- Risk management
- Waste
- Program management

- PD self assessment / performance measurement
- Lean PD practices
Thank you very much!