Lean Aircraft Initiative
Plenary Workshop

LEM IPT

October 8-9, 1997

Presented By:

Ed Harmon, Northrop Grumman Corporation
Tom Shields, MIT
Don Meadows, Lockheed Martin Corporation
LEAN AIRCRAFT INITIATIVE

LEM IPT Has Focused On Three Areas

- Development of “Web” Version Of LEM V 1.0
  - Prototype Site Demonstrated
  - Process On Schedule

- Expansion Of Database In LEM V 1.0
  - Activity Funded By Mantech
  - In Place And Identification Of Data Sources Initiated

- Development Of Alternative Module To LEM
  - Task Force Identified And Evaluated Candidate Options
  - LEM IPT Selected Option For Recommendation To Board
  - Seek Executive Board Approval To Continue
Lean Enterprise Model

Phase II Activity Schedule

LAI Milestones
- Executive Board Meetings

LEM Version 1.0 Web Development
- Decision Point / Release

LEM Version 1.0 Data Updates
- MIT-Based Research & Metrics
- External Database Res. & Metrics
- Data Release

LEM “New Module” Exploration
- Task Force Chartered
- Conceptual Trade-off
- Development Proposal
- Development Decision

LEM “New Module” Development
- Release Module on Web
Presentation Of Phase 2 Status

Version 1.0 Web Development...... Tom Shields

Version 1.0 Data Updates.............. Ed Harmon

“New Module” Exploration............ Ed Harmon

“New Module” Development......... Don Meadows
Presentation Of Phase 2 Status

Version 1.0 Web Development..... Tom Shields

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Outline

- Web LEM development specifications
- Web LEM development process
- Web LEM alpha site demonstration
Lean Enterprise Model

Web LEM Development Specifications

- LEM Version 1.0 will not be modified
- Will have comparable Visual Basic features
- Accessible on LAI home page (protected)
- Link to LAI references (new feature)
- Web LEM to be downloadable by member
- Member specific data must be loaded on member’s intranet
- Supported by Netscape & Microsoft browsers
- No new documentation
Lean Enterprise Model

Web LEM Development Process

- User group formed
- Determination of Web host format
- Determination of Web development method
- Employment of professional user interface designer
- User interface design reviewed by the users group
- Development of the Web LEM alpha test site
- Review by the users group
- Updates to the site based on users group
- Opening of the site to a broader review (Beta test)
- Update to final site configuration
- Opening of the Web LEM site
Presentation Of Phase 2 Status

Version 1.0 Web Development..... Tom Shields

Version 1.0 Data Updates.......... Ed Harmon

“New Module” Exploration......... Ed Harmon

“New Module” Development....... Don Meadows
Collaborative Effort in Support of Enhancing LEM Version 1.0 With External Database Research and Metrics

» Government: AF Mantech (Funding Source)
» Industry: Textron Systems (Management/Resources)
» Academia: MIT (Data Validation)

Objective Is to Supplement Current MIT-Based Research and Metrics in LEM With Research and Metrics Existent in Any Other Relevant and Accessible Data Sources.

Effort Initiated in August ‘97

» Researchers Co-located at MIT’s LAI Center
» Closely Aligned With LEM IPT Activities
» 7 Step Process Initiated
1. Review LEM
   – Identify & Understand Where the Holes Are, and Why
   – Identify & understand the Tall Poles
2. Survey Available Sources of “Universal” Data
   – Internet Sources, Corporate/Industry Consultants...
3. Screen Applicability to Enabling/Supporting Practices
   – Use Existing Measures
   – Add New Measures
   – Match to Data Holes and Big Payoff Metrics
4. Collect, Format and Organize New Data
5. Test (Validate) New Data
   – Working With MIT/LAI Focus Groups
6. Input Approved Data (LEM Web Version)
7. Report and Document
Examples Of LEM External Database Opportunities
Lean Enterprise Model

Presentation Of Phase 2 Status

Version 1.0 Web Development..... Tom Shields
Version 1.0 Data Updates............ Ed Harmon
“New Module” Exploration......... Ed Harmon
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## LEM “New Module” Task Force Members

