16.660 / 16.853 / ESD.62J Introduction to Lean Six Sigma Methods
January (IAP) 2008

Lean Supply Chain Basics

Impact of Supply Chain Management

"Only 7% of companies today are effectively managing their supply chain. However, these companies are 73% more profitable than other manufacturers."

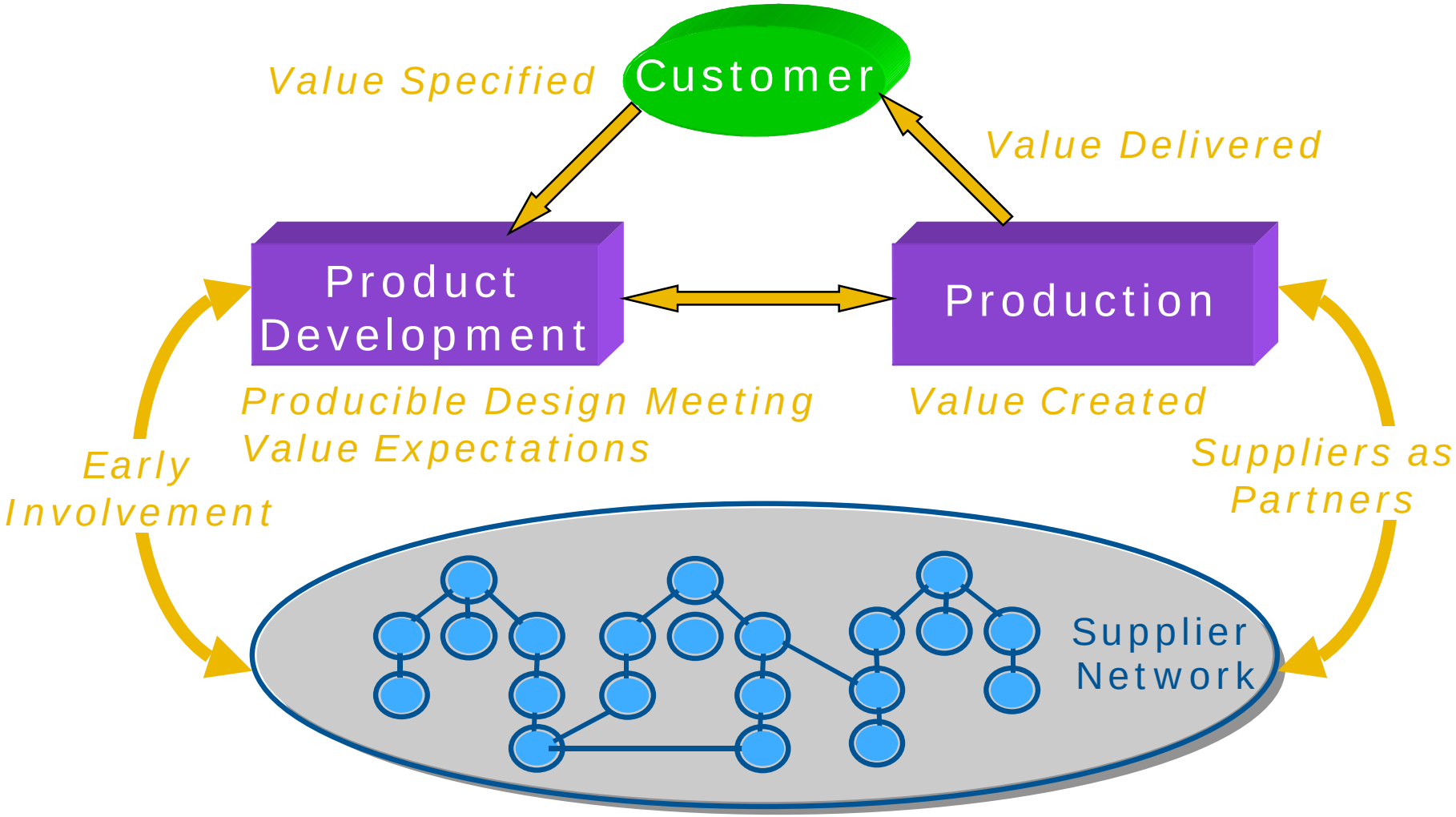
Deloitte & Touche Study, October 2003

Learning Objectives

At the end of the module, you will be able to:

- Recognize the importance of suppliers in the enterprise
- Describe key attributes of a lean supply chain
  1. Alignment of supply chain design with product characteristics
  2. Supplier participation in material flow and logistics
  3. Supplier involvement in design and development
  4. Seamless information flow
- Discuss methods for the improvement of existing supply chains

Suppliers Are Critical In The Value Chain



Typically, 60-80% of Value Added by Suppliers

What Does a Supply Chain Look Like?

