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**Customer and Supplier Integration  
Across the Supply Chain**  
*Lean Aircraft Initiative Implementation Workshop*

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## **I. Introduction and Executive Summary**

The integration of customers and suppliers along the supply chain involves a fundamental transformation of the way business is conducted in the Aerospace industry. Lean Aerospace Initiative (LAI) members, as well as representatives from their supplier base, had the opportunity to examine this challenge and the dynamics of implementing system-wide change during the third implementation workshop sponsored by LAI, February 12-13, 1998 in Palm Beach Gardens, Florida.

Designed and facilitated by LAI's Implementation Integrated Product Team (IPT), the workshop, "Customer and Supplier Integration Across the Supply Chain", honed in on practices embedded in the Lean Enterprise Model (LEM). These included strategic alliances, long-term agreements, centralized procurement, integration of suppliers in engineering and manufacturing, supplier certification and development, as well as underlying issues of trust and communication. Through open dialogue around these topic areas, a broad cross-section of prime contractors, first through third tier suppliers, union officials, and government officials, collectively representing 17 LAI member organizations, concluded that "the customer-supplier story cuts across all twelve overarching practices."

Overall, the workshop was designed to foster a learning environment characterized by open sharing, respect for each other's views, willingness to discuss difficult issues, and appreciation for sensitive and confidential information. These objectives were supported by focusing in on three case studies interspersed with a series of coordinated thought exercises.

**Case 1: Textron Long Term Agreement (LTA) Initiative** – Case presenters traced the evolution of the LTA initiative back to the "Procurement 10X Lean Initiative" and an internal assessment of the procurement flow process. Textron developed base-line measures for current performance, streamlined processes, conducted comprehensive training, challenged employees by "raising the bar" and identified enablers for future improvements. This resulted in the "Best Value Concept" focused on teamwork, quality, delivery, and affordability and eventually gave way to the Long Term Agreement Initiative with the objective of Partnering with suppliers and focusing on the lowest cost of ownership versus lowest price.

**Case 2: Lockheed Martin Aeronautics Material Management Center Centralized Procurement** – After reviewing rationale for consolidation and key areas of opportunity, case presenters delved into consolidation strategies and approaches to managing change. Among them – Supplier Product and Process Improvement (SPPI). SPPI is a strategy which employs lean principles, value engineering, Six Sigma, Kaizen Tools and eliminates non-value added processes and

requirements. It also uses alternative materials and sources, applies commercial practices, and it allows for the sharing of savings with a supplier.

### **Case 3: Boeing Supplier Relationships in JDAM's Transition to Rate Production –**

According to presenters, Boeing's Supplier Relationship Vision is to have suppliers consider themselves to be partners with a shared feeling of responsibility, accountability and authority for the continued success and market expansion of the JDAM family of products. Their ability to move forward with this vision reflect relationships built on affirmed commitment to the vision, open and honest communication, mutual trust, incentives beyond those of contract, self-directed team with Boeing leadership, and decisions made at lowest possible level. This presentation highlighted the integration issues associated with the shift from engineering design to manufacturing.

In addition to the cases, Hajime Ohba, General Manger of the Toyota Supplier Support Center, along with Christine Parker a Specialist in Research and Training with the same organization, provided a keynote presentation. The Toyota Supplier Support Center exists not just to help Toyota suppliers but to advance lean principles in North America – to further learning and to build capability at a macro-system level.

The report that follows summarizes recommendations from the conference, the three case studies, and the findings of the working groups on the keys to supply chain integration, and on ways to address the problems. The Appendixes feature details on the conference itself, notes from the different sessions, and the supplier game.

## **II. Workshop Findings and Recommendations**

The last five years have yielded both increased interdependency between customers and suppliers, and the increased use of Long Term Agreements (LTAs) to govern supplier relationships. Suppliers increasingly serve on integrated product teams, and increasingly find their businesses linked to other organizations in the supply chain through electronic interfaces that facilitate everything from sharing of designs to inventory management to clearing of payments. New contractual forms have arisen between organizations to share risk. Relationships have proliferated at all levels between prime contractors and supplier organizations. In the military world, the increased use of commercial standards has sped a shift from procurement guided by detailed specifications to the co-development of systems that meet overall mission requirements. How should organizations working to implement lean principles think about the optimal structure of their supply chains, given these trends?

The one dominant lesson that emerges from extensive workshop dialogue on these and related issues is that the drive toward increased application of lean principles is also driving increased interdependency across the supply chain – a phenomena with far reaching implications. Simply put, shifts in technology, volumes, product mix, organizational structure, and other factors all have magnified implications in a world where customer/supplier relations are more tightly integrated. This is clearly a fundamental strategic issue for the defense aerospace industry.

### **Background**

General thinking on supply chains can be presented in two contrasting models: 1) the market model and 2) the partnership model. In the market model, the contracting organization will outsource to several competing suppliers and rely on market forces and the threat of lost business to drive cost and quality improvements. Organizations are more wary about sharing business and production insights with one another because the suppliers are more likely to have relationships with rival firms and the contractors fear strengthening the supply chains of rivals as an unintended consequence of strengthening their own. As a result there is little integration of engineering functions, reduced opportunities for continuous improvement initiatives, and, generally greater distrust between organizations in different parts of the chain. This model tends to be applied more often where cost is the driving imperative.

In the partnership model, contracting organizations will have deeper, more long-term relationships with fewer vendors, whom in turn tend to have relationships with fewer customers. This helps build communication channels and trust, which facilitates more extensive knowledge sharing across organizations. This closer relationship is expected to lead to bigger performance improvements, particularly in the areas of quality and speed.

But there are sometimes incentive problems. For one, partners are sometimes reluctant to share information that they feel the other side may use to erode their profit margins (for suppliers) or to go after their business (for contractors). Suppliers often end up with more specific assets dedicated to a particular contractor, or “more of their eggs in one basket,” increasing business risk that demand might shift down. Contractors can end up with fewer suppliers capable of meeting their demand, creating problems if demand shifts. Sometimes, suppliers take the knowledge learned through continuous improvement undertaken with one customer on one product line and transfer it to other products and customers. The partnership model, pioneered by Toyota, tends to be applied more often where quality is a top priority, and where suppliers are more likely to be captive.

So what to do when cost, quality, and flexibility are all increasing priorities? On February 2-3, 1998, employees from 14 LAI member organizations, including representatives from multiple organizational levels and functions from both customers and suppliers, competitors, newly merged partners, unions, and the U.S. government, came together to discuss supplier integration. The picture that emerged was one of trying to develop new organizational relationships and contractual forms that retained benefits of both the market and partnership models without breaking down from the resulting tensions.

