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Ten Things You Should Know - What Prime's Value in Their Integrated Supply Chains

Presented to
NDIA National Small Business Conference
by
Dr. Kenneth W. Sullivan, P.E.
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Areas of Focus

- Supply Chain Analysis
  - Multi-Tiered, Multi-Channel Supply Chains
  - Enterprise Value Stream Mapping
  - Data Mining Throughout Supply Chain

- Supply Chain Design and Optimization
  - Inventory and Network Optimization
  - Enterprise Approach to Solution
  - Development of Simulation Models

- Product Life Cycle Management
  - System Definition: Object BOM and Information BOM
  - System Design: Publish and Subscribe Network
  - Implementation

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Attributes

- Experiences in both public and private sector
  - "Best practices" implementation
  - Federal Government
    - US Army
    - US Air Force
    - Department of Transportation
    - NASA-MSFC
- Perceived as "non-competitive" partner
- Flexible and experienced workforce
  - Full-time, non-academic staff
  - Government and private sector experience prior to joining UAH
  - Interface with academic staff (subject matter experts)
- Customized training and implementation
  - Tailored for specific customer needs
  - On-site training and implementation

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Primary Customers

- AMCOM Office for Continuous Improvement
  - Supply chain analysis for Chinook, Apache and Kiowa
  - Identification of critical paths
- AMCOM Command Analysis Directorate
  - Supply chain modeling for Chinook blades and various aviation assembly platforms
  - Determination of optimum inventories to support readiness requirement
- Army Materiel Command (AMC)
- AMRDEC Supply Chain Integrated Product Team
- NASA Ares Program – Upper Stage Supply Chain Analysis

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Strategic Partners – The Company We Keep:

- MIT Forum for Supply Chain Innovation
- Lean Advancement Initiative (LAI) at MIT
- National Defense Industry Association (NDIA)
- National Council for Advanced Manufacturing (NACFAM)
- Supply Chain Council (SCOR)

"So where is this guy coming from?"

- NASA – MSFC (7 years)
  - Materials and Processing Laboratory
  - Chief Engineer/Project Office
- Private Sector (8 ½ years)
  - Precision Machine Shop (primarily aerospace)
  - High volume commercial production
- University of Alabama in Huntsville (8 ½ years)
  - Contract support to US Army (AMCOM) for Industrial Base Branch (Team Leader/Manager)
  - Lean implementation and training at government and private sector corporations
  - Team lead for UAH AMCOM supply chain analysis team
    - Multi-tired evaluation of the Army Aviation supply chain
    - Team visited over 50 suppliers

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Today's Reality

- Strategic Trends Shaping Industry and Government
  - Growing Specialization and Focus on Core Competencies;
  - Outsourcing in the Search for Lower Costs;
  - Continuing Movement Towards Globalization

- Implications
  - Manufacturers and Prime Contractors Have Become Integrators, Assemblers & Business Managers;
  - Hundreds of Companies and Organizations Now Work Together to Deliver Value to the Customer;
  - Critical Need for Integrated Management, Visibility, Coordination and Collaboration

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The Top 10 Things to Know

1. Your critical position in the big picture of delivering value to the final customer
2. Importance of communication and the role of supply chain roundtables
3. Supply chain management and metrics
4. Use of collaboration tools for forecasting and planning.
5. Lean Implementation in both manufacturing and business processes
   -- both within your organization and at the interfaces with other companies
6. Innovative strategies for increasing value added
7. Understanding requirements and challenging status quo
8. New and emerging contract structures
9. Economic, industrial and demographic trends
10. Supply Chain innovations such as incentivized work in process

1. Your critical position in the big picture of delivering value to the final customer

What is a Supply Chain?