End-user

Customer

Prime Mfg./ Supplier

First Tier Supplier

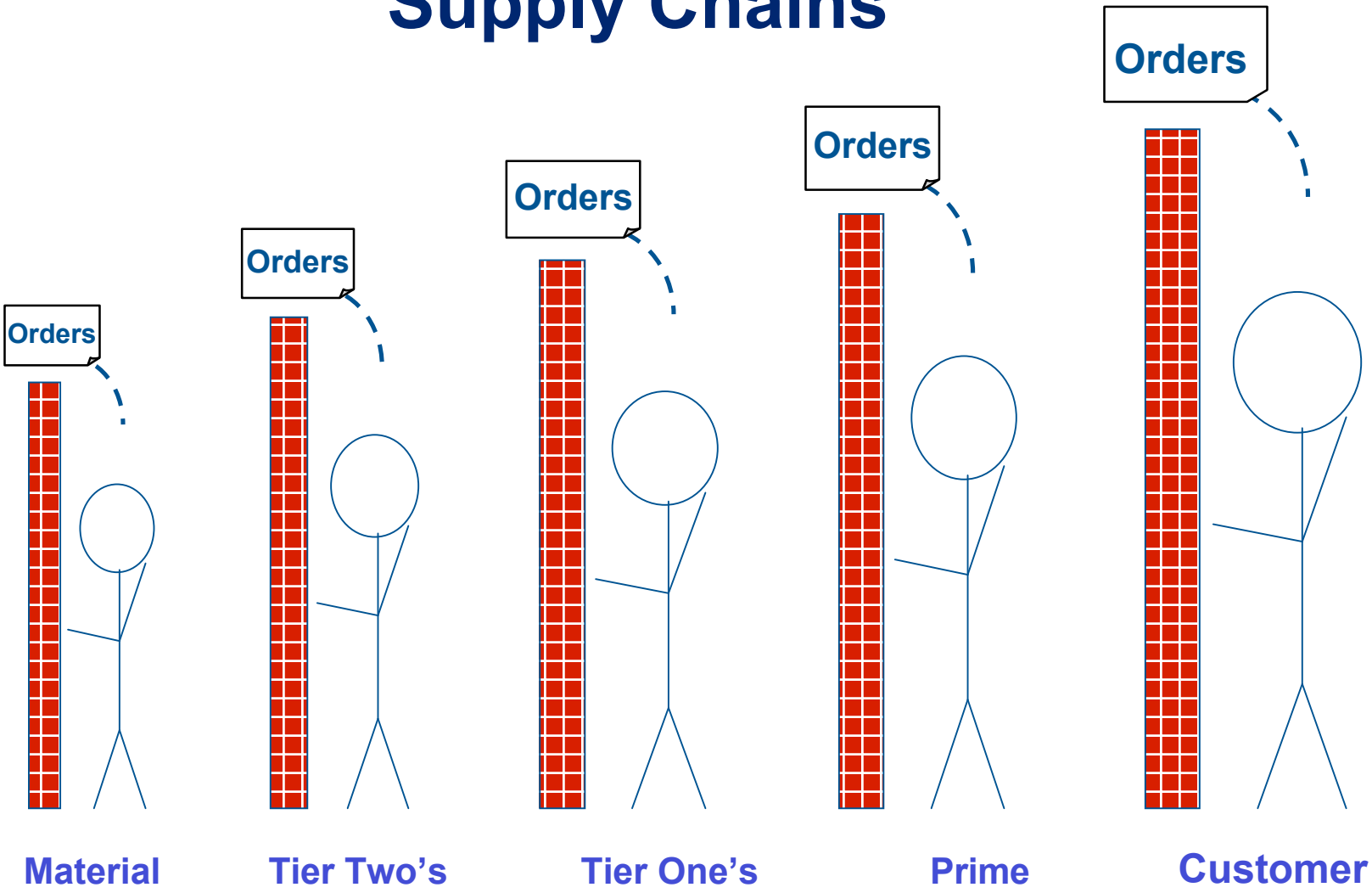
Second Tier Supplier

Material Supplier

Raw Material Supplier

As you move down the supply chain, each successive tier represents a smaller percentage of the Prime's main business base than the previous tiers.

Current State of Many Supply Chains



Communications across the supply chain is like tossing orders over a brick wall!

Lean Supply Chain Exercise

1. Gather your team around easel paper or a chart.
2. Discuss each concept on the list below.
3. On your chart, write a prioritized list of concepts that would best create a lean supply chain.

- Collaboration
- Efficient supply chain with little flexibility
- Limited communication
- Localized focus on continuous improvement
- Responsive and agile
- Based on product characteristics
- Enterprise approach
- Long lead times
- One supply chain for all products
- Supplier commitment to long term relationship
- Internal corporate focus
- Build to order
- Visibility of demand
- Continuous improvement activities that include suppliers & customers

Key Attributes of a Lean Supply Chain

1. Alignment of supply chain design with product characteristics
2. Supplier participation in material flow and logistics
3. Supplier involvement in design and development
4. Seamless information flow

1 - Matching Supply Chains with Products

- "Push" supply chain is focused on *efficiency* for meeting predictable demand at lowest cost.
  - Typically for long product lifecycle and mature or commodity items
- "Pull" supply chain is focused on *responsiveness* for unpredictable demand to avoid inventory & stock outs.
  - Typically for shorter product life cycle, custom items
- The reality is that a given product may have components of both the efficient and responsive supply chain designs. This approach has been labeled the Hybrid Supply Chain.