For instance, several organizations are developing sophisticated make-buy evaluation tools – attempting to take advantage of closer, partnership-style relationships to facilitate the shifting of work on a “market” basis between internal divisions and external suppliers. Other organizations are offering “gainsharing” opportunities to introduce market-style incentives into supplier-partner relationships. Many are shifting their focus from the “cost” of parts to the “value” of supplies, a framework that includes elements such as reliability of design and timeliness of development and delivery. Most are sharing design functions throughout their supply chains to try and leverage core competencies in other parts of the extended enterprise. Other innovations are examined in greater detail below.

A picture also emerged of the critical role of team formation, development of interpersonal relationships, and creation of learning organizations that can regenerate high levels of performance in the face of personnel changes or fluctuations in demand. Closer relationships necessitate more careful consideration of communication mechanisms, and ways to build on good communication to realize the trust necessary to attain the highest levels of effectiveness.

The conversation that ensued drew on all elements of the Lean Enterprise Model. Twelve prominent elements are enumerated below in Table 1:

**Table 1**

**LEM Enabling Practices Related to Supply Chain Integration**

- Identify and Optimize Enterprise Flow
- Assure Seamless Information Flow
- Optimize Capability and Utilization of People
- Make Decisions at Lowest Possible Level
- Implement Integrated Product and Process Development
- Develop Relationships Based on Mutual Trust and Commitment
- Continuously Focus on the Customer
- Promote Lean Leadership at All Levels
- Maintain Challenge of Existing Processes
- Nurture a Learning Environment
- Ensure Process Capability and Maturation
- Maximize Stability in a Changing Environment

**Recommendations**

On the second day of the workshop, participants developed recommendations for successful integration along six dimensions:

1. Communication and Trust Across the Supply Chain
2. Supplier Integration in Engineering and Design
3. Supplier Integration in Production and Sustainment
4. Strategic Alliances and Long-Term Partnerships Between Customers and Suppliers
5. Supplier Certification, Development and Diffusion of Innovation
6. Centralization and Strategic Planning in the Procurement/Materials Management Function

These are summarized in turn below.

**1. Communications and Trust Across the Supply Chain**

**Selected recommendations:**

- Adopt/implement/invest in aerospace sector electronic commerce with appropriate security to support entire supply chains
- Streamline sharing of protected information with suppliers -- place legal and contracts representatives on IPT's
- Develop reward sharing across the supply chain -- incentives flow directly to individuals based on improvements in cost, quality, on-time delivery
- Implement frequent, personal communications between top executives and team members to achieve positive reinforcement of corporate commitments.

**2. Supplier Integration in Design and Engineering**

**Selected recommendations:**

- Make a conscious decision to implement, advocate, nurture, and support a long term commitment to supplier integration



- Provide significant compensation and rewards at all levels to support total team success (Rewards and Punishments?)
- Leadership provides necessary resources to support supplier integration
- Establish and uphold business relationships with suppliers that incentivize their commitment and support (hard guarantees)
- Implement a process or group to facilitate and assure supplier integration

### **3. Supplier Integration in Production and Sustainment**

#### **Selected recommendations:**

- Establish regular meetings of executive IPT (see LEM) and include the supply chain
- Set and support the vision of the value stream
  - . Quantifiable goals with incentives
  - . Active information flow
- Enable change during production and sustainment through:
  - . Business practices
  - . Tools
  - . Culture
  - . Organization
  - . Education and Training
- Respond to and anticipate change throughout the value chain

### **4. Strategic Partnerships**

#### **Selected recommendations:**

- Get senior management buy-in, commitment, and support -- develop methods, process, and specific procedures for strategic partnerships
- Develop business case and plan, including exit Criteria
- Develop “win-win” strategies and mechanisms that maximize benefits while minimizing associate liabilities; i.e., “don’t tie me up”
- Seek out opportunities for reward and recognition -- “Nurture” relationships

### **5. Centralization and Strategic Planning in the Procurement/Materials Function**

#### **Selected recommendations:**

- Enable procurement/material management functions to be a strategic partner through training and development
- During the restructuring of business operations, coordinate in real time the implications for purchasing, procurement, and material management
- Balance pressure to centralize or decentralize based on system/people capabilities, nature of operations, nature of materials -- for example: Centralize commodity items, decentralize custom and subcontract items.

#### **Additional finding -- a recommended curriculum for training and development in the procurement/ materials function:**

- . Negotiating partnerships, not just contracts
- . Knowledge of products, commodities
- . Knowledge of engineering and manufacturing processes
- . Cost accounting and forecasting principles
- . IPT membership and capability to coach

- . Citizenship in industry
- . Principles of “supply chain management”
- . Principles of system integration technology

## **6. Supplier Certification, Development and Diffusion of Innovation**

### **Selected recommendations:**

- Re-orient/clarify values and metrics
  - . From: Measuring your suppliers -- To: Measuring total system effectiveness
- Commission values clarification team (by CEO)
  - . Characterize emerging and strategic business priorities; Translate to values and operating principles/ behaviors; Simple articulation for enterprise alignment -- ‘True North’
  - . Commission and empower deployment team
  - . Values and metrics agreement across (vertical and horizontal) extended enterprise; Develop deployment toolset -- ‘War Room’
- Aggressively Implement - Just Do It!!!
  - . Stop analyzing; Deploy accountable teams; Provide experienced implementation expertise; Adjust deployment details at lowest level, as required

### **Selected Research Implications**

In analyzing supply chain integration, it is essential to understand the dynamics when values and assumptions are revealed -- such as in make-buy decisions or restructuring of supplier contracts. Managers and researchers also must anticipate system implications of increased interdependency, though they are often invisible in the abstract. In terms of measuring results, managers must assess the performance implications of more integrated supplier arrangements – divisions cannot be allowed to optimize their own numbers at the expense of other parts of the chain. Finally, it is necessary to look further upstream to assess supplier and lean implications at the time when an initial program is established – at that time exploring assumptions about customer preferences and industry capability

### III. Textron Long Term Agreement Initiative

*Presented by the Textron Systems SFW Group*

“The supplier base was always in trouble in the past. If you talked to an engineer about a problem, it was always [the supplier’s] fault. That attitude has really changed.”

-- Textron Presenter

#### Background

Textron Corporation has operations in five major sectors: Aircraft, Finance, Industrial, Automotive, and Systems & Components. Textron Systems, in the last group, builds products in three main segments: Electronic Systems, Commercial Products, and Smart Munitions. The LTA Initiative was originally launched by the SFW group, but is now being implemented business-wide.

#### Developing the LTA Initiative

The Long Term Agreement Initiative grew out of an earlier effort, *the 10 X (Ten Times) Lean Initiative*. The 10 X program set a goal of ten-fold improvement in identified processes within one year. The procurement department at Textron Systems worked to achieve this in three steps.