"…every effort involved in producing and delivering a final product or service, from **the supplier's supplier to the customer's customer."**

Duclos, Vakurka, Lummus (2003)

"Supply chain management is a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the **right quantities, to the right locations, and the right time, in order to minimize system wide cost while satisfying service level requirements."**

David Simchi-Levi, Philip Kaminsky and Edith Simchi-Levi
Designing and Managing the Supply Chain, 2nd Edition

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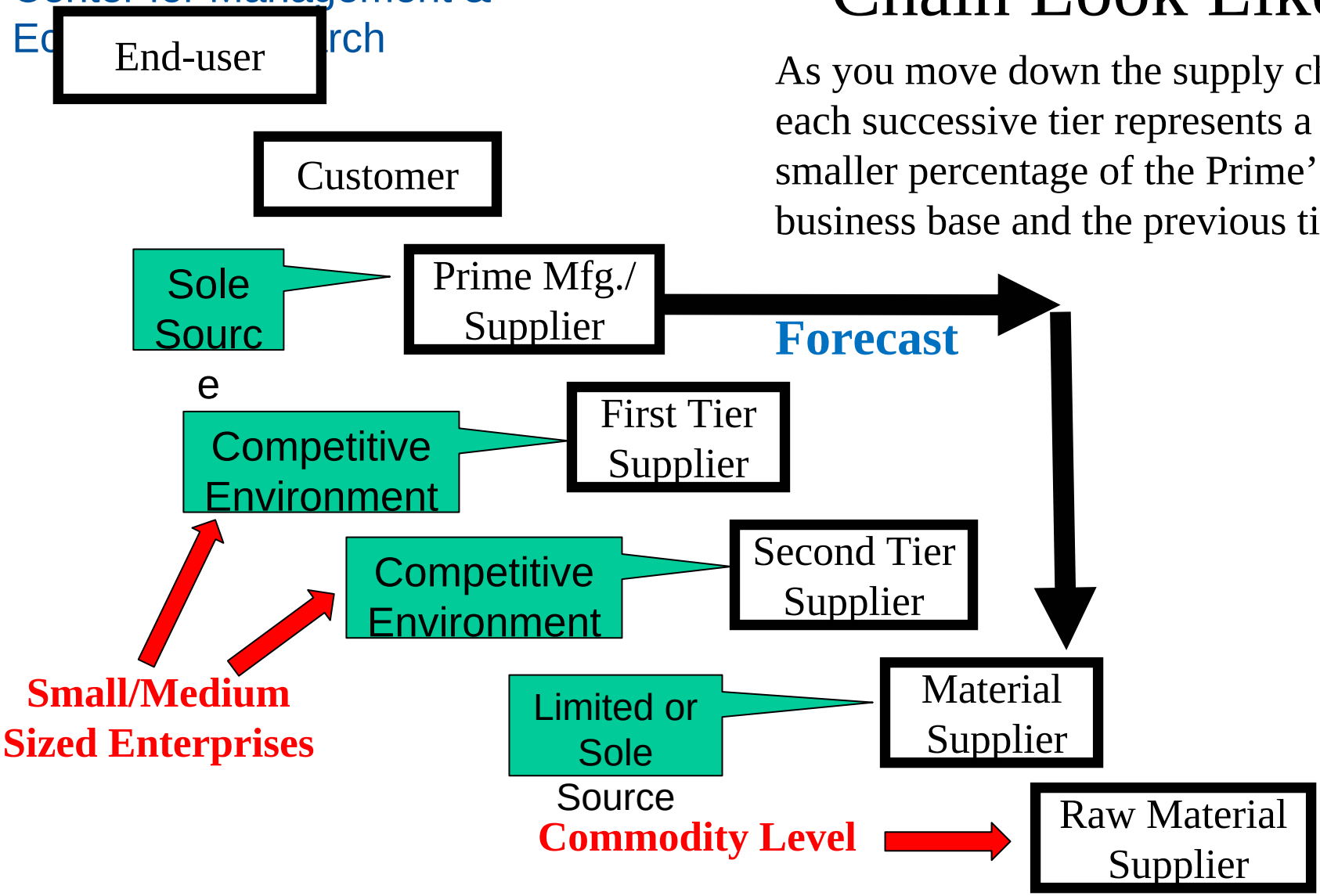
What Does a Supply Chain Look Like?