2 - Supplier Participation in Material Flow and Logistics

- **Just-in-time deliveries**
  - Eliminates inventory - but parts *must* show up on time!
- **Kitting for point-of-use**
  - Eliminates unpacking, looking for parts - requires supplier involvement in production system design
- **Vendor-Managed Inventory**
  - Vendor owns it, keeps track of it, until it is used
- **Third Party Logistics**
  - Have FedEx handle these?

Different supply chain designs require different practices

Atlas V Launcher Supplier Kitting and Direct Delivery

Vendor-Supplied Tubing (Old Method)
Conventional Packaging, handling and Inventory

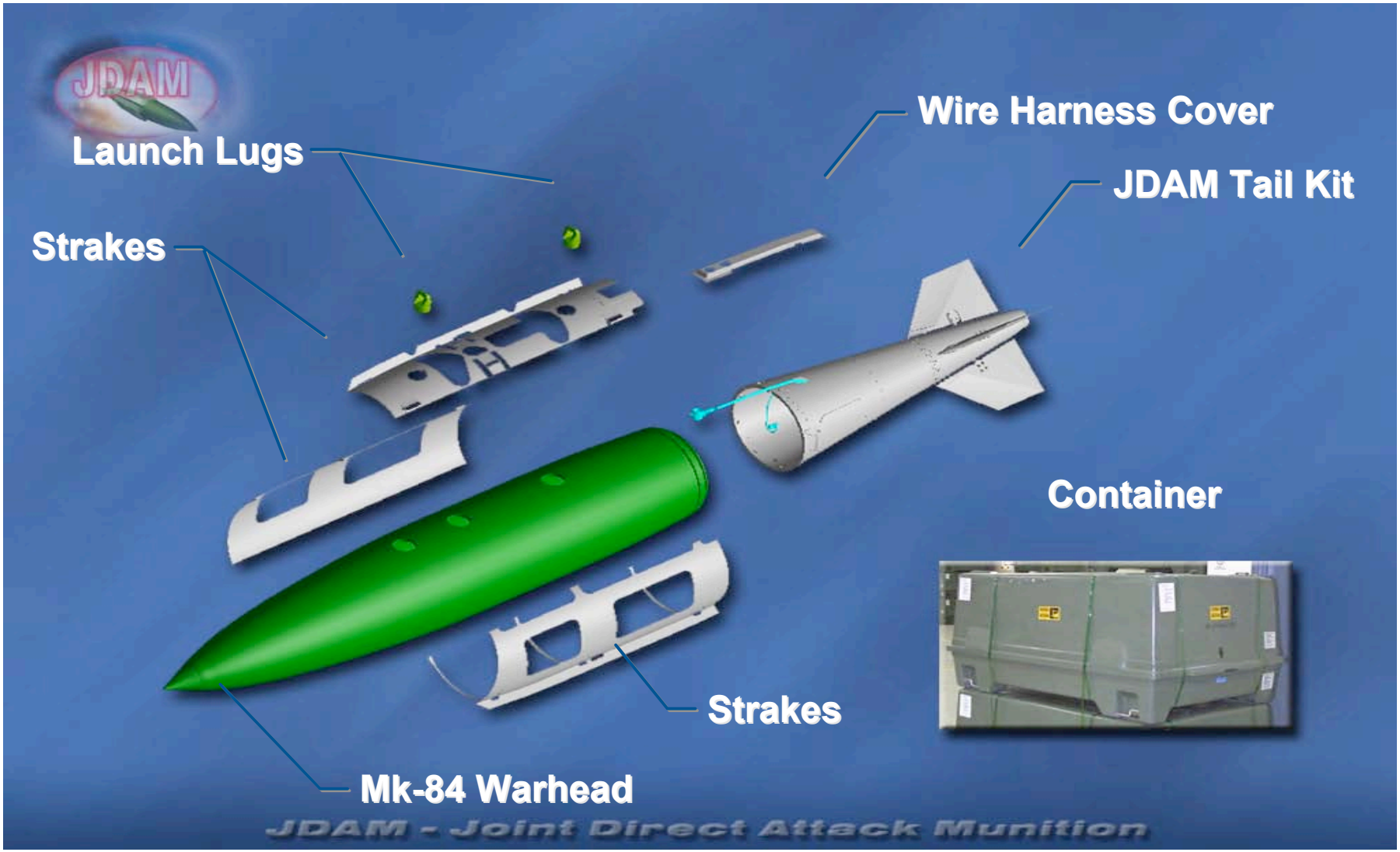
Vendor-Supplied Tubing (New Method)
Reusable Container and Shadow Boards

Photographs removed due to copyright restrictions.

