LEAN AEROSPACE INITIATIVE
Supplier Networks Research Team Workshop
Building Lean Supplier Networks

January 13-14, 2000

Presented by
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Document: Team Summary
Phase III Team Charter

**CHARTER:** Develop and deploy concepts, strategies and tools that optimize value streams supporting the design, production and sustainment of aerospace systems offering best lifecycle value

**EXPECTED BENEFITS:** Best lifecycle value to the customer; “win-win” prime-supplier relationships; significant network-wide (value stream) performance improvements & shared benefits

- Greater efficiency; higher quality
- Lead time reduction
- Flexibility and responsiveness

**CO-LEADS**

**MIT**
Kirk Bozdogan
Charlie Fine

**INDUSTRY**
George Reynolds
Northrop Grumman
ESSS

**GOVERNMENT**
Hamid Akhbari
C-17 SPO, WPAFB
Major Phase III
Research Topics

* Strategies, methods & tools for flowing lean principles throughout multi-tiered supplier networks
  - **Lean transformation roadmap:** Change management strategies & enablers; implementation steps & metrics
  - **Methods and tools:** Self-assessment tool; common supplier development guide; value stream mapping; performance metrics; gainsharing methods; electronic integration practices

* Models for innovative supply chain integration to deliver best lifecycle value to customer
  - **Supply chain design & integration models for building dynamic sustainable network-wide competitive advantage**
  - **Fostering & “pulling” innovation over supplier networks**
  - **Information infrastructure for building integrated virtual enterprises enhancing flexibility & responsiveness**

+ Involves major international cross-benchmarking survey in collaboration with UK-LAI & LARP

* Joint with Acquisition Research Team & with Lean Sustainment Initiative; in collaboration with UK-LAI, LARP and ISCM (see Chart #6)

# Joint with Product Development Research Team.
Additional Phase III Research Topics*

- Cross-functional integration of procurement, production and sustainment operations and processes
- Optimizing centralized/decentralized procurement strategies
- Developing sustaining supplier relationships in an environment of changing aerospace market conditions
- Mapping the supplier knowledge value stream
- Designing new information-technology-mediated organizational structures, business practices and management strategies fostering interorganizational learning
- Linking technology roadmaps across government-prime-supplier networks

*Contingent upon availability of additional funding (not listed in priority order)
### Products

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<tr>
<th>PRODUCT CATEGORIES</th>
<th>MAJOR PRODUCTS <em>(Examples)</em></th>
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| **OUTREACH**       | • Provide “content” support to regional supplier workshops  
                   | • WEB-based communication products (on-going)  
                   | • *Annual “for fee” conferences on special topics open to all small-to-medium size aerospace suppliers*  |
| **LEARNING**       | • Topical and/or implementation workshops (twice a year)  
                   | • Lean transformation roadmap, methods & tools  
                   | • Summer short course on supply chain management strategies and methods (yearly, starting in 2001; provide support to “Integrating the Lean Enterprise” short course in June 2000)  
                   | • *Supply chain design & management self-assessment tool*  
                   | • *Common supplier training and development guide*  
                   | • *IT tools for mapping supplier knowledge value stream*  |
| **ENDURING**       | • Contributions to Lean Enterprise Model (LEM)  
                   | • Conference reports, working papers and publications  
                   | • Book contribution –“SUPERCHAINS”  |
| **POLICY**         | • Policy recommendations (potential examples)  
                   | ⇒ Fostering innovation in supplier networks  
                   | ⇒ Interoperability, globalization & international collaboration  |

*Contingent upon availability of additional funding.*
SYNERGY: Links to Other Activities

- **LAI-related activities**
  - Lean Sustainment Initiative (LSI)
  - LAI international collaborative projects (e.g., UK-LAI; LARP)
  - Labor Aerospace Research Agenda (LARA)

- **Other MIT activities**
  - Integrated Supply Chain Management Program (ISCM), Center for Transportation Studies
  - International Motor Vehicle Program (IMVP)
  - Center for Innovation in Product Development (CIPD)
  - System Design and Management Program (SDM)