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



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The Issue at Hand

1. Why do we need to continually improve an existing supply chain?
   - Requirements change (unforeseen)
   - Dynamics in supply base

2. Why are we concerned about the supply base?
   - Approximately 70% of the parts assembled by the OEM are purchased/manufactured from suppliers*
   - Suppliers must function in a global market
     - DoD smaller percentage of business base
     - Cost of working on Government projects
   - Numerous single point failures

***Source: MIT Forum for Supply Chain Innovation**

2. Importance of communication and the role of Supply Chain Roundtables

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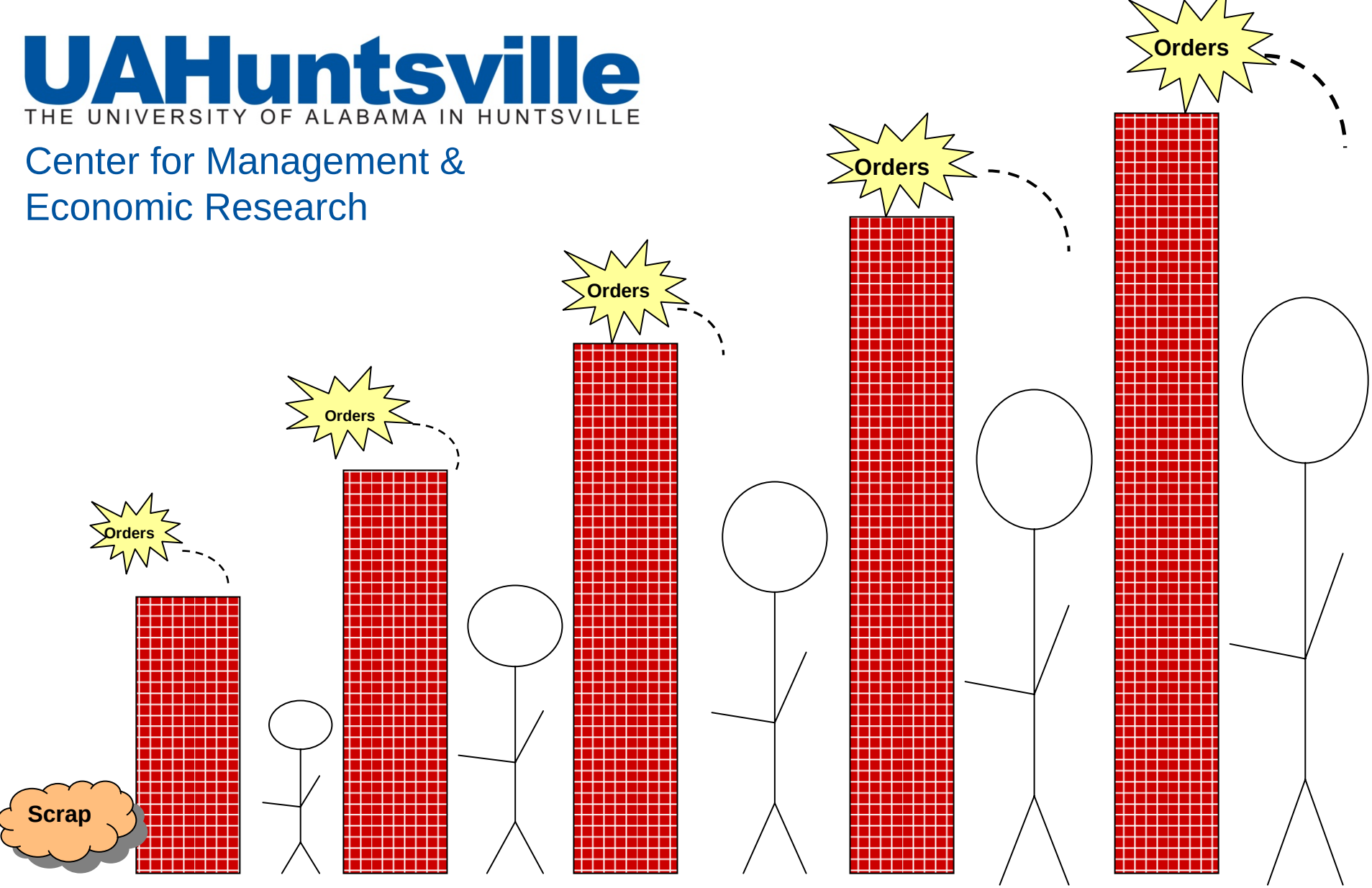