Category	Reduction
Inventory Carrying Cost	$35,000 per ship-set
Internal Handling Cost	$12,000 per ship-set
Cycle-Time	20 weeks to 14 weeks

Source: Lockheed Martin Missiles and Space Systems

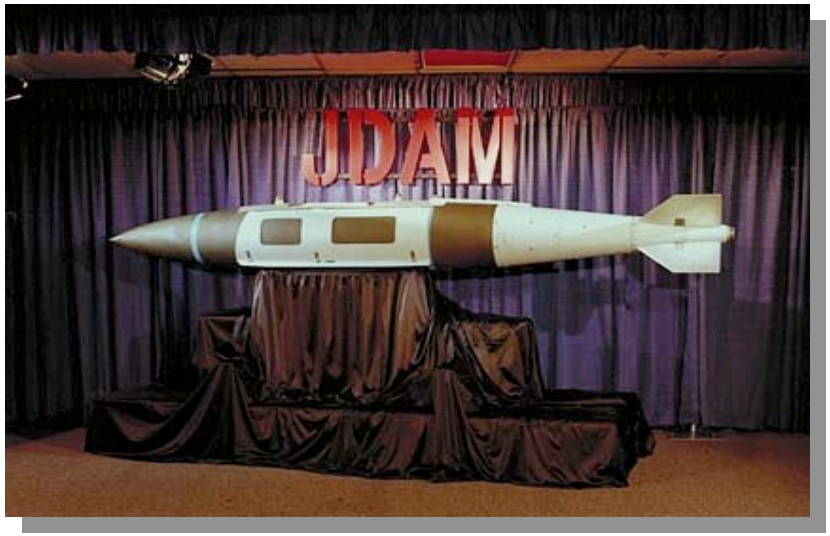
3 - Supplier Involvement in Design and Development



Courtesy of Boeing. Used with permission.

SOURCE: Karen E. Darrow (The Boeing Company), "The JDAM Experience: Lean Principles in Action," Presentation at the SAE Aerospace and Automated Fastening Conference & Exhibition, September 22, 2004.

Early Supplier Integration



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SUPPLIER INTEGRATION

- Part of *proposal* team
- Understood project goals - GOAL CONGRUENCY
- Understood requirement for low cost, seamless assembly

SUPPLIER VALUE CREATION

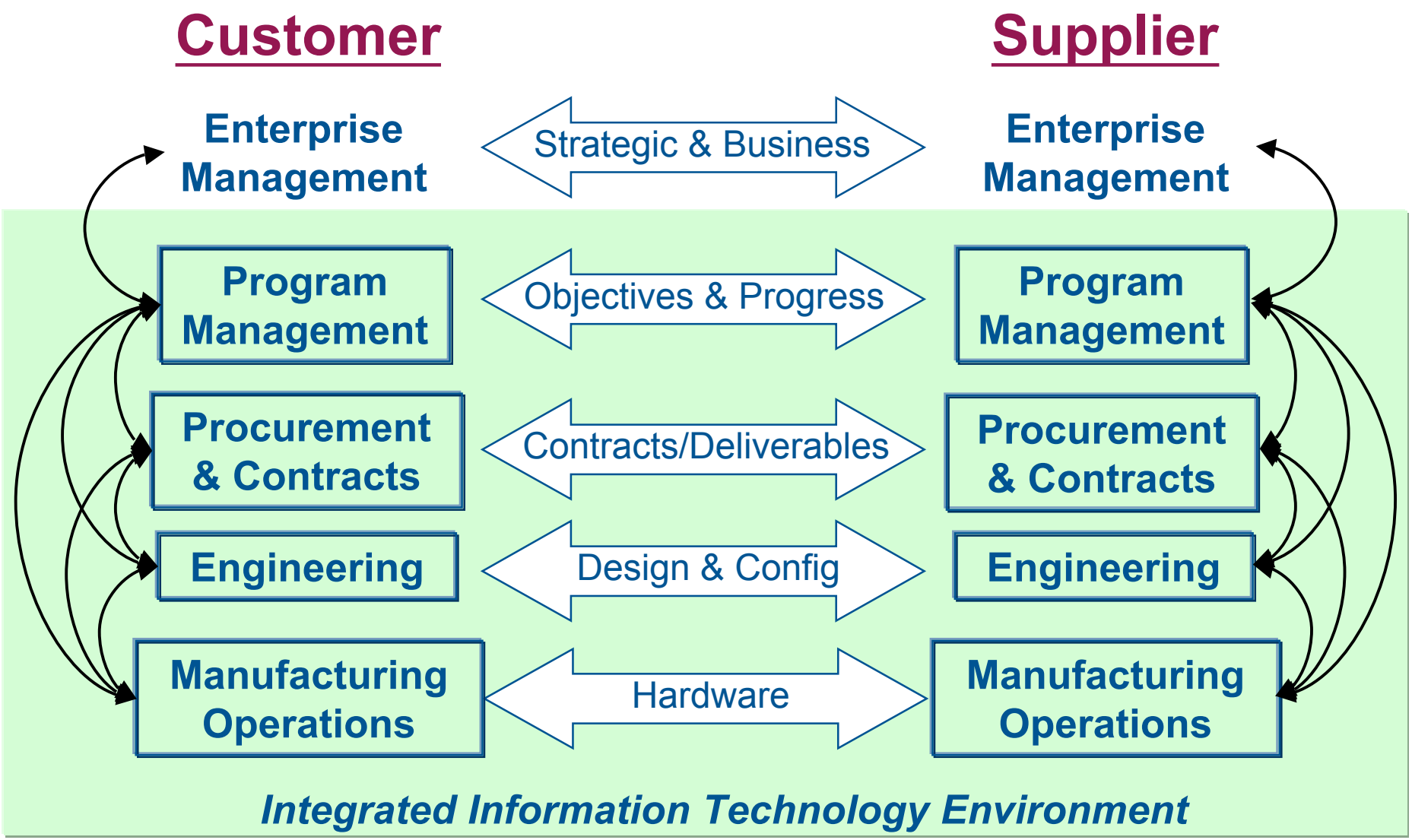
- Major modification to system architecture
  - From "partitioned architecture" to "integrated architecture"
- Reduced Wiring / Connectors
  - Reduced unit cost
  - Improved reliability
- Re-allocated "Work Share"