- **Other organizations**
  - Regional organizations (e.g., NESI, CMTC)
  - National organizations - expected (e.g., AIA, NIST)
LEAN AEROSPACE INITIATIVE
Supplier Networks Research Team
Phases I & II Research Summary
Research Progress (Phases I & II)

**LEARN AEROSPACE INITIATIVE**

**PROCESS:**
- Survey research, case studies, site-visits, workshops

**PRODUCT:**
- Briefings, customized survey feedback, reports, theses, inputs to LEM

**IMPACT:**
- Research findings implemented by consortium members (on-going)

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**INFORMATION INFRASTRUCTURE**
- Examined effective IS/IT approaches for supplier integration
- Identified enablers for architectural innovation
- Examined causes & impacts of engineering changes

**EARLY SUPPLIER INTEGRATION**
- Examined make-buy criteria
- Developed framework for 3-D concurrent design of supply chains

**SUPPLY CHAIN DESIGN**
- Defined benefits of long-term supplier partnerships & strategic alliances
- Documented effective supplier certification & training practices
- Identified methods for enhancing critical supplier processes
- Defined supplier quality improvement methods

**STRATEGIC PARTNERSHIPS**
- Conducted major benchmarking survey (baselined current practices; identified effective strategies for supplier base streamlining)
- Developed lean supply chain management framework

**SUPPLIER DEVELOPMENT**
- Developed lean supply chain management framework

**SUPPLIER NETWORK RATIONALIZATION**
Summary of Major Products
(Phases I & II)

- Output of major benchmarking survey on supply chain management practices in aerospace industry
  - Communication of emerging lean practices (numerous briefings/presentations)
  - Customized feedback packages to sponsor companies

- Lean supply chain management framework (Team Product)
  - Overarching, enabling, supporting & operating practices
  - Performance metrics at all levels

- Learning workshops & symposia (Illustrative)
  - Electronic integration of supplier value streams (cross-industry) -- Feb 99
  - Barriers to flowing lean principles throughout value stream (cross-industry) -- June 99
  - Regional Supplier Workshops (on-going support)

- Invited briefings at major sponsor events (Examples)
  - AF MANTECH strategic planning meeting -- Feb 95
  - Boeing materiel management executives meeting -- March 96
  - Sundstrand Supplier Council -- March 96
  - Texas Instruments Supply Chain Integration Forum -- Sept 96
  - F-22/F119 Executive Supplier Conference -- June 99
Summary of Major Products
(Phases I & II -- Continued)

- Invited presentations at national conferences, workshops and special events
  - NAECON -- May 95
  - National Research Council (policy Issues in aerospace offsets -- sponsored by DOD, Dept of Commerce, DARPA, White House) -- June 97; Jan 98
  - Ship Design and Shipbuilding Technology Symposium -- May 97
  - Defense Science Board
    - Industry Consolidation Task Force -- Sept 97
    - Acquisition Reform Task Force -- Jan 98
  - OSD Cost Analysts Annual Conference -- Feb 98

- Many reports and publications (Illustrative topics)
  - Early supplier integration into design & development
  - Three dimensional concurrent design of products, processes & supply chains
  - Sharing the benefits of interorganizational R&D collaboration with suppliers
  - International aerospace offsets: policy issues
  - Collaborative learning networks in defense aerospace industry
  - Dual-use supplier management & strategic international sourcing
  - Controlling uncertainty through close ties with suppliers

- Contributions to the Lean Enterprise Model (LEM) -- Datasheets
Lean Supply Chain Management Framework

(1) Proactive planning, integration & management of the supplier network
(2) Early and substantial supplier involvement in design and development
(3) Mutually beneficial relationships
(4) Synchronized production and delivery
(5) Continuous cost reduction and quality improvement
Early supplier integration into product development*