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Collaboration and Trust

- Companies in the supply chain are averse to risk and investment resulting in little or no inventories
- Lack of forecast/understand demand
- Share lessons learned
- Roadmap to/for SC implementation
- SC alerts
- Meet business expectations
- Develop a proactive culture
- Velocity of information

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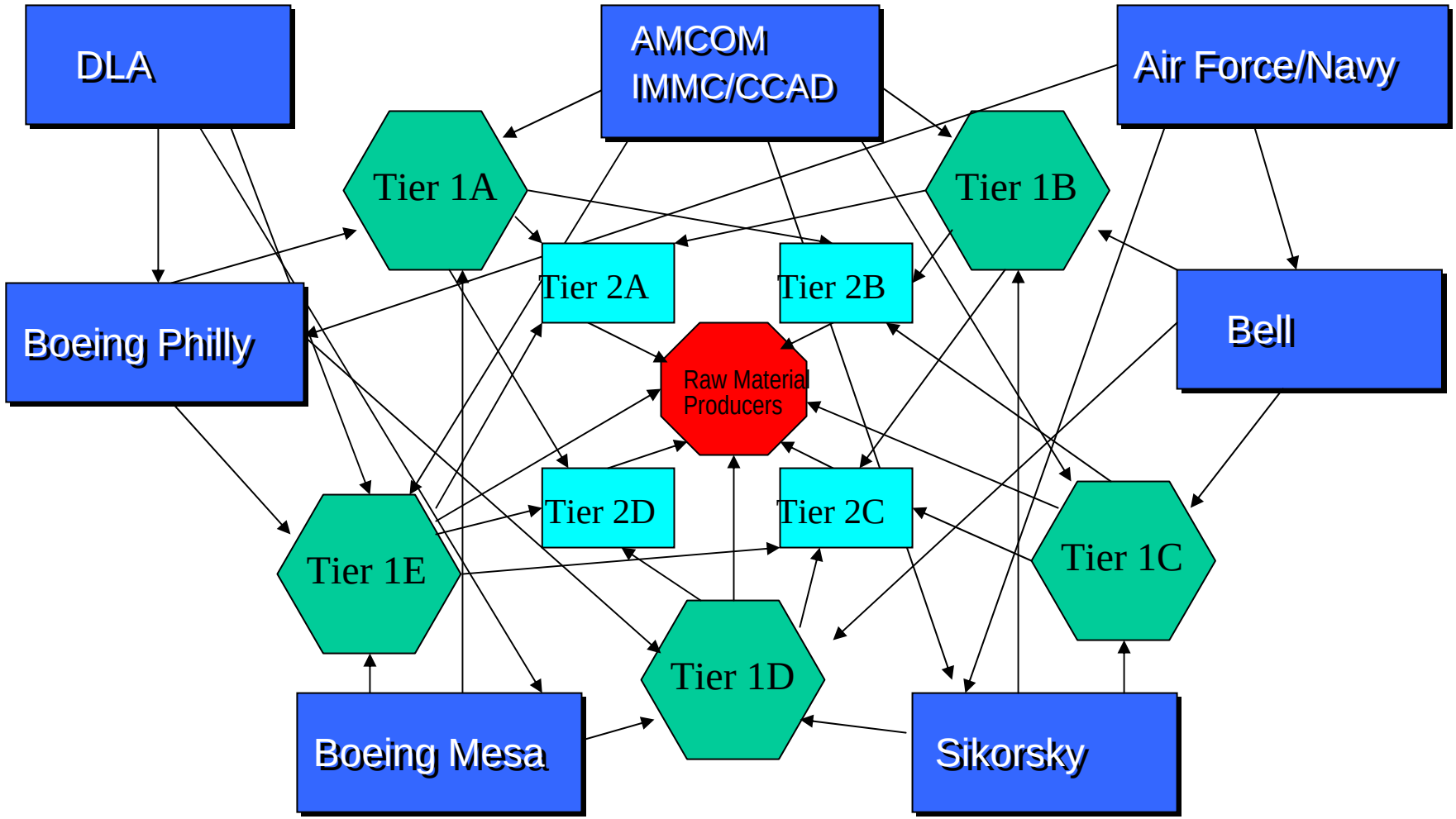
Importance of Supply Chain Knowledge