The first was to develop a map the *procurement process flow*, broken down into five steps: Administrative, Pre-Award, Award, Post Award, and Miscellaneous. Based on this map they did a baseline assessment of how the process was working, and identified significant “low-hanging fruit.”

Sample Metrics used in the assessment:

- Audit & Compliance percentages
- Buyer Cycle Times
- Delivery Status

An example of an opportunity was the excessive time it took to get requisitions out. The team attacked the problem by developing an electronic system that puts orders directly into the buyer’s queue. As a side benefit, the process enhancements led to a 50 percent reduction in the size of the procurement manual.

The second step was to implement the *Best Value Concept*. The idea was to look at the total cost of acquisition and ownership – overall quality, delivery and affordability – instead of just the initial price. As a result, the group may pay more up front, but realizes less expense overall. Major savings have been attained by getting rid of problems caused by parts that were cheaper to procure, but ultimately more costly to use in production.

To enable the Best Value approach, Textron created *Supplier Evaluation Teams*, comprised of buyers, quality engineers, and product engineers. These teams began working day to day with

suppliers to look at the procurement process, identify improvement opportunities, and evaluate ways that both Textron and its suppliers could alter their processes to achieve better results. The teams are supported by two full-time financial analysts, who often offer valuable insight on where cost can be reduced.

### **Working with Customers and Suppliers**

To help open communication channels, Textron brought in representatives from its customers to meet with suppliers, and expanded annual supplier conferences to include more product lines. This helped convey customer requirements, and gave suppliers an opportunity to present improvement ideas to users downstream in the supplier chain. Going forward, these conferences are now growing to include second and third tier suppliers. The deeper communication also extends to design functions, where Textron engineers now have much more interaction with suppliers. In one instance, it has extended to involving suppliers in a development program.

Textron also invites suppliers into its training sessions, and has run special training sessions solely for suppliers. For instance, a seminar on statistical process control was identified as particularly useful. The strategic intent of the group was to disseminate the enablers of high quality and lower cost throughout the supply base.

The third phase is to implement *Long Term Agreements* (LTA's) linked to incentive and recognition systems that reward top suppliers. The system is called the *Best Value Selection and Supplier Management Process* and identifies best value suppliers through, a supplier rating system, total cost (as opposed to lowest price) criteria, and the presence of a continuous improvement process. Attributes of a Best Value Supplier can be found in **Exhibit 1**.

#### **Exhibit 1**

##### **Attributes of a Best Value Supplier**

- High Quality
- Continuously Improves Affordability, Reducing Supplier Costs and Total Cost of Ownership
  - Is Approved
  - Is Certified
  - Is Preferred
- Always meets Delivery Commitment
- Continuously Reduces Process Variability Through SPC
- Team Player
- Facilitates Open Communication
- Provides TS with a Competitive Advantage

## Supplier Categories

Textron has three supplier categories:

**Approved** – A supplier that has met minimum requirements through a Pre-Award Survey or by qualifying through the Government Qualification Process.

**Certified** – A supplier that has demonstrated “exceptional quality performance” during a certification examination period.

**Preferred** – A supplier that achieves a consistent reduction in the variability of critical processes while improving delivery and affordability.

Once a supplier is certified, Textron no longer tests and approves all incoming shipments, and instead relies on random sample testing. To reach this stage, a supplier must have a 90 percent rating and must have previously sent three perfect shipments. Suppliers also have to sign a critical process control agreement stipulating that Textron suppliers cannot change their suppliers without notifying Textron. Beyond those companies it works with most closely, Textron now applies these three levels of certification across all its programs, with the goal of certifying suppliers to the preferred level even when there is no immediate logic to execute an LTA.

## Developing Long Term Agreements

Textron has currently developed 25 LTAs covering 118 parts through the program. Most of these LTAs are 5 year agreements, though some are 3 years. LTA's now comprise 73 percent of the group's procurement, by dollars.

Implementing LTAs is conceived as a 5-step process:

1. Understand baseline and define scope
2. Selection criteria to meet objectives
3. Develop terms and conditions
4. Execute procurement process
5. Supply chain continuous improvement and measurement (metrics).

The “Best Value” selection method is broken down into four weighted components: Quality (40 percent), Price (30 percent), Delivery (15 percent), and Responsiveness (15 percent). Gainsharing from continuous improvement is usually split 50/50, with 50 percent of the savings going to the supplier, and 50 percent to the end customer (which often prefers to take the savings in kind by placing additional orders). Through this program, Textron's overall supplier base has contracted from 72 to 49 suppliers. Casting suppliers were reduced from six to two.

One benefit of the new system is the enhanced ability to do pre-planning. People in the procurement department are now able to work on requisitions in February that will not actually arrive until April. This helps buyers meet the month to month goals by which they are evaluated. Across the supply base, Textron is increasingly using “we get / you get contracts” where as soon as a contract is let to Textron, the supplier knows immediately that they will get pre-arranged pieces of the work. Other benefits to suppliers are listed in **Exhibit 2**.

## **Exhibit 2**

### **What Suppliers Can Expect from the New System**

- A right to share in savings
- Certification
- Earned Evaluation Benefit as “Best Value” in source selection
- Open communication
- Feedback on performance
- Participation in buyer-sponsored training
- Long-term business relationships

### **Future Directions**

The near-term SFW objective is to beat the “Design to Unit Production Cost” or DTUPC goal set for 1998. Textron sets these goals by talking to suppliers, looking at percentage changes over time, and plugging supplier data into the Textron cost model. Sometimes suppliers are reluctant to cooperate, but Textron finds this to be the case less and less often. Sometimes Textron finds that there is no more cost to take out of a given production process.

Textron Systems has also set stretch goals to:

- Improve the Cpk of all processes to a minimum of 1.33
- Certify all part numbers under LTA
- Establish challenging continuous improvement plans to improve quality and reduce cost
- Create a system to effectively and efficiently evaluate/implement proposed changes and share gains for mutual benefit
- Expand to all products / business lines.

## **Lockheed Martin Centralized Procurement Initiative**

*Presented by the Aeronautics Material Management Center*

### **Background**

The Aeronautics Material Management Center (AMMC) is the main procurement organization for all of Lockheed-Martin's (LM's) aeronautics programs: Tactical Aircraft, Airlift, and Reconnaissance / Advanced Development Programs. Programs covered include the F-16, F-22, C130, JSF, X-33, SR-71, as well as spare parts for the L-1011. Major production facilities are located in Marietta, Georgia, Ft. Worth, Texas, and Palmdale, California.