<table>
<thead>
<tr>
<th>Air Force</th>
<th>Industry</th>
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<tbody>
<tr>
<td>John Crabill</td>
<td>Ed Harmon</td>
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<td>Dave Judson</td>
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<td>Mick Hitchcock</td>
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<th>M.I.T.</th>
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<td>Kirk Bozdogan</td>
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<td>Mark Klein</td>
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**LEM IPT Recommendation**

Develop “Complementary Module”

- **Need Identified During Phase 1**
  - Reference Module Provided “Lean Practice Model”
  - Desire For “How To” Tool

- **Looked At Four Options**
  - System Dynamics
  - “How To”
  - “What To”
  - Knowledge Base

- **“Implementation Module” Chosen As Most Valuable**
  - Organizes Lean Practices Into Proper Sequences
  - Provides “How To” Guidance
Current LEM Module

1. Identify & Optimize Enterprise Flow
2. Assure Seamless Information Flow
3. Optimize Capability & Utilization of People
4. Make Decisions at Lowest Possible Level
5. Implement Integrated Product & Process Development
6. Develop Relationships Based on Mutual Trust & Commitment
7. Continuously Focus on the Customer
8. Promote Lean Leadership at All Levels
9. Maintain Challenge of Existing Processes
10. Nurture a Learning Environment
11. Ensure Process Capability & Maturation
12. Ensure Requirements Stability

• 12 Overarching Practices
• 61 Enabling Practices
• 297 Supporting Practices
• Benchmarking Database
• Case Studies

LEM Implementation Module

• Organized, Time-Sequenced Arrangement of Lean Practices
• Tailored to Each Sector, Including Supplier Base
• Selected Stages of Weapon System Life Cycle (e.g. Product Development, Production, Sustainment)

Implementation Module Is Template Based
Lean Enterprise Model

Expansion Knowledge Base
Of Lean Development, Design, Build And Sustainment Practices

LAI Process Of Knowledge Growth

Notional

- Release of LEM V 1.0
- Focus Group Activity & Development of LEM
- IMVP

Today
Expanding Knowledge Base Of Lean Development, Design, Build And Sustainment Practices

Development Of Implementation Module Will Continue Knowledge Growth

Notional

- Release of LEM V 1.0
- Focus Group Activity & Development of LEM
- IMVP

End Of Phase 2

Organized, Time-Sequenced Arrangement of Lean Practices

Today

‘93 ‘94 ‘95 ‘96 ‘97 ‘98 ‘99 ‘00 ‘01 ‘02
Expanding Knowledge Base Of Lean Development, Design, Build And Sustainment Practices

Potential For Further Knowledge Growth

Notional

- Release of LEM V 1.0
- Focus Group Activity & Development of LEM
- IMVP
- Organized, Time-Sequenced Arrangement of Lean Practices

E 93 '94 '95 '96 '97 '98 '99 '00 '01 '02
Framework For Executing This Activity

- LEM IPT Industry Consortium As Prime
  » Need LAI Consortium Member Commitment To Support

- Creation Of IPTs To Develop Specific Flow Modules
  » Sector Representation
  » Focus Group Oriented

- Lean Forum IV Potential Funding Source
  » Need For Implementation Module Identified As A High Priority
  » Competitive Source Selection
  » Contract Activity Start June, 1998

- Organizing, Planning And Concept Definition Covered Within Current Scope Of LAI
Presentation Of Phase 2 Status

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Objective:

To meet the request of consortium members for a “how-to” guide for implementing Lean Production.
**REQUIREMENTS:**

- Enhance decision making on how to become lean; in particular, provide key sequential steps required
- Meet the needs of each sector of LAI (airframe, engines, electronics, space)
- Complete task within the Phase II timeframe
Lean Implementation Model: Approach

- Utilize precedence network models to capture experience of LAI consortium members
- Create common model where feasible; capture sector peculiarities as required
- Involve designated representatives from each sector in the development of model(s)
- Create conceptual framework that integrates current LEM reference model with new implementation precedence models
Lean Enterprise Model

LEM Implementation Framework

**Implementation Precedence Models**

- Toyota Production Model
- Space Sector
- Airframe Sector
- Engine Sector
- Electronics Sector
- Product Development & Other Non-recurring Enterprise Model(s)

**Interactive Q&A Knowledge Base**

Select Model

Tailor to company-specific needs & conditions

Company “A” Lean Model

Suppliers’ Lean Models

Lean Enterprise Reference Module (Phase I LEM)