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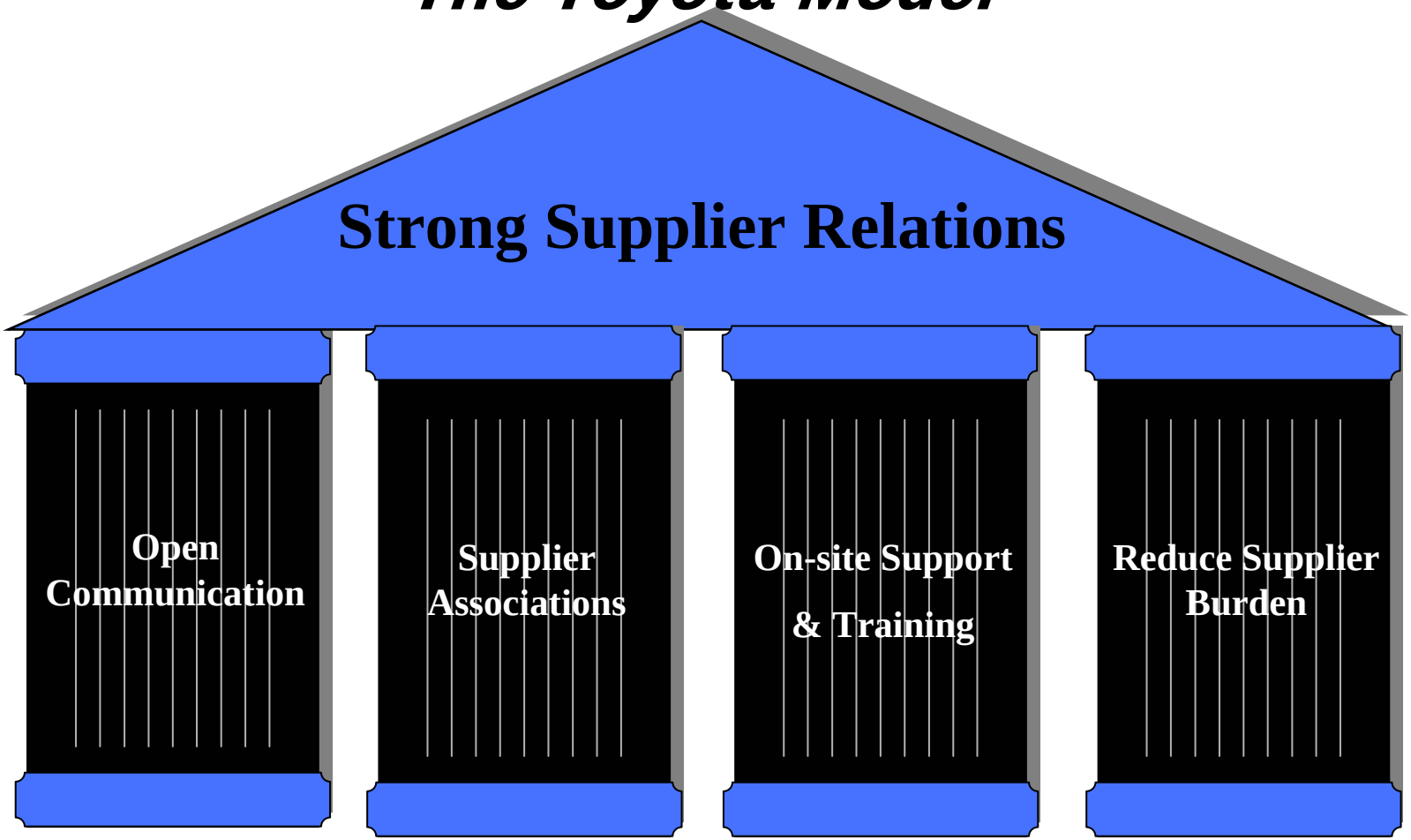
Four Columns of Collaboration