The main objectives of the AMMC are stated in a simple statement pinned to the wall of every employee on the Supplier Product and Process Improvement teams (described below):

- Reduce Cost
- Improve Quality
- Reduce Inventory
- Reduce the Supplier Base
- Reduce the Span Time

### **Origins of the Initiative**

Lockheed Martin undertook the centralization of procurement in 1995, based on the recommendations of a study done by external consultants. That study noted that materials were the number one area of cost concentration (47 percent of total costs), and, based on best-practice benchmarking, recommended that LM geographically centralized procurement and related functions.

At the time, LM had 14,000 suppliers, but just 2% (230) accounted for 75 percent of expenditures. Rejections of supplier materials were a major cost driver. LM also discovered that inventory comprised 72 percent of total assets, and that procurement staffing comprised almost 5 percent of total employment for the company in the sector. The goal of the centralization initiative was to lower costs by better leveraging volume.

The first stage of consolidation was to go to each of the three main divisions and document their current processes. This helped identify best practices and get people thinking about a future state. The group then brought in other stakeholders, such as quality control, to develop a "to be" definition. They then did a gap analysis comparing their current state and desired future state and began drilling down into the details of how to make the future vision work. To support this process, the group built a dedicated room where people could come in and monitor the progress of the initiative, and use simple tools (such as post-it notes) to think about training and CQI processes.

Under the new program, procurement was split into two categories: Central Operations and Site Operations, detailed in **Exhibit 3**. About 60 percent of the procurement staff is now located in

Ft. Worth (AMMC headquarters). About 85 percent of materials procured are for the Ft. Worth and Marietta plants.

### Exhibit 3

#### Central Operations vs. Site Operations

##### Central Operations

Procurement  
Procurement Quality Assurance  
Acquisition Reform Initiatives  
Advanced sourcing  
Management, Administration, Legal

##### Site Operations

Procurement for Development Programs  
Integrated Product Teams Support  
Engineering R&D, New Business Support  
Emergency Site Requirements  
Reports Solid Line to Central

#### Consolidating Groups

Lockheed Martin pursued consolidation strategies for four groups:

##### *Major Production*

- Aggregation of Requirements / Leveraging Suppliers
- Purchasing Commodity Teams
- Supplier Product and Process Improvement
- Preferred Suppliers

##### *Minor Production*

- Long-term Purchasing Agreements
- Group Purchasing Agreements
- Outsource Non-Strategic Work
- Standardization

##### *Indirect Material & Services*

- Standardization
- Migration to “Best Contracts”
- Long-Term Agreements
- Integrated Supply Concept

##### *Procurement Quality Assurance*

- Sector Quality Terms & Conditions
- Reduced Inspection
- Expand Supplier Management Programs

For minor production, LM was able to aggregate some purchase orders with other divisions of Lockheed-Martin and even with some suppliers. For Indirect Material & Services, LM was able to reduce procurement costs by setting standards on things like gloves and office supplies. They took the Granger catalogue and put it in barcode form so that orders can now be placed with a light pen, which sends the request straight to vendors.



## Lean Initiatives

As part of the centralization initiative, LM began working more intensively across divisions and with suppliers to reduce cost. Initiatives under this rubric included Supplier Integrated Product Development, Commodity Teams, the STAR / Select Supplier Certification Process, SPC Certification, and working with suppliers on product / process improvement.

The process was essentially two-fold:

- 1) Identify suppliers where LM could leverage volume to reduce cost, and
- 2) Improve supplier performance.

For the second of these, improving supplier performance, there were four main methods:

- Using Lean Principles, Value Engineering, Six Sigma, and Kaizen Tools
- Eliminating Non\_Value-Added Processes & Requirements
- Using Alternate Materials & Sources
- Applying Commercial Practices

Generally, LM aims to certify all of its suppliers through the “STAR” standards (which all of LM’s internal suppliers already meet).

Four sets of suppliers were targeted for intensive interaction, those with: 1) significant dollars per aircraft, 2) high potential for savings, 3) potential for long-term relationships, 4) quality and delivery problems. Companies selected were then asked to participate in *Supplier Process and Product Improvement (SPPI)*, through which teams were assembled that included AMMC personnel, engineering leads from the production sites, and supplier personnel.

## Supplier Process and Product Improvement

In 1997, these teams commenced on *Phase 1* of SPPI, which consisted of information gathering on high cost and problem areas, creative workshops (see **Exhibit 4**) to implement analysis tools and identify high pay-off projects, and a prioritization process to formalize cost / benefit analyses and conduct risk assessment. These steps were normally accomplished over the course of about four weeks. For a project to get green-lighted out of this stage, it had to promise a relatively high return on investment, and had to have a champion. The last step was to begin implementing the projects and capturing the savings.

Brad Deacon, representing Allied Signal (which was the supplier in 3 of 9 initial SPPI pilots), commented that the initiative had been much better implemented than earlier LM efforts in the area. He identified three key elements of the superior roll-out: 1) the fact that suppliers were brought into the process at a much earlier point and given thorough training on the initiative and tools to be used, 2) exceptionally well managed communication throughout the process, and 3) successful work on the part of AMMC to get other groups within LM on board, especially engineering.

In 1998, LM will move into *Phase 2*, which will consist of team training in lean manufacturing principles, kaizen, and Six Sigma. The group will also stage Kaizen events focused on process mapping, immediate enhancements, and long-term improvements. Phase 2 will also include extension of the program to second and third tier suppliers.

#### **Exhibit 4**

##### **Creative Workshop Tools and Techniques**

- Ongoing Supplier Initiatives Review
- Review Previously Identified Projects
- Facilitated Brainstorming
- Functional Analysis & Systems Technique (FAST)
- Pareto Analysis
- Statistical Process Control
- Control Charts
- Cause and Effect Analysis
- Cost Targeting
- Project Clustering, Rating & Ranking

##### **Results to Date**

So far SPPI initiatives with 9 suppliers have been launched. From these, 200 projects have been identified, 126 are in progress, and six have been fully implemented. From these last six, LM estimates it has saved \$550,000 in instant contracts, and \$1.6 million in future contracts. Savings on other identified projects are expected to reach \$56.6 million for deliverable hardware, and \$148.3 million on logistics support by 2003. About 20 projects are going to be launched with C-130 suppliers this spring. Lockheed Martin stated it was committed to sharing savings from improvement efforts with suppliers.

Overall the centralization initiative has “booked” \$208 million in savings (as audited by the corporate staff) and is expected to achieve another \$365 million from commitments made for future procurement. The AMMC goal is to achieve \$410 million in savings as part of the Corporate Cost Reduction Commitment. More than \$30 million of these savings are expected to come from consolidation of purchasing for indirect materials such as office supplies. Personnel savings have been only a small percentage of the gains to date. Lockheed Martin believes the value of the program is even greater than the savings figures reflect because it is helping the company develop lower bids for new projects.