PRODUCT VALUE CREATION

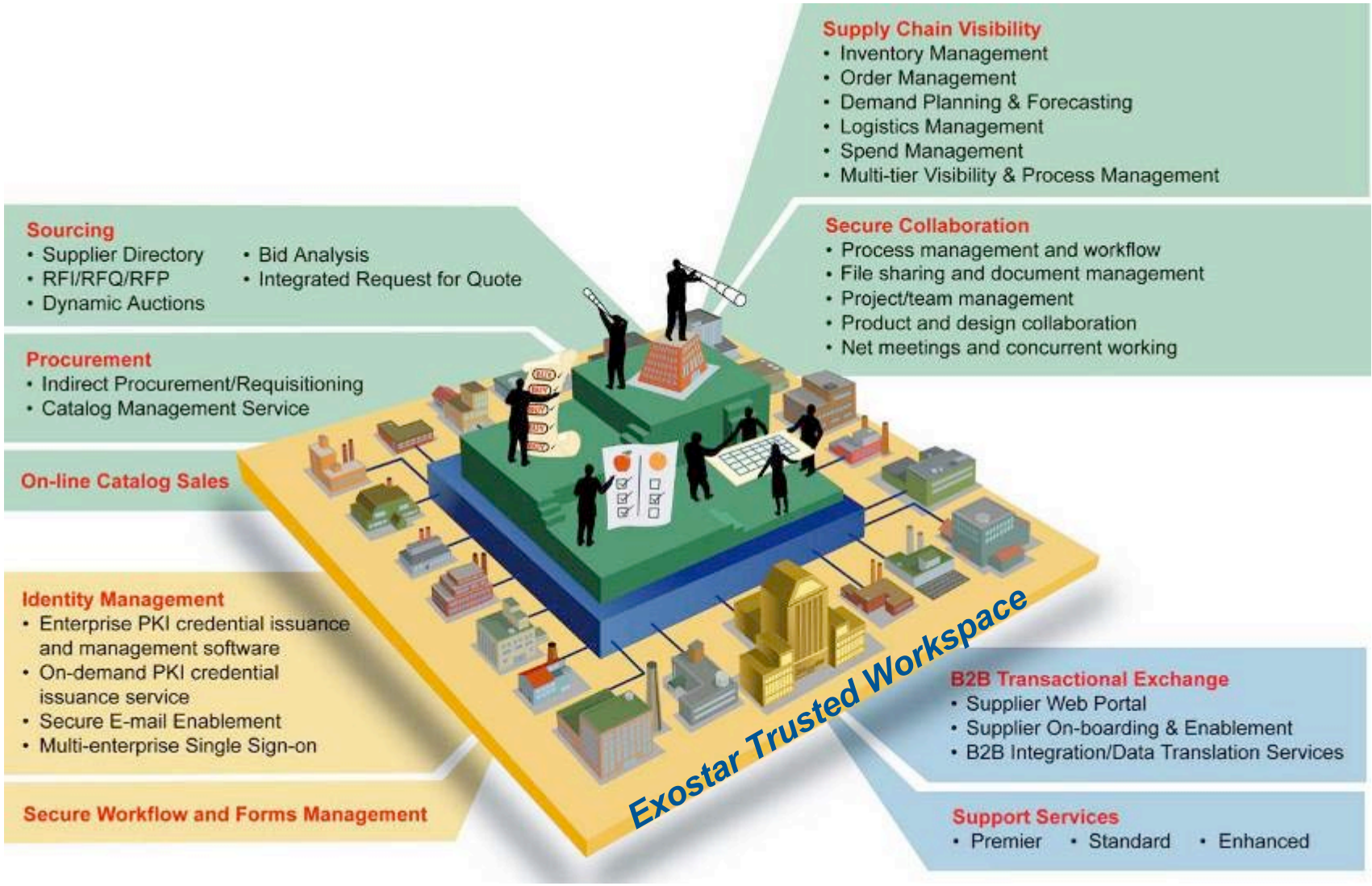
- Original cost est. - $68+ K
- Final actual cost - $15 K
- Unit costs reduced > 75%
- Total savings > $2.9 B

