Lean Aerospace Initiative
Plenary Workshop
Identifying the Product Development Value Stream

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MIT
Research Sponsored By LAI
Objective

- Apply the concepts of value and value stream, familiar in the production world, to product development
  - Use to focus LAI research in Product Development (PD) Focus Team
  - Provide framework to member companies for value stream analyses of their PD processes
Potential Benefits

- Concepts and tools for improved PD
- Existing generic PD process mappings do not show value of each step to a particular project - Value stream analysis an obvious tool here
- Can also be used to radically challenge/change processes
- Product Development has very high leverage on overall product value
  - Value in leaner (especially more timely) PD
  - Also high payoff for better PD effort
  - not necessarily looking for less effort
**The PD Value Stream**

- **Manufacturing**
  - Material flows
  - Physical transformation
  - Raw material -> finished product

- **Product development**
  - What flows?
  - What transformations are performed?
  - What are the “raw” and “finished” states for a product definition?
Focus Team initiative at Spring 98 Plenary meeting
MIT working group meetings - white paper
Workshop in LA (hosted by Northrop-Grumman)
Continuing working groups
~9 faculty and staff, ~11 students, ~40 industry, ~10 government

Important problem

Unique cooperative effort

Ideal application of the LAI concept
LA Workshop Issues

- **Boundaries and Interfaces**
  - Where does PD start/stop?
  - What are the inputs? The outputs? The value?

- **Value and Value Stream**
  - What is “value” in the context of PD?
  - What are the value stream(s)?

- **Information flow as an analogy to Material flow**
  - Does this idea work?
  - What are its consequences?
  - Can the approach in *Lean Thinking* be applied to PD using this analogy?
**Boundaries and Interfaces**

- **PD is embedded in the overall enterprise**
  - Before mapping PD Value Stream, must specify range of activities to be considered
- **Boundaries and interfaces must be very carefully specified - they will dictate:**
  - Definitions of value and value added
  - Risks to be addressed
  - Upstream and downstream considerations
- **Product - Generic PD process map**
  - Example high level map at end of charts in packet
  - Full map available at http://lean.mit.edu
  - or shortcut and avoid frames by jumping directly to http://lean.mit.edu/private/focus/prod_dev/prod_dev.html
● Value at end of PD is not realized yet
  – Must pass to manufacturing, sustainment, upgrades, before being realized by end user
● Tacit value is created (value to the enterprise)
  – human capital, expertise, synergies
● Very high leverage on overall product value
  – Less PD effort ≠ more value
● Exact definition depends on boundaries, interfaces, intents
● Product - Case study research ideas
“A revealing method [to determine the activities in the value stream] is to...put yourself in the position of a design as it progresses from concept to launch, an order as information flows from initial request to delivered product, and the physical product as it progresses from raw material to the customer, and describe what will happen to you along the way” - Womack and Jones, Lean Thinking

- Manufacturing -> Material
- Product Development -> Information
Candidate model

- Hypothesis: *Information plays the same role in the product development value stream that material plays in the manufacturing value stream*
- Product development activities transform information
- Information in many forms converges to define a design just as many parts come together to make a product
- Products: Information classification, the seven info-wastes, ideas for eliminating waste
Seven Wastes

- Over-production
- Inventory
- Transportation
- Unnecessary Movement
- Waiting
- Defective Products
- Processing

_Do they apply to information_?
The Seven Info-Wastes

1 Over-production
   - Easier and cheaper to do with info, but still waste...
   - Creation of unnecessary data and information
   - Information over-dissemination
   - Pushing, not pulling, data

2 Inventory
   - Lack of control
   - Too much in information
   - Complicated retrieval
   - Outdated information, obsolete information
Seven Info-Wastes (continued)

3 Transportation
   - Information incompatibility
   - Software incompatibility
   - Communications failure
   - Security issues

4 Unnecessary Movement
   - Lack of direct access
   - Reformatting

5 Waiting
   - Late delivery of information
   - Delivery too early (leads to required rework)
6 Defective Products
   - Haste
   - Lack of reviews, tests, verifications
   - Requirement is for information or knowledge and data is delivered

7 Processing
   - Unnecessary serial production
   - Excessive/custom formatting
   - Too many iterations
Ideas for Eliminating Info-Waste

- Standardize!
- Use "best-in-class", non-proprietary tools and applications
- Single master source for data and information, change controlled
- Interchangeable information modules
- Assure timely delivery and availability
- Provide efficient interfaces, including human<->machine
Conclusions

- Major progress in limited time
  - Community formed
  - Products disseminated (web site)
- Initial concept clearly has merit
  - Useful way of thinking about PD process
  - Information analogy allows some direct applications
- Current products are collected wisdom
- Next step - formulating a research agenda
- The future - a consistent framework for research, tools for industry
Supplemental: Accessing Products

- On our web site
  - MIT white paper
  - Detailed PD process map
  - Working group reports and presentations
- Most are downloadable MS PowerPoint or Word files
- Updated often
- Access
  - Click down to the PD focus site from: http://lean.mit.edu
  - Or (avoids frames), go direct to:
    http://lean.mit.edu/private/focus/prod_dev/prod_dev.html
  - You will need a password; see your LAI point-of-contact
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Supplemental: A Candidate PD Process

Product Development Process

Co. Bus. Position
Constraints Strategies
System Def’n
Preliminary Design
Design To (Design Risk)
Build To (Manufacturing Risk)
Qual Design (Performance Risk)
Hardware
Supported Operational Systems

Support Standards
Production Standards
Design Standards
Program Attributes

Production
Support

Co. Value
Customer Value

Customer Perceived Risk

Support Standards
Co. Value

Barriers
• Training
• Measurements
• Culture

Customer Requirements (Operational Risk)

Systems Requirements

Design To

Build To

Qual Design

FAIT

Detail Design

Preliminary Design

System Def’n

Constraints Strategies

Co. Bus. Position

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### Supplementary: Types of Information

<table>
<thead>
<tr>
<th>Products of Product Development Process</th>
<th>Product Info (CAD, PDM, MRP)</th>
<th>Process Info (Shop Floor Layout, ERP)</th>
<th>Project Info (Accounting, Project Mgmt)</th>
<th>Business Info (ROI Analysis)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer Requirements</strong> – Cost, performance, schedule, supportability, technology information</td>
<td>X</td>
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<tr>
<td><strong>Concept Definition</strong> – simulation models, trade studies, analysis data, system architecture</td>
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<tr>
<td><strong>Product Performance Specifications &amp; Reports</strong> – Payload, weight, power, aerodynamic performance, etc.</td>
<td>X</td>
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<tr>
<td><strong>Product Definition</strong> – Drawings, specifications, models, parts lists</td>
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<tr>
<td><strong>Risk Definition</strong> – Product development risk identification, mitigation plans, status</td>
<td>X</td>
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<tr>
<td><strong>Product Operations &amp; Support</strong> – Operating procedures, maintenance manuals, training materials</td>
<td>X</td>
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<td><strong>Product Cost</strong> – Cost As Independent Variable data, development cost, operational cost, life cycle cost</td>
<td>X</td>
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<tr>
<td><strong>Product Schedule</strong> – schedule status</td>
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<tr>
<td><strong>Production Support</strong> – work instructions, procedures, process specifications, tool information, training materials</td>
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<tr>
<td><strong>Product Certification</strong> – Analysis, test, and inspection data, configuration data, safety data</td>
<td>X</td>
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<tr>
<td><strong>Lessons Learned</strong> – Process/product improvements</td>
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