The Role of a Network Centric Supplier City and Regional Clusters
Unlocking commercial competitiveness for a viable industrial base

Respectfully presented by:

Michael C. Galluzzi

NASA Supply Chain Manager
HQ ESMD & JSC CxP Level II

Network Centric Supplier City consists of multiple Customers, Universities, State EDC's, and Suppliers. Each "City Node" is managed by one Operator and is focused on a common geographic region, capability or industry and doesn't exclude other Nodes in other locations (Virtual).
Overview

NASA Industrial Base is facing grave challenges

- CxT is major disruption compounded by financial market crisis
- Liquidity degraded further by various export and tax regulations
- ITAR and International competition impacting variables
- NASA supplier base product diversification estimated at 9% avg. [Final Report, Assessment of Supplier Capabilities to Operate in a MBE, NIST MEP 10/22/2009]
  - Range: 0.01% to 84%

NASA influence over the Aerospace Industry limited

- NASA HSF product has shrunk to 3% of the Aerospace Industry
  - 16% of the Space Sector [AIA Report]

NASA visibility into complex supply chains indistinct

- 75% of Space technology innovation R&D investment is performed below the prime. [US Air Force Research Lab Study, 2008]
- Industrial Base is the Cornerstone to technology innovation
- NASA trying to connect the links of the supply chain [www.nasa.gov]
SCRL Model Approach

- TRL
- MRL
- MRA*
- Product Life Cycle

Management
Framework
- Product Data
Management

Supply Chain
- End-to-end
- Total Life cycle
- Inter-agency

Enterprise Supply Chain Development

SCM Best Practices
- Key Performance Indicators
- SCOR

SCRL Model Benefits
- TRL, MRL beyond DDT&E into Ops
- Common Risk Measures
- Configurable SC
- Standardized product quality assessment
- Framework for Contract and data requirements

* Manufacturing Readiness Assessment: “The ability to harness the manufacturing, production, quality assurance and industrial functions to achieve an operational capability that satisfies mission needs” Department of Defense, Manufacturing Readiness Assessment (MRA) Desk book, May, 2009
National Aeronautics and Space Administration

Contract Requirements with SCOR KPI

OBJECTIVE SUPPLY CHAIN KEY PERFORMANCE INDICATORS

Strategic
- % increase in Inter-agency Supplier Capability
- Upstream Supply Chain Flexibility
- Forecast Accuracy
- Inter-agency Supply Chain Manufacturing Capacity Utilization
- Overall Perfect Order Fulfillment
- Delivery Cycle Time
- Source Selection Cycle Time
- Total time to Manufacture
- Operational

NASA

Program

Project

SOURCE

• Supplier Info (Who, What, Financial, Functional capability, Risks)
• Interagency Commonality
• Supply Chain Modeling & Simulation

PLAN

• Source Specifications
• Supplier Economic Stability
• Network Centric Supplier City Option

SOURCE

MAK E

• Lead Times, VMI Levels, Lower Tier Quality
• Optimized inventory levels
• CAD to CAM interface
• Standard 3D Models

DELIVER

• Perfect Order Fulfillment
• Quality
• Cost
• Quantity
• Improved Cycle time
• Schedule Updates
• Supply Chain Flexibility

RETURN

• Mission Status

Supplier

Company Information by lower tier supplier

Inventory

Vendor Managed Inventory and Quality by Lower Tier
- (WIP MRO and SRU level)

Delivery

Delivery Performance by lower tier supplier

Mission

Certificate Information
- COFR

www.nasa.gov
Solution
Network Centric Supplier City

- Improve quality through product demand aggregation
  - Volume + Liquidity = Product Quality

- An connected network of regional “Industrial Clusters”*
  - Shared physical and virtual infrastructure

- Facilitate smart CAD to CAM design for rapid assembly
  - Model based Network-centric enterprise (TDP to MPDF)

- Seamless coordination of suppliers in multiple supply chains

Citizens of the City

- Lower-tier Small-Medium Suppliers, States, Universities, Independent workforce providers, Non-profit City Manager, Lead System Integrator, Banks, Insurance Groups, Legal Council

Clusters: Groups of industries that share common or complementary markets, suppliers or workforce skills. US Economic Development Administration / Dept of Commerce, January 2007