Ref: Lean Enterprise Value, pp 138-140, 206-207

4 - Seamless Information Flow
Requires communication on many levels



Exostar Offerings



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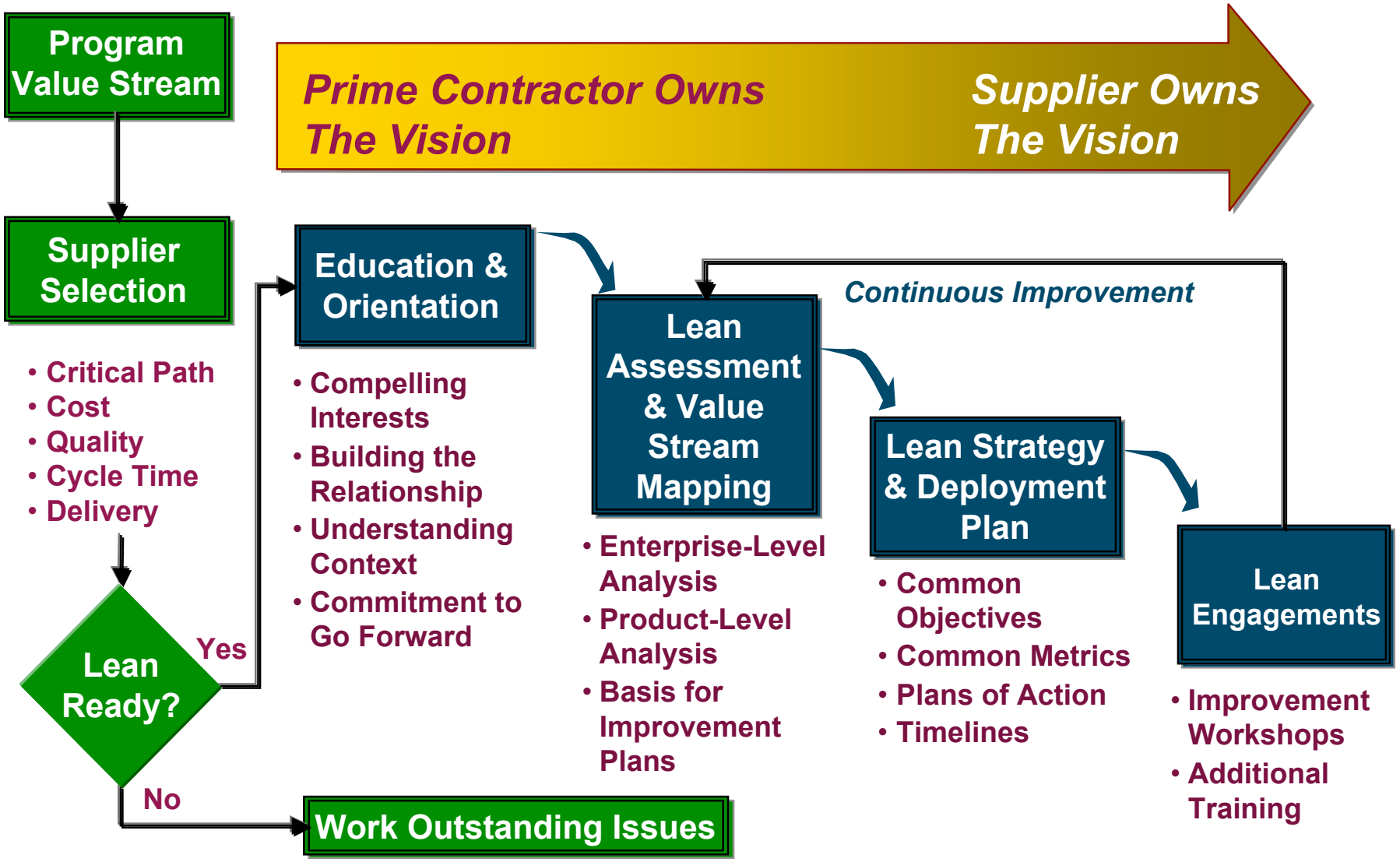
EXOSTAR Facilitates Supply Chain Management Streamlining

At Rolls-Royce the eProcurement implementation has produced a number of quantitative and qualitative benefits, including:

- **Rationalizing the direct supplier base from more than 5,000 to several hundred**
- **Reduction in cost of goods of up to 20%;**
- **Reduction in inventory value levels as much as 80%;**
- **Reduction in errors due to the elimination of manual re-keying of buying data;**
- **Reduced cycle time, in some cases by up to 80%;**
- **Near-elimination of paper and fax processes.**
- **Improved relations with suppliers, who have benefited from reduced transaction costs and improved efficiency.**

Improving Supply Chains



Example: Hicksville Machine Works Corp.

- Supplier worked with prime to implement lean
- Prime (Boeing) provided expertise and training for 5S, Statistical Process Control, and Set-up Time Reduction
- Savings shared, plus many additional benefits:

"... a good example of what good team work between a vendor and sincere Boeing personnel, ... can do. ... my Company is much more competitive than ever before. Following are some of parts we were able to reduce the unit prices on:

P/N	Previous Unit Price	New Unit Price
17P2A5224-1NC	$1815.00	$751.68
17P2A5821-1	$1992.00	$639.33
17P2A5829-1NC	$2531.72	$1024.00

These types of savings will apply to all parts we manufacture."