References, data, & benchmarks to each model type and individual implementation step

Linkages tailored to needs of specific company
Lean Enterprise Model
Version 1.0
November 4, 1996

PRINCIPLES
- Meta-Principles -
  Responsiveness to Change • Waste Minimization
- Enterprise Principles -
  Right Thing at Right Place, Right Time, and in the Right Quantity
  Effective Relationships within the Value Stream
  Continuous Improvement
  Optimal First Delivered Unit Quality

ENTERPRISE LEVEL METRICS
  Flow Time
  Stakeholder Satisfaction
  Resource Utilization
  Quality Yield

1. Identify and Optimize Enterprise Flow
2. Assure Seamless Information Flow
3. Optimize Capability and Utilization of People
4. Make Decisions at Lowest Possible Level
5. Implement Integrated Product and Process Development
6. Develop Relationships Based On Mutual Trust and Commitment
7. Continuously Focus on the Customer
8. Promote Lean Leadership at All Levels
9. Maintain Challenge of Existing Processes
10. Nurture a Learning Environment
11. Ensure Process Capability and Maturation
Lean Enterprise Model

Toyota Production Model

Source: Yasuhiro Monden, *The Toyota Production System*, p. 4
Lean Enterprise Model

**LEM Implementation Framework**

**Implementation Precedence Models**
- Toyota Production Model
- Space Sector
  - Airframe Sector
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- Electronics Sector
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**Interactive Q&A Knowledge Base**

**Select Model**

**Tailor to company-specific needs & conditions**

**Company “A” Lean Model**

**References, data, & benchmarks to each model type and individual implementation step**

**Lean Enterprise Reference Module (Phase I LEM)**

**Suppliers’ Lean Models**
Lean Enterprise Model

Airframe Sector—Example

Identify Process Flows
- Simplify & Purify Process Flows
  - Correct / Optimize Process Sequence & Shop Paper
  - Rearrange Shop to Match Flow
  - Develop New Method of Scheduling Work Flow
  - Reduce WIP Inventory
  - Reduce Throughput Time

Implement Process-Based Costing
- Implement Cost of Non-Quality
  - Restructure Management & Organization
  - Reduce Classifications & Train
  - Reduce Setup and Transport Time
- Implement Lean Prod. Teams - Employee Empowerment

Implement Total Productive Maintenance
- Implement JIT Material Delivery System
  - Implement Visual Control
    - Institute 5 S's
  - Reduce Lot Sizes & Further Reduce Inventory
  - Implement Jidoka, Pokayoke, & SPC
  - Standardize Operations

Implement New Measurement Systems
- Implemented Suggestions
- Reduce WIP Inventory
- Reduce Throughput Time

Framework for Continuous Improvement in Place

Source: Lockheed Martin Corporation
Lean Implementation Model Features

**Phase II**
- Introduces precedence relationships among key lean practices; allows implementers to focus on reduced, time-phased data set

**Future**
- Provides “click-on” linkage from precedence step to LEM reference model with availability of research results, definitions, barriers, enablers, lower level practices
- Allows high level overview of Lean with extensive “drilldown” capability
- Provides potential of narrative descriptions of each step, reasons for the precedence position, and practical methods of achieving any particular step
Create precedence models for each sector
Rationalize each model to a common model where possible
Create conceptual “click-on” linkage to LEM reference model & other data bases
» create high level architecture/design
» generate cost & schedule for future proposed effort
Capture sector discussions & experience on precedence steps for incorporation into future database
Evaluate COTS/other decision support systems as management aids in lean implementation
Lean Enterprise Model

LEM Implementation Framework

Phase II: 

Implementation Precedence Models

- Toyota Production Model
- Space Sector
- Airframe Sector
- Engine Sector
- Electronics Sector
- Product Development & Other Non-recurring Enterprise Model(s)

Interactive Q&A Knowledge Base

Select Model

Tailor to company-specific needs & conditions

Company “A” Lean Model

Suppliers’ Lean Models

References, data, & benchmarks to each model type and individual implementation step
Lean Implementation Model

Schedule & Major Milestones

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<th>Activity</th>
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<td>Define the Concept</td>
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<td>Executive Board Approval</td>
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<td>• Form Teams</td>
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<td>• Validate &amp; Refine</td>
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