Governor Perry of Texas defined an industry cluster in SB275, Government Code, Section 481.001 (6) as “a concentration of businesses and industries in a geographic region that are interconnected by the markets they serve, the products they produce, their suppliers, the trade associations to which their employees belong, and the educational institutions from which their employees or prospective employees receive training.”

www.nasa.gov
City Tenets

Self-funded with marginal revenue sharing
- Free-market stimulant
- Blanket City Source Qualification IDIQ Contract
- City Manager with ISO, OSMA, DCMA Qualifies City Members
- State owned facilities are operated “at cost”
- Critical technology development focused

Proprietary confidential data – secured and integrated
- Model Based Enterprise Architecture: PDM, CAD/CAM and MRP

Integrated Supplier Assessment Tools used to ID members
- Supply Chain Readiness Level (SCRL)
- Supply Chain Operations Reference Metrics (SCOR)
- PrimeSupplier - Economic Stability Index model
- PrimeMap – Mapping of critical capabilities
- OMB database - Contracts

Inter-agency and commercial demand aggregation
- Manage manufacturing capacity to meet demand surge

www.nasa.gov
Network-Centric Supplier City

- Model Based Network Centric Enterprise
- Distinct Roles and Responsibilities
- Collaborated Product Demand Planning
- Shared Facility Co-operative
- NASA Center for Advanced Manufacturing

Benefits

- Perfect Order Fulfillment
- Improved product quality
- Lower product and inventory cost
- Supplier viability improved by:
  - Reduced labor expense
  - Exposure to new customer needs
  - Increased hardware demands
- Reduced product Lead time
- Increases State tax revenue
- Reduced Supplier revenue tax
- Better visibility to manage
  - Counterfeit parts
  - Contract Change Orders

Customer requirements
- MRO to Subsystem production

www.nasa.gov
Network Centric Supplier City Increase Productivity

- Efficient access to specialized inputs, employees, information, institutions and “public goods” such as training programs and training institutions
- Ease of coordination across suppliers
- Rapid diffusion of best practices
- Ongoing, visible performance comparisons and strong incentives to improve vs local rivals

NCSC stimulate and enable innovation

- Better ability to perceive innovation opportunities
- Presence of multiple suppliers and institutions to assist in knowledge creation
- Ease of experimentation given locally available resources

NCSC Facilitate Commercialization

- Opportunities for new companies and new lines of established business are more apparent
- Lower barriers to entry into cluster related businesses because of available skills, supplies, etc.

Competition is fundamentally enhanced by externalities / linkages across firms, industries and associated institutions
National Aeronautics and Space Administration

Recommendations

Establish a National Manufacturing Strategy

- a) Productivity;
- b) Investment in aerospace industry;
- c) Research and development intensity;
- d) Technology innovation;
- e) Employment, workforce skills and development;
- f) International competitiveness;
- g) National security

Create Interagency Supplier City working group

- Coordination Inter-agency activity with National Security Space Office, MDA, ARMY, etc…
- Intra-NASA coordination across directorates and with institutional groups
- Support to Administrator and senior NASA management for determining:
  - Critical Technology Program development strategy
- Define the measurement framework using (SCOR KPI) then integrate into the budget process.
- Involve suppliers during the DDT&E phase of the product lifecycle to ensure manufacturability.

Place SCM disciplines in acquisition processes and policy

- Establish a common enterprise information architecture to provide consistency and synchronization between supply chain participants (PDM,ERP,MRP,CAD/CAM)
- Establish Supply Chain Management contract language to ensure Subcontract management
- Obtain visibility of the supplier base and continually assess their economic health
- Require IB considerations into strategic processes e.g. Mfg Readiness Level (MRL) during DDT&E as well as Supply Chain Readiness Levels (SCRL) for operations and sustainment
### SCRL Model Characteristics Table