The long-term potential savings estimate from the consultant study were in the \$2 billion range, but Lockheed Martin estimates it missed 35-40 percent of these savings in the year it took to ramp up, largely because of the need to make new purchasing commitments.

Under the new system, STAR suppliers have increased from 49 to 142, and SPC suppliers have increased from 606 to 694. Product yield has increased from 99.8 to 99.9 percent (across 44 million pieces received) and the supplier base has shrunk 36 percent. Inventory turns have increased 36 percent, span times have fallen 2 percent, despite an increase in industry lead times of 16 percent.

### **Future Directions**

There are still some challenges to be faced under the new system. Even after centralization, LM must use two different systems to handle orders originating from Marietta and Ft. Worth. More broadly, there is some concern about suppliers sharing innovations with other primes that compete against Lockheed Martin. So far, the firm has adopted a philosophy of not tying suppliers hands by trying to rein them in.

To improve implementation of the program under Phase 2, a survey was sent to all AMMC employees, yielding 432 responses (45 percent). Though 75 percent viewed the initiative favorably, the feedback was that AMMC needed to increase the focus on employee communication, promoting team building, conducting participative management training, and improving supplier communication.

#### **IV. Supplier Relationships in JDAM's Transition to Rate Production**

*Presented by members of the extended JDAM's supply team*

For the shift to the production phase for the JDAMs (Joint Direct Attack Munitions), Boeing Aircraft and Missiles in Missouri has attempted to implement a Lean production system incorporating elements from the Lean Enterprise Model (LEM). The production system is set up on a “kanban” model, where all the inventory is kept on the factory floor, and there is only enough inventory kept on hand for three units. It is currently ramping up to a production level of 20,000 units a year.

Several factors have enabled the JDAM team to implement this system (see **Exhibit 5**). First the project was designated as a DoD acquisition pilot project. Second, the group created IPTs at both the executive and product level that involved both suppliers and the government.

##### **Exhibit 5**

###### **Enablers**

The JDAM Production System will achieve the vision and produce quality products which exceed our customer's expectations by embodying these enabling principles:

- Continuously improve processes, products, and people
- Perform our work as a self-directed work team
- Train team members to be cross-functional
- Produce on demand – neither early or late
- Instantly identify waste by maintaining a visible factory
- Ensure quality through process control
- Work intimately with our supplier partners

Third, Suppliers were brought into a preferred supplier certification program, and most entered into long term, performance based contracts. The 22 suppliers on the program are put into one of two categories: 1) Major-critical (9, which have Class II change authority), and 2) Others (13). Both sets are part of LTA efforts, and metrics and predictive indicators are shared throughout the chain (see **Exhibit 6**). The certification system rates suppliers on the basis of deliveries and quality, with 100% in both categories being gold, 95% and 99% respectively being silver, and 90% and 98% being bronze. Gold levels are required to maintain cost and schedule at planned production rates. So far, supplier delivery and quality performance are not yet at target levels, but the group feels they have built a positive, supportive relationship with suppliers to meet specified goals in the relatively near term.

Focusing on supplier relations was particularly critical for the program, as procured materials constitute more than 90 percent of JDAM cost. Boeing does no fabrication in its own facilities, and

production personnel levels are on a downward ramp from 120 (EMD phase) to 12 (production phase), with 65 currently working on the start-up.

## **Exhibit 6**

### **Supply Chain Relationship Principles**

- Affirmed commitment to the visions
- Open and honest communication
- Mutual trust
- Incentives beyond complying with the contract
- Self-directed team with Boeing leadership
- Decisions made at the lowest possible level

Fourth, the IPTs developed “electronic co-location” which allowed them to securely share unix files. Lastly, to enhance flexibility on the production line, Boeing negotiated a single mechanic classification for the project with the IAM. Throughout the process, the team focused on key process controls (e.g., getting CPKs up to 1.33 – currently more than 70 percent meet or exceed this level). Inventories currently run at 1-3 months of stock, and the facility is producing at a rate of less than 12 turns a year. The goal is to be at more than 100 turns within five years.

### **Going Forward**

The group feels they have several major challenges to work on in ramping up production. One is to re-energize the executive-level IPT to ensure sponsorship at top levels and ensure that aggressive targets are met. A second is to launch two production initiatives. LRIP 1 will focus on process improvements such as shipping and storing all parts in re-usable containers, reducing inventory levels down to 3-4 days, optimizing trucking routes, and continuing to conduct training in lean principles. LRIP 2 will implement bi-weekly demand-based shipments, and begin more heavy reliance on electronic integration.

## **V. Keys to Supply Chain Integration**

As an exercise in thinking through supply chain issues, dilemmas in the Boeing JDAM example were considered in six break-out discussions. Each group consisted of a mix of participants representing a cross-section of industry representatives. Report-backs follow.

### **Group A – Enabling procurement/material management functions to be a strategic partner through training and development**

A curriculum to provide training and skills within the procurement function should include:

- Negotiating partnerships, not just contracts
- Knowledge of products, commodities
- Knowledge of engineering and manufacturing processes
- Cost accounting and forecasting principles
- IPT membership and capability to coach
- Citizenship in industry
- Principles of “supply chain management”
- Principles of system integration technology

### **Group B – Organizational Issues in Implementing LTAs**

Purchasing, procurement, material management, and restructuring should be coordinated on a real time basis with business operation restructuring. Successful computer system integration will depend on coordination with restructuring

It is not necessary to completely centralize or decentralize. A balance can be driven by system/people capabilities, nature of operations, nature of materials. Example: Centralize commodity items, decentralize custom and subcontract items.

### **Group C – Forming Strategic Partnerships**

The following were deemed the critical elements of forming strategic partnerships:

- Get senior management buy-in, commitment, and support
  - Develop methods, process, and specific procedures for strategic partnerships
- Develop business case and plan
  - Exit Criteria
- Develop “win-win” strategies and mechanisms
  - Maximize benefits while minimizing associate liabilities; i.e., “don’t tie me up”
- Seek out opportunities for reward and recognition
  - “Nurture” relationships

### **Group D – Supplier Integration in Production and Sustainment**

How do you continue to integrate suppliers and maintain productive partnerships?

- 1) Regular meeting of executive IPT (example: LEM)
  - Include supply chain
- 2) Set and support the vision of the value stream (example: Toyota SSP)
  - Quantifiable goals with incentives
  - Active information flow
- 3) Enable change through a strategy which includes (example: Boeing, St. Louis)
  - Business practices
  - Tools
  - Culture
  - Organization
  - Education and Training

All of the above need to permeate the organizations

- 4) Respond to and anticipate change throughout the value chain (example: JDAM).