The Toyota Model



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Supply Chain Roundtables

- Identify critical suppliers at all levels of the supply chain for selected critical assemblies
- Representatives from the customer, OEM and all levels of the supply chain presented current status of the project from their point of view
- Breakout groups met to discuss issues
- Actions developed and assigned
- Actions continually updated
- Roundtables reconvene every three to four months or until collaboration becomes part of culture
- *Suppliers can coordinate/initiate the roundtables*

Note: Often third party organizations can serve as an effective facilitator

3. Supply Chain Management and Metrics

Supply Chain Truths

A Supply Chain Must Be Structured According to Product Characteristics and Customer Demands

Supply Chains Must Be Planned (Designed) or Will Not Perform to Requirements

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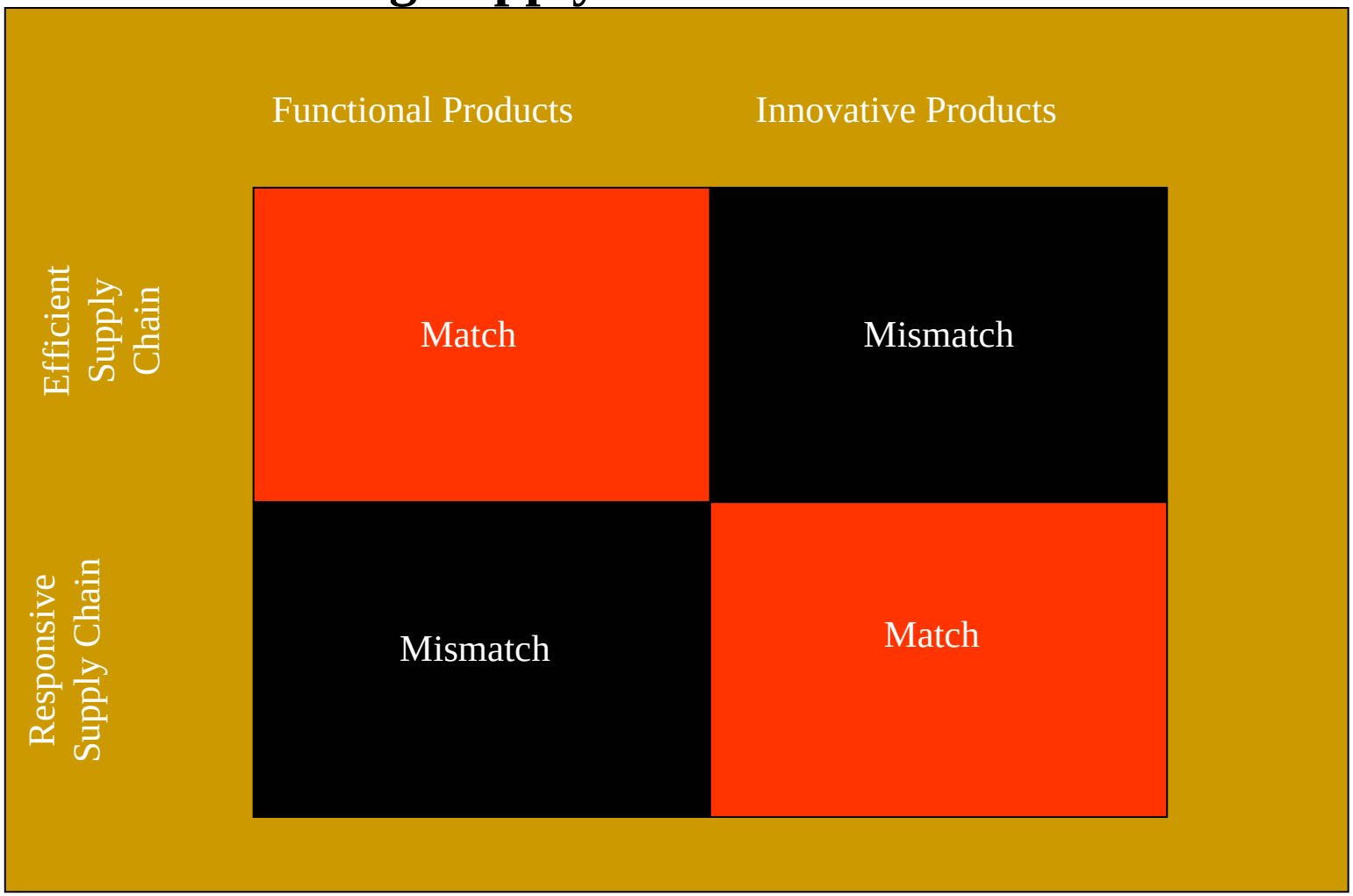
Designing the Supply Chain for the Specific Product

- Many companies attempt to shove everything through one supply chain structure and then wonder why some problems continue;
- Must recognize that products have different characteristics and generally need to be managed in a different manner with an aligned supply chain; and
- Efficiency and Responsiveness are generally in direct conflict.

Matching Supply Chains with Products



Marshall L. Fisher, Harvard Business Review, March-April 1997

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Process

- Identify Critical Parts for Analysis
- Visit Prime and Suppliers
- Map Supply Chain
- Identify Critical Path and Critical Sub-components
- Attack low-hanging fruit; identify longer term improvements-immediate results
- Look for opportunities to proliferate improved processes to other parts
- Raise overall supply chain awareness
- Removal of “stove pipe” mentality – enterprise approach