-Jack Spezio, President

Courtesy of Boeing. Used with permission.

Supply Base Stratification - Five Levels

Strategic Alliance

Certified

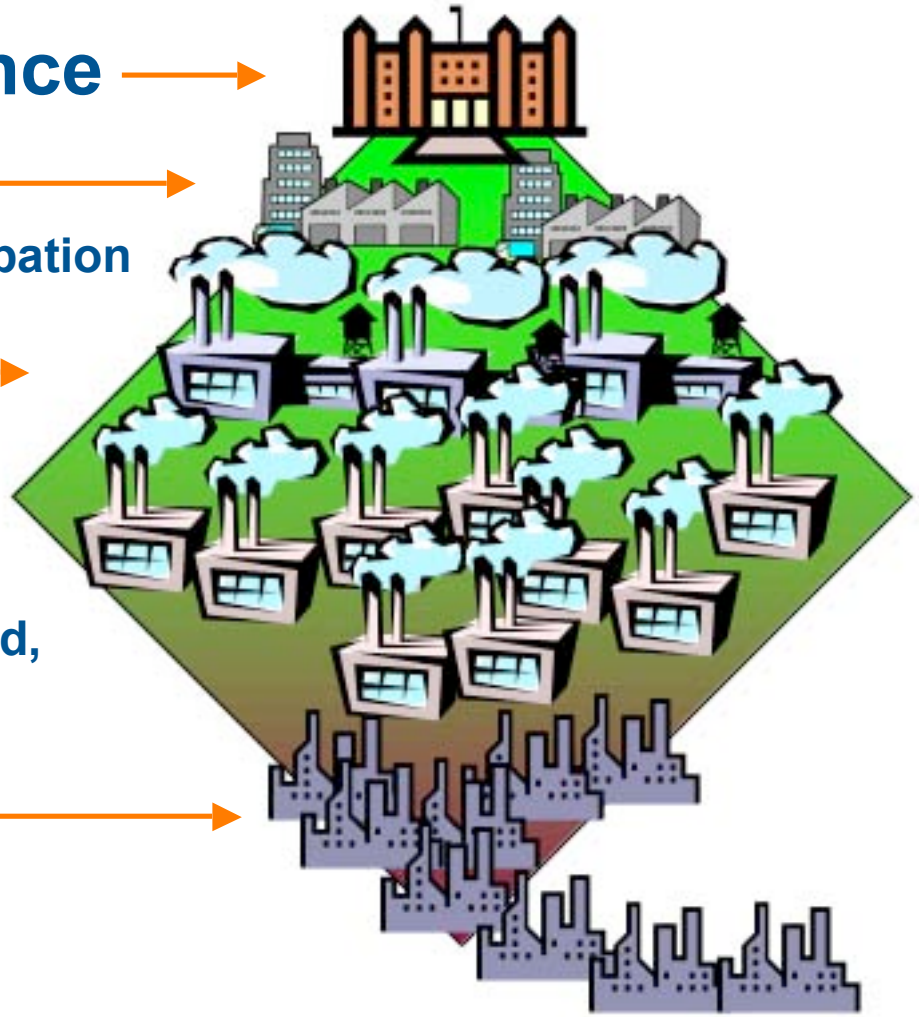
Gold, Silver, Bronze, Probation

Strategically Important

Core

High Performing, Standard, Potential, Legacy

Disengaged



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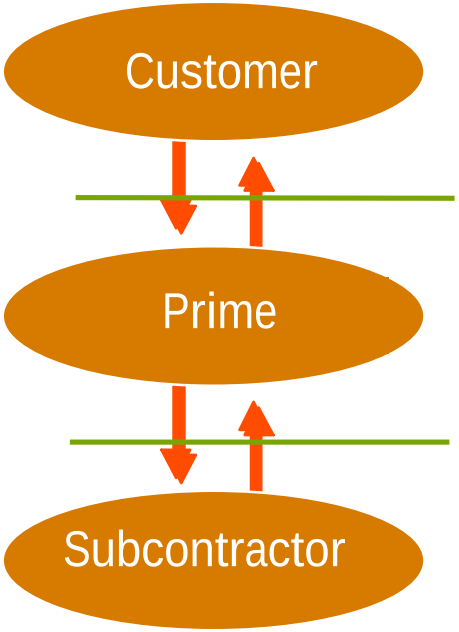
Future State in Lean Relationships