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>JIT-WIP, VMI Inventory</strong></td>
<td>Placement of raw material, WIP and finished goods throughout the supply chain</td>
</tr>
<tr>
<td><strong>Mfg Demand Relationship Visibility</strong></td>
<td>Ability to see who, what and how at varying levels of the supply chain</td>
</tr>
<tr>
<td><strong>Strategic Sourcing Demand Aggregation Methodology</strong></td>
<td>Approach to sourcing, make-buy decisions, and supplier and SKU consolidation</td>
</tr>
<tr>
<td><strong>Supplier/Customer Relationships</strong></td>
<td>Working relationships between suppliers and customers at varying levels of the supply chain</td>
</tr>
<tr>
<td><strong>Collaborative Forecast Demand Planning</strong></td>
<td>Flow of information up and down the supply chain</td>
</tr>
<tr>
<td><strong>Industrial Base Lifecycle Awareness</strong></td>
<td>Visibility and awareness throughout the supply chain of the current lifecycle phase</td>
</tr>
<tr>
<td><strong>SC Modeling and Simulation Technology</strong></td>
<td>Application of modeling and simulation to improve supply chain performance</td>
</tr>
<tr>
<td><strong>SCOR KPI</strong></td>
<td>Use of metrics to evaluate and improve supply chain performance</td>
</tr>
<tr>
<td><strong>DMSMS Risk Management</strong></td>
<td>Management of part availability risk (including obsolescence, sole-sourcing and counterfeit parts)</td>
</tr>
<tr>
<td><strong>Supplier and Product Line Criticality</strong></td>
<td>Focus level on critical items and suppliers</td>
</tr>
<tr>
<td><strong>Industrial Base Economic Stability Index</strong></td>
<td>Long-term viability of the industrial base</td>
</tr>
<tr>
<td><strong>Manufacturing Readiness</strong></td>
<td>Monitoring the manufacturing readiness of the supply chain</td>
</tr>
<tr>
<td><strong>Technology Readiness</strong></td>
<td>Monitoring the technology readiness of the supply chain</td>
</tr>
<tr>
<td><strong>Sub-Tier Management</strong></td>
<td>Assurance that all levels of the supply chain adhere to SCRL standards</td>
</tr>
<tr>
<td><strong>Commodity Price Adaptability</strong></td>
<td>Impact of variations in the price of commodities (steel, energy, etc.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristics</th>
<th><strong>SCRL 1</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>JIT-WIP, VMI Inventory</strong></td>
<td>Inventory levels are not known throughout the supply chain.</td>
</tr>
<tr>
<td><strong>Mfg Demand Relationship Visibility</strong></td>
<td>Only direct customers and suppliers are known.</td>
</tr>
<tr>
<td><strong>Strategic Sourcing Demand Aggregation Methodology</strong></td>
<td>Suppliers throughout the supply chain are not visible beyond the next-level customer and no supplier or SKU consolidation efforts in place.</td>
</tr>
<tr>
<td><strong>Supplier/Customer Relationships</strong></td>
<td>Supplier/customer relationship is defined only by the T’s &amp; C’s of contract or purchase order.</td>
</tr>
<tr>
<td><strong>Collaborative Forecast Demand Planning</strong></td>
<td>Only information necessary for placing and processing orders is exchanged between supply chain entities</td>
</tr>
<tr>
<td><strong>Industrial Base Lifecycle Awareness</strong></td>
<td>Activities and visibility are related only to current and known orders.</td>
</tr>
<tr>
<td><strong>SC Modeling and Simulation Technology</strong></td>
<td>Modeling and simulation technologies are not used for any supply chain activities</td>
</tr>
<tr>
<td><strong>SCOR KPI</strong></td>
<td>Supply chain performance is not measured.</td>
</tr>
<tr>
<td><strong>DMSMS Risk Management</strong></td>
<td>Risk Management is not in place at any level.</td>
</tr>
<tr>
<td><strong>Supplier and Product Line Criticality</strong></td>
<td>Critical items and suppliers are not known.</td>
</tr>
<tr>
<td><strong>Industrial Base Economic Stability Index</strong></td>
<td>Suppliers are not known beyond next level in the supply chain</td>
</tr>
<tr>
<td><strong>Manufacturing Readiness</strong></td>
<td>Mfg Readiness not measured but Mfg opportunities have been identified</td>
</tr>
<tr>
<td><strong>Technology Readiness</strong></td>
<td>Technology readiness is not measured.</td>
</tr>
<tr>
<td><strong>Sub-Tier Management</strong></td>
<td>SCRL is not being assessed.</td>
</tr>
<tr>
<td><strong>Commodity Price Adaptability</strong></td>
<td>Commodity prices not monitored.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Characteristics</th>
<th><strong>SCRL 5</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>JIT-WIP, VMI Inventory</strong></td>