### **Group E – Supplier Integration in Design and Engineering**

Recommendations

- 1) Leadership should make conscious decisions to implement, advocate, nurture, support and makes a long term commitment to supplier integration
  - Provide significant compensation and rewards at all levels to support total team success (Rewards and Punishments?)
  - Leadership must follow through on decisions and delivery of support (funding, resources) necessary to bring about the change to supplier integration.
- 2) Establish and uphold business relationships with suppliers that incentivize their commitment and support (hard guarantees)
- 3) Implement a process or group to facilitate and assure supplier integration

### **Group F – Communications and Trust**

- Adopt/ implement/ invest in aerospace sector electronic commerce with appropriate security to support entire supply chains
- Put legal and contracts on IPT's with responsibility for streamlining protected information sharing and for developing reward sharing across the supply chain
- Establish team-based financial and other incentives that flow directly to individuals based on improvements in cost, quality, on-time delivery
- Implement frequent, personal communications between top executives and team members to achieve positive reinforcement of corporate commitments.

## **VI. Addressing Problems in Supply Chain Integration**

There are a number of problems and potential conflicts that arise in closer integration with suppliers, including potential diffusion of best practices to competitors, erosion of incentives to perform with increased security, and managing inevitable strains in the relationships. Several of these were considered in turn by the group.

### **Potential Problem 1: Deep information sharing and production improvement with suppliers runs the risk that suppliers may use these products and capabilities in their business with the prime contractor's competitors**

#### *Best Case Scenario:*

- Joint efforts facilitates continued improvement (cross-flow of ideas)
- Joint efforts expand the business base, providing greater opportunities for improvement
- Joint efforts demonstrate commitment to long-term relationships and creating an environment such that the team wants to work together on other projects

#### *Worst Case Scenario:*

- Primes risk loss of key unique capabilities in bidding for future programs

#### *Recommendations:*

- Don't tie suppliers hands
- Ensure subcontractors advance notice on future competitions

### **Potential Problem 2: Ensuring control and alignment with sub-tier suppliers on design changes**

#### *Best Case Scenario:*

- Clearly defined product requirements
  - Flow down to all tiers
- Mutually agreed upon specifications to meet the requirements
- Clear communication – information flow down and up the chain

#### *Worst Case Scenario:*

- Vague requirements
- “Guard-banding” what is truly needed

#### *Recommendations:*

- Cross-supplier IPT to define clear / “real” requirements
- Continuous improvement of communication / information flow

### **Potential Problem 3: Managing the hand off within supplier organizations as JDAM goes from design to manufacturing**

Designs should not be “handed off” to manufacturing. They should be jointly developed by design and manufacturing functions.



IPT focus will place greater emphasis on manufacturing, freeze/block changes

*Best Case Scenario:*

- Little transition required. Hardware can be built with no change to make it producible. Prime contractor has verified process capabilities at supplier to produce hardware as designed.

*Worst Case Scenario:*

- Incapable processes at supplier. Costly redesigns, missed delivery schedules.

**Potential Problem 4: Impact of turnover at executive level in supplier organization and in prime organization on supplier issues**

*Best Case Scenario:*

Executive team recognizes a change mission and convenes to renegotiate their new mission (production and execution), roles, membership, and agreements for success.

*Worst Case Scenario:*

- Executive team members that made initial decisions and commitments lose focus on the “common purpose” or move off the team – winner vs. executor mentality

A – CEO at subcontractor turns over

B – Supplier is acquired by a competitor

*Recommendations:*

- Convene Refocusing meetings on a regular basis throughout a program’s life cycle.

**Potential Problem 5: Ensuring the demand flow capability of suppliers.**

*Recommendations:*

- Recognize long term relationships
- Understand capabilities on the team, and the opportunities
- Product yield predictability
- On-going validation of capacity management
- Frequent visible two-way communication of schedule status and issues
- Transportation planning and contingency

**Potential Problem 6: Ensuring reverse diffusion of innovation**

*Best Case Scenario:*

- Team exceeds cost, quality, and delivery goals via open sharing of ideas
- Get follow on contracts

*Worst Case Scenario:*

- Loss of contract to Lockheed Martin
- Future business jeopardized resulting from:
  - Breakdown of Communication
  - Lack of resources
  - Over-specification by contractor

- Supplier unable to deliver (re-bid required)

*Recommendations:*

- Effective means of communication
  - Electronic commerce systems that span the supply chain
- Incentive programs (individuals as well as companies)
- Team management (to manage turnover)
- Early involvement in engineering changes
  - Performance based specifications

**Potential Problem 7: Assuring effective team-level decision-making on supplier issues**

*Best case Scenario:*

- Smooth transition
- Right information to right people at the right time
- No functional dependency problems between suppliers

*Worst Case Scenario:*

- No clear decision-making process
- Fail to meet cost goals
- Late/Bad decisions

*Recommendations:*

- Continue electronic communications
- Bi-weekly teleconferences with each supplier
- Document team decision process
- Rebuild team working relationships

**Potential Problem 8: Which metrics should be shared with suppliers – which ones, how frequently**

*Best Case Scenario:*

- Metrics:
  - Delivery
  - Cost
  - Quality (supplier defects)
  - System-wide (company-customer)
  - Metrics shared monthly
- Other sharing besides Metrics:
  - Production forecasts
  - Cost performance

*Worst Case Scenario:*

- No metrics, no communications, arms length relationship

*Recommendations:*

- Ensure sharing by whole team

**Potential Problem 9: Uncertainty about the future government role in supplier certification and development**

*Recommendations:*

- Government funding directed at lean practices and the enablers of gold certification
  - front loaded investment
- Continued economic incentives to meet or exceed improvement curves
- Government as “user” to provide performance feedback to the team for improvement opportunities.
- Government shouldn’t dictate terms, over-regulate teams, or fail to provide incentives.
- Government is clearly a long-term member of the IPT.