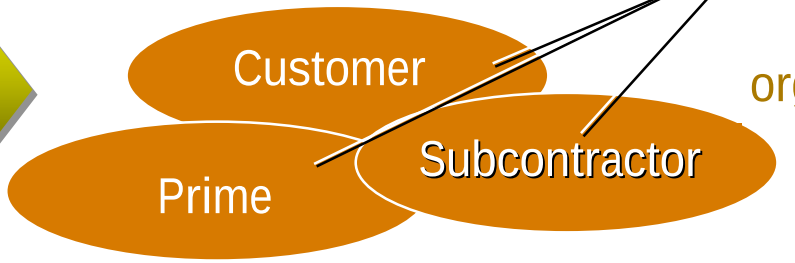
"Old" Approach

Rigid vertical interfaces and control



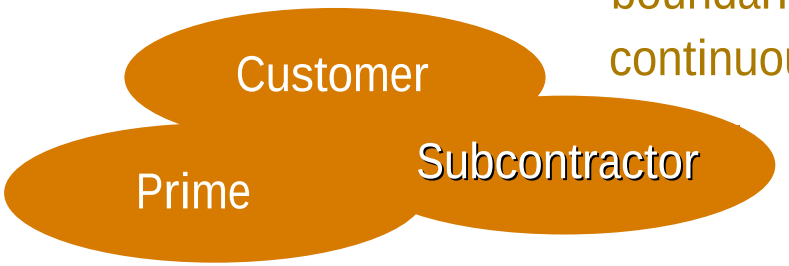
"Current" Lean

Collaborative with rigid organizational interfaces



"Emerging" Lean

Virtual Team without boundaries enabling continuous innovation

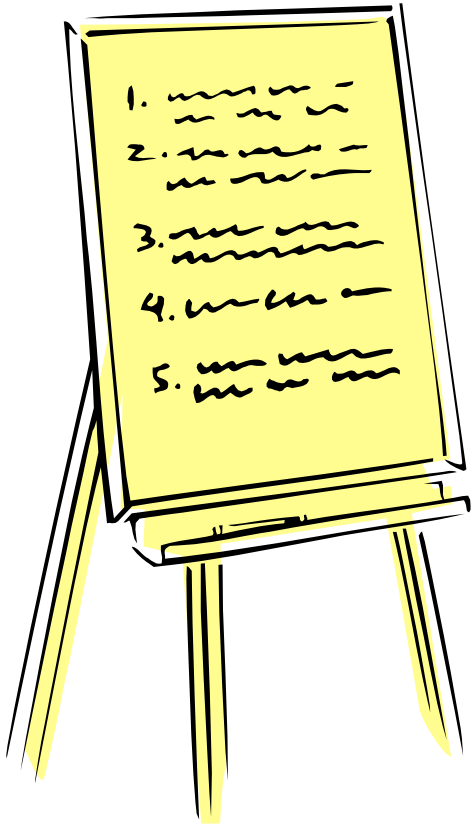


Lean Supply Chain Wrap Up

- Suppliers are critical to lean enterprise success
- Supply chains need to be understood and designed to meet the needs of the product enterprise needs
- Legacy supply chains can be improved through win-win customer-supplier teamwork.

Supply Chain Management is a lean enterprise core competency

Exercise



- What aspects of a Lean Supply Chain can you implement today to improve your enterprise's performance?
- Spend the remaining time capturing these on an easel chart for your team's use.

Reading List

Bozdogan, K., Deyst, J., Hoult, D., Lucas, M., "Architectural Innovation in Product Development Through Early Supplier Integration", R&D Management, Vol 28, No 3, 1998, 163-173.

Dyer, Jeffrey H., *Collaborative Advantage: Winning through Extended Enterprise Supplier Networks,* New York: Oxford University Press, 2000.

Dyer, Jeffrey and Nobeoka, Kentora, "Creating and Managing High-Performance Knowledge-Sharing Network: The Toyota Case," *Strategic Management Journal,* 21, 2000, 345-367.

Fine, C., *Clockspeed: Winning Industry Control in the Age of Temporary Advantage*, Reading, MA: Perseus Books,1998

Fisher, M.L., "What is the Right Supply Chain for your Product," *Harvard Business Review*, Vol. 75 (2), Mar/Apr, 1997, 105-116.

Ghemawat, Pankaj, "Distance Still Matters, The Hard Reality of Global Expansion." HBR. Sept, 2001

Kraljic, "Purchasing Must Become Supply Management," HBR, September - October 1983

Liker, J.K. and Yu, Yen-Chun, "Japanese Automakers, U.S. Suppliers and Supply-Chain Superiority," *MIT Sloan Management Review*, Vol. 42 (1), Fall 2000, 81- 94.

Liker, J.K., Kamath, R. R., Wasti, S.N., and Namagachi, M., "Supplier Involvement in Automotive Component Design: Are There Really Large US/Japan Differences?, *Research Policy*, 25, 1996, 59-89.

MacDuffie, J.P. and Helper, S., "Creating Lean Suppliers: Diffusing Lean Production Through the Supply Chain," *California Management Review*, 39, 1997, 118-115.

Sako, Mari, "Supplier Development at Honda, Nissan and Toyota: Comparative Case Studies of Organizational Capability Enhancement," *Industrial and Corporate Change*, 13 (2), 2004, 281-308.

Simchi-Levy, D., Kaminski, P., Simchi-Levy, E., *Designing and Managing Supply Chains*, McGraw-Hill, 2002.

Takeishi, Akira, "Knowledge Partitioning in the Interfirm Division of Labor: The Case of Automotive Product Development," *Organization Science,* Vol. 13 (3), May-June 2002, 321-338.

Venkatesan, "Strategic Sourcing: To Make or Not to Make," HBR, November-December, 1992

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