<td>Inventory is strategically placed throughout the supply chain to minimize total supply chain inventory costs while still satisfying the readiness demands of the system</td>
</tr>
<tr>
<td><strong>Mfg Demand Relationship Visibility</strong></td>
<td>All upstream supply chain entities (and the parts they produce) and distributors are known as needed to maximize enterprise performance.</td>
</tr>
<tr>
<td><strong>Strategic Sourcing Demand Aggregation Methodology</strong></td>
<td>All sourcing decisions are made to optimize benefit to the enterprise. Programs in place to regularly monitor and reduce unnecessary redundancy of suppliers and SKUs to standardize products, quality and cost.</td>
</tr>
<tr>
<td><strong>Supplier/Customer Relationships</strong></td>
<td>Supplier/customer relationships allow for teamwork to improve the supply chain. Multi-organization improvement events are ongoing.</td>
</tr>
<tr>
<td><strong>Collaborative Forecast Demand Planning</strong></td>
<td>Collaborative system is utilized to provide real-time demand and other pertinent information to the lowest level of the supply chain</td>
</tr>
<tr>
<td><strong>Industrial Base Lifecycle Awareness</strong></td>
<td>Health of downstream supply chain entities and lifecycle phase at all levels are known and tracked at each level with periodic updates.</td>
</tr>
<tr>
<td><strong>SC Modeling and Simulation Technology</strong></td>
<td>Modeling and simulation technologies are utilized to provide what-if analyses of supply chain risks at all levels of the supply chain. Modeling and simulation are demonstrably improving supply chain performance based on SCOR KPIs</td>
</tr>
<tr>
<td><strong>SCOR KPI</strong></td>
<td>SCOR metrics and best practices utilized at all levels of the supply chain to provide standard measure of performance and these metrics are routinely used to improve supply chain performance</td>
</tr>
<tr>
<td><strong>DMSMS Risk Management</strong></td>
<td>Risk Assessments are performed to Level 3+ and down to raw material for critical parts / suppliers. Risk Mitigation Plan is approved and implemented - Triggers defined - Action steps and timing is clearly defined. Risk monitoring and cross functional team review is scheduled.</td>
</tr>
<tr>
<td><strong>Supplier and Product Line Criticality</strong></td>
<td>Contingency plans for critical items / suppliers is in place down to raw material. Contingency plans in place with clear trigger, actions steps and timing. Critical item and supplier monitoring is implemented. Risk monitoring and cross functional team review is scheduled.</td>
</tr>
<tr>
<td><strong>Industrial Base Economic Stability Index</strong></td>
<td>Supplier viability assessments complete to level 3+ and to raw material for critical items and suppliers. Proactive monitoring in place and scoring method defined. Suppliers are regularly monitored and future assessments are scheduled with triggers defined throughout lifecycle. Modeling is used to perform what-if analysis of industrial base.</td>
</tr>
<tr>
<td><strong>Manufacturing Readiness</strong></td>
<td>Mfg Readiness is optimized at multiple locations.</td>
</tr>
<tr>
<td><strong>Technology Readiness</strong></td>
<td>Technology readiness is not measured.</td>
</tr>
<tr>
<td><strong>Sub-Tier Management</strong></td>
<td>SCRL is regularly assessed throughout the enterprise supply chain and a level of 5 is sustained</td>
</tr>
<tr>
<td><strong>Commodity Price Adaptability</strong></td>
<td>Long-term contracts in place that provide flexibility for commodity price fluctuations.</td>
</tr>
</tbody>
</table>

[www.nasa.gov](http://www.nasa.gov)
Purpose:
- Identify and map cross-element suppliers and their multi-functional capabilities to support agency supply chain

Results:
- Eliminate search lead-time for secondary source
- Improve Interagency collaborative demand planning and improve product line viability

Payoff:
- Visibility of critical processes and critical vendors to allow for a configurable supply chain
- Reduced indirect non-recurring costs associated with DMSMS

www.nasa.gov
**Purpose:**
- To determine programmatic influences on supplier economic stability and effect on cost, quality and schedule

**Results:**
- Improve awareness of Industrial Base health
- Reduce DMSMS non-recurring mitigation costs
- Improved collaborative forecast demand and financial planning

**Payoff:**
- Shows the impacts of changes in last-need dates and purchase order dates to program readiness
- Strong product innovation and economic growth