## **Appendix 1: Workshop Design Overview**

### **The purpose of the workshop**

- *Data collection and shared learning for the benefit of the entire consortium -- driven by Implementation IPT*
- *Individual/organizational learning and linkages*

### **Attendees**

- Teams of 3-5 representatives from 14 organizations
  - *Customers and Suppliers*
  - *Competitors*
  - *Newly merged partners*
  - *Union and management representatives*
  - *Multiple organizational levels and functions*

### **Schedule**

#### **Day One**

- *Morning case study: Long-term agreements (Textron)*
- *Afternoon case study: Centralized procurement (Lockheed Martin)*
- *Five breakout groups meeting in morning and afternoon*
- *Keynote lunch presentation -- Toyota Supplier Support Center*

#### **Day Two**

- *“The Supplier Game” simulation*
- *Morning case study: Transition from engineering to manufacturing (JDAM -- Boeing/McDonnell Douglas)*
- *Small group analysis*
- *Sub-tier supplier panel*

## **Appendix 2: Notes on the Recommendations**

### **1. Centralization and Strategic Planning in the Procurement/Materials Management Function**

Enable procurement/material management functions to be a strategic partner through training and development

Training and skills should include:

- Negotiating partnerships, not just contracts
- Knowledge of products, commodities
- Knowledge of engineering and manufacturing processes
- Cost accounting and forecasting principles
- IPT membership and capability to coach
- Citizenship in industry
- Principles of “supply chain management”
- Principles of system integration technology

Purchasing, procurement, material management, and restructuring should be coordinated on a real time basis with business operation restructuring. Successful computer system integration will depend on coordination with restructuring

It is not necessary to completely centralize or decentralize. A balance can be driven by system/people capabilities, nature of operations, nature of materials. Example: Centralize commodity items, decentralize custom and subcontract items.

### **2. Strategic Partnerships**

- Get senior management buy-in, commitment, and support
  - Develop methods, process, and specific procedures for strategic partnerships
- Develop business case and plan
  - Exit Criteria
- Develop “win-win” strategies and mechanisms
  - Maximize benefits while minimizing associate liabilities; i.e., “don’t tie me up”
- Seek out opportunities for reward and recognition
  - “Nurture” relationships

### **3. Supplier Integration in Production and Sustainment**

- 1) Regular meeting of executive IPT (example: LEM)
  - Include supply chain
- 2) Set and support the vision of the value stream (example: Toyota SSP)
  - Quantifiable goals with incentives
  - Active information flow
- 3) Enable change through a strategy which includes: (example: Boeing, St. Louis)
  - Business practices
  - Tools
  - Culture
  - Organization

- Education and Training

All of the above need to permeate the organizations

4) Respond to and anticipate change throughout the value chain (example: JDAM)

#### **4. Supplier Integration in Design and Engineering**

- 1) Leadership makes conscious decision to implement, advocate, nurture, support and makes a long term commitment to supplier integration
  - A. Provide significant compensation and rewards at all levels to support total team success (Rewards and Punishments?)
  - B. Leadership decision and delivery of support (funding, resources) necessary to bring about the change to supplier integration.
- 2) Establish and uphold business relationships with suppliers that incentivize their commitment and support (hard guarantees)
- 3) Implement a process or group to facilitate and assure supplier integration

#### **5. Communications and Trust**

- Adopt/ implement/ invest in aerospace sector electronic commerce with appropriate security to support entire supply chains
- Put legal and contracts on IPT's with responsibility for streamlining protected information sharing and for developing reward sharing across the supply chain
- Establish team-based financial and other incentives that flow directly to individuals based on improvements in cost, quality, on-time delivery
- Implement frequent, personal communications between top executives and team members to achieve positive reinforcement of corporate commitments.

#### **6. Supplier Certification, Development and Diffusion**

Re-orient/Clarify Values and Metrics

From: Measuring You Suppliers

To: Measuring Total System Effectiveness

Multi-directional

Engagement

(Horizontal As

Well As Vertical)

Interdependencies

- Value Added Contributions

- Best Practices Contributions

**Risk/Reward Sharing Agreement**

## The “How”

1. Commission (by CEO) Values Clarification Team
  - Characterize Emerging and Strategic Business Needs and Priorities
  - Translate to Values and Operating Principles/ Behaviors
  - Simple Articulation for Enterprise Alignment -- ‘True North’
  
2. Commission and Empower Deployment Team
  - Values Agreement Across (Vertical and Horizontal) Extended Enterprise
  - Metrics Agreement
  - Develop Deployment Toolset, e.g., ‘War Room’
  
3. Aggressively Implement - Just Do It!!!
  - Stop Analyzing
  - Deploy Accountable Teams
  - Provide Experienced Implementation Expertise
  - Adjust Deployment Details at Lowest Level, as Required

## **Appendix 3: Team Notes on Supplier Integration in Engineering & Design**

Prepared by: Bob Akins, Lockheed Martin E&M

These notes reflect the raw data compiled by the team. The team's summary information as presented during the workshop was collected after the presentations.

### **Elements of Topic Definition** (listed in team's rank order of importance)

1. How to integrate suppliers early
2. Information flow ie. internal to functional and external to tiers
3. Collaborative design
4. Design to (X) Cost, etc.
5. Design tool compatibility and inter-operability
6. Overlap to mfg. and the rest of chain, ie., producibility
7. Cost & schedule commitment
8. Supplier developmental affordability ie., training
9. Reduce costs
10. Goal of cycle time reductions
11. Common goal throughout the chain
12. Customer and supplier integration - IPPD
13. Continuous communication
14. Process vs. mayhem
15. Prime customer commitment to suppliers
16. Issues of intellectual property
17. Identify true value throughout the chain
18. Trade offs to get at best value
19. Proactive approach to personal relationships within chain
20. When not to integrate suppliers
21. Training design engineers in IPPD
22. Cost sharing incentives

### **Top 3-5 Elements of Topic**

1. How to integrate supplier in design
  - Early involvement (varies across the chain)
  - Supplier selection and compatibility
  - Enabling organizational structure, philosophy and policy
  - Information flow throughout the process
2. Consideration across the full life cycle

### **Textron Case Study Observations & Comments**

- Started late in process and design was set
- Progressive supplier certification was a core component
- Unclear if they are trying to bridge the process to development phases
- A key distinction was long term agreement vs. long term relationship
- Process is driven only to 1st tier suppliers
- Groundwork is laid for early involvement in future efforts
- Concern: long term commitment is tied to near term performance
- Cost issue, are they avoiding costs or saving?



### **Engineering Integration Show Stoppers (listed in team rank order)**

1. Funding instability throughout supply chain
2. Lack of trust between customer & supplier, eg., Textron case
3. Partial implementation of new processes
4. Improper application of a proper implementation
5. Desire & education to work in a team environment
6. Participant buy in lacking
7. Development suppliers are not production suppliers
8. Favoritism shown within the team
9. Anti-trust/regulatory violations

### **JDAM Case Observations & Comments**

- A good start that stalled
- Primarily an assembly/integration house
- Electronic linkage is good start towards better tools
- Early executive involvement across the chain

### **Supplier Integration Insights**

- Suppliers not involved as “the way its always been”
- There are still many infrastructure barriers, eg., software, incentives
- Ford example - single product/single person equals ownership
- Pilot approach is recommended
- Rule based design implemented across the chain drives team & mfg focus of capabilities
- Must act on supplier recommendations
- Guidelines/checklist for implementing integrated product design needed (its an iterative process)
- Geographic separation still a significant issue - Email not enough! Need to build relationships!