Information infrastructure for supplier integration*+

*Building Information Systems to Integrate the Manufacturing Supply Chain* - Michelle Antonelli; MS Thesis, EE&CS and Technology and Policy; Supervisors: Dr. Daniel Whitney & Dr. Kirk Bozdogan (Completed: May 99)

*Information Infrastructure for Collaborative Product Development*++: Anna Öhrwall Rönnbäck, PhD Candidate; Licentiate Thesis; Supervisor: Prof. Staffan Brege, Linköping Univ., Sweden (Expected Completion: March-April, 2000)

* Joint with Product Development
++ Collaborative project with Lean Aircraft Research Program (LARP), Linköping Univ., Sweden
Make-buy and strategic outsourcing decisions

Make-Buy Strategies in the U.S. Aerospace Industry - Rob Perrons; MS Thesis, Technology and Policy; Supervisor: Dr. Kirk Bozdogan; (Completed: Aug 97)

Dual-Use Supplier Management and Strategic International Sourcing in Aircraft Manufacturing - Prof. Todd Watkins, Lehigh Univ.; Working Paper (Revised/completed Oct 97)

Strategic Outsourcing and Supplier Integration in the Helicopter Sector - Rudy Prudente; MS Thesis, System Design and Management Program (SDM); Supervisor: Dr. Kirk Bozdogan (Completed: Feb 99); collaborative project with LARP

Outsourcing - Strategic and Operational Realities: Reine Wasner, PhD Candidate; Licentiate Thesis; Supervisors: Prof. Ove Brandes, Prof. Staffan Brege (Completed Oct 99); collaborative project with LARP
Engineering changes and design-manufacturing integration over the supplier network*

* Causes and Impacts of Class One Engineering Changes: An Exploratory Study Based on Three Aircraft Acquisition Programs -
  Ted Hsu; MSThesis, Aeronautics and Astronautics and Technology and Policy; Supervisors: Dr. Kirk Bozdogan & Prof. John Deyst (Completed: May 99)

* System Dynamics Modeling of Barriers to Design-Manufacturing Integration over the Supplier Network # - Bill Blake; MS Thesis, SDM; Supervisors: Prof. Daniel Frey & Dr. Kirk Bozdogan (Expected completion: March-April, 2000)

* Joint with Product Development
  # Title approximate
Managing transition to a performance-based business environment (continuation of Phase I research on “Supplier Network Restructuring, Integration and Governance Structures”)


Transition to Commercial Practices in the U.S. Aircraft Industry - Ernest (Jay) Campbell; MS Thesis, Sloan School of Management; Supervisors: Dr. Don Rosenfield & Dr. Kirk Bozdogan ( Completed: May 98)

Supply Chain Management Practices in the U.S. Engine Sector -
Bill Gostic; MS Thesis, Sloan School of Management, Sloan Fellows Program; Supervisors: Dr. Don Rosenfield & Dr. Kirk Bozdogan (Completed: May 98)

Production Networks Revisited: Causes and Consequences of Supplier and Customer Linkages in the Metal Manufacturing Sector - Cynthia Cook, Ph.D. Thesis, Harvard University; Supervisor: Prof. Peter Marsden (Completed: Jun 99)
Phase II Specific Research Projects & Products (5)

- Sharing the payoffs of collaborative R&D in the supply chain

  “Pie-Division” in Interorganizational Collaboration - Prof. Sandy Jap, MIT; Working Paper (Completed: Oct 98)

- Supplier integration in the electronic instruments sector

  Achieving Supplier Integration through Implementation of Supplier Managed Inventory Programs - Mike Bravo; MS Thesis, SDM; Supervisor: Dr. Kirk Bozdogan (Completed: Jan 99)

- Technology supply chain management

  Research completed; main results published


  Joint with Policy and External Environment

  Joint with Product Development
Supply chain coordination strategies and mechanisms

Direct and Indirect Bargaining Costs and the Scope of the Firm - Prof. Duncan Simester (MIT Sloan School) & Prof. Marc Knez (Univ. of Chicago); Completed Aug 99.