## **Appendix 4: Notes on the Toyota Presentation and the Sub-Tier Supplier Panel**

### **Toyota Supplier Support Center**

Why establish a supplier support center?

- The thinking behind the system
- Applying the thinking

Application of the Toyota Production System in conditions of low volume and variable demand

- The concept of “True North”
- What is wrong with batch production?
  - High volume and low variety versus other conditions

- A deceptively simple question -- what do your customers (government and airlines) want?

“Customers in this industry behave the way they do within the constraints that the industry has set for them. If the industry had different capabilities, then the customers would behave differently.”

### **Sub-Tier Supplier Panel**

#### **Initial questions for the Sub-Tier Supplier Panel:**

- What is the recipe for trust?
- How do you want us to do business with you?
- How receptive are you to new ideas?
- Will you absorb hard costs or reduced lead times in exchange for assistance from OEMs?
- What is the motivation to be involved?
- How do you deal with multiple customers with different requirements and different certification programs?
- How much have you saved with lean principles?
- Is there a willingness to invest in exchange for long-term agreements?

### **Sub-Tier Supplier Panel**

- To build trust, show it in your behavior – no surprises (even with bad news)
  - Consider the following four combinations based on products and customers: 1) one product/one customer; 2) many products/one customer; 3) one product/many customers, 4) many products many customers – don't treat them all the same
  - For a small supplier, bidding on work may be betting the business – so give us advance notice, even when exploring options
  - It comes down to personal relations with individuals in the customer's organization – so restructuring can have a big impact
  - Long-term agreements enable business planning and job security for employees, but the rules are different
  - We can't set up dedicated lines for each business on low volume contracts (is this a barrier to lean? No, but it makes it harder)
  - Give sub-tier manufacturers a design allowance and build trust – so everything doesn't need to be requalified
  - Focus on overall value, not just cost
  - "Build to print" is a vague definition of responsibility and requires sensitivity
  - Integrated teams with suppliers can be a key source of competitive advantage
  - Customer focus on lean can help drive lean implementation in suppliers
  - Don't just communicate around bad news/crises
  - Manage trust at all levels
  - Use of dedicated business unit for each customer to manage different certification
  - Educate customers on "best value"
  - Standardize on the information and CAD/CAM technologies – give us an interface that we can use
- Conclusions
    - *Communications is critical*
    - *Process improvement needs to be an integrated activity*
    - *Sharing metrics is essential*
    - *You can't force capability*
    - *It's clear we have shared destiny*
    - *Flexibility in changing with the environment – metrics, communication, etc.*

## Appendix 5: Supplier Game

### The Supplier Game

This simulation involves process improvement teams from four different stakeholder organizations. Each organization has a program budget, part of which it can devote to process improvement. The overall program budgets are as follows.

Stakeholder	Program Budget
System Program Office	\$25 million
Prime Contractor	\$100 million
Tier 1 Supplier	\$50 million
Tier 2 Supplier	\$15 million

You have received mixed signals about just how much money can be devoted to process improvements. One thing is clear, however – your goal is to gain as much as you can.

In this simulation there will be at least seven opportunities to launch process improvement initiatives. In each case, your team will face a strategic choice – do you want to adopt a “Combined” or an “Independent” strategy? Based on your choice and the choices of other stakeholders, you can either gain or lose money relative to your program budget.

There is a great deal of slack and waste in your operations. In order to address this “muda” you need to spend money to save money. For either a “combined” or an “independent” strategy, there are certain staffing and other resource costs that you will spend even before you indicate your improvement strategy to the other stakeholders. The core issue is whether this spending is covered by subsequent gains or whether it ends up as a net cost.

Given all the slack and waste in the system, many “independent” initiatives will yield short term gains. There is a point, however, where too much “independent” activity will overwhelm the system and result in costs to everyone. While a “combined” strategy is very effective if all four stakeholders are involved, the costs will outweigh the benefits if even one stakeholder is not involved. The following payoff matrix illustrates these realities:

Mix of strategic choices	Gains and losses based on strategic choices
All four choose “Independent” strategies	Each stakeholder loses \$100 K
3 choose “Independent” strategies 1 chooses “Combined” strategy	“Combined” strategy loses \$300 K “Independent” strategies gain \$100 K
2 choose “Independent” strategies 2 choose “Combined” strategies	“Combined” strategies lose \$200 K “Independent” strategies gain \$200 K
1 chooses an “Independent” strategy 3 choose “Combined” strategies	“Combined” strategies loses \$100 K “Independent” strategy gains \$300 K
All four choose “Combined” strategy	Each stakeholder gains \$100 K

The reverse side of this information sheet provides an overview of the way the simulation will be run and a score sheet to track your progress.

Here's how the simulation will be run:

- Round 1:** Discussion within each team (2 minutes), followed by simultaneous presentation of strategies.
- Round 2:** Discussion within each team (1 minute), followed by simultaneous presentation of strategies
- Round 3:** Planning within each team (30 seconds), negotiations among all four team representatives (2 minutes), then discussions within each team (30 seconds), followed by simultaneous presentation of positions
- Round 4:** Discussion within each team (1 minute), followed by simultaneous presentation of strategies
- Round 5:** Planning within each team (30 seconds), negotiations among team representatives (2 minutes), then within each team (30 seconds), followed by simultaneous presentation of strategies.
- Round 6:** Discussion within each team (1 minute), followed by simultaneous presentation of strategies
- Round 7:** Negotiations among all team members at both tables (3 minutes), then within each team (1 minute), followed by simultaneous presentation of strategies.

Use this score sheet to keep track of your team's efforts in each round:

Your Starting Budget:

\_\_\_\_\_

	<i>Your Strategy</i>	<i>Other Three Strategies</i>			<i>Dollars you Won/Lost</i>	<i>Your Cumulative Budget</i>
<b>Round 1</b>	_____	_____	_____	_____	_____	_____
<b>Round 2</b>	_____	_____	_____	_____	_____	_____
<b>Round 3</b>	_____	_____	_____	_____	_____	_____
<b>Round 4</b>	_____	_____	_____	_____	_____	_____
<b>Round 5</b>	_____	_____	_____	_____	_____	_____
<b>Round 6</b>	_____	_____	_____	_____	_____	_____
<b>Round 7</b>	_____	_____	_____	_____	_____	_____

Simulation adapted by Joel Cutcher-Gershenfeld and Robert McKersie from "Win All You Can" by National Training Laboratories, 1997

***Combined***

***Independent***