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Example Supply Chain Map

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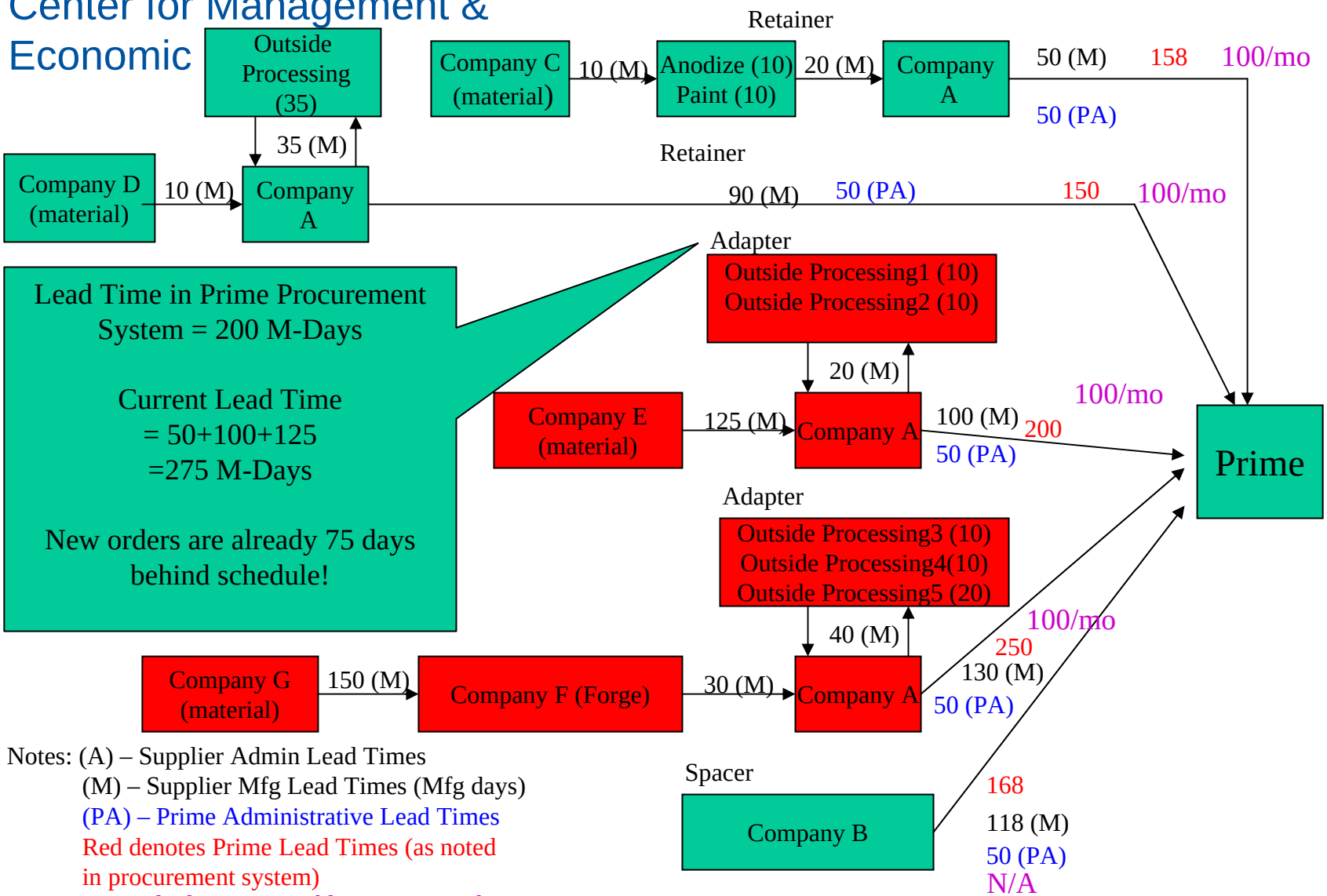

Lead Time in Prime Procurement System = 200 M-Days

Current Lead Time
= 50+100+125
=275 M-Days

New orders are already 75 days behind schedule!

Notes: (A) – Supplier Admin Lead Times
(M) – Supplier Mfg Lead Times (Mfg days)
(PA) – Prime Administrative Lead Times
Red denotes Prime Lead Times (as noted in procurement system)
Purple denotes monthly capacity without impact to normal through put

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Performance Metrics

SCOR (Supply Chain Operations Reference) Model was designed to help:

- identify, define, and measure metrics across the supply chain

- identify weak links in the supply chain by using business best practices

- reduce costs through reduced inventories and improved order fulfillment time

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SCOR Bottom Line

SCOR was developed around:

- **Common Terminology (e.g., Processes, Metrics)**
- **Common Definitions (e.g., Metrics – Perfect Order Fulfillment)**
- **Evolves around Common Processes in Enterprise Supply Chain:**
  - **Plan**
  - **Source**
  - **Make**
  - **Deliver**
  - **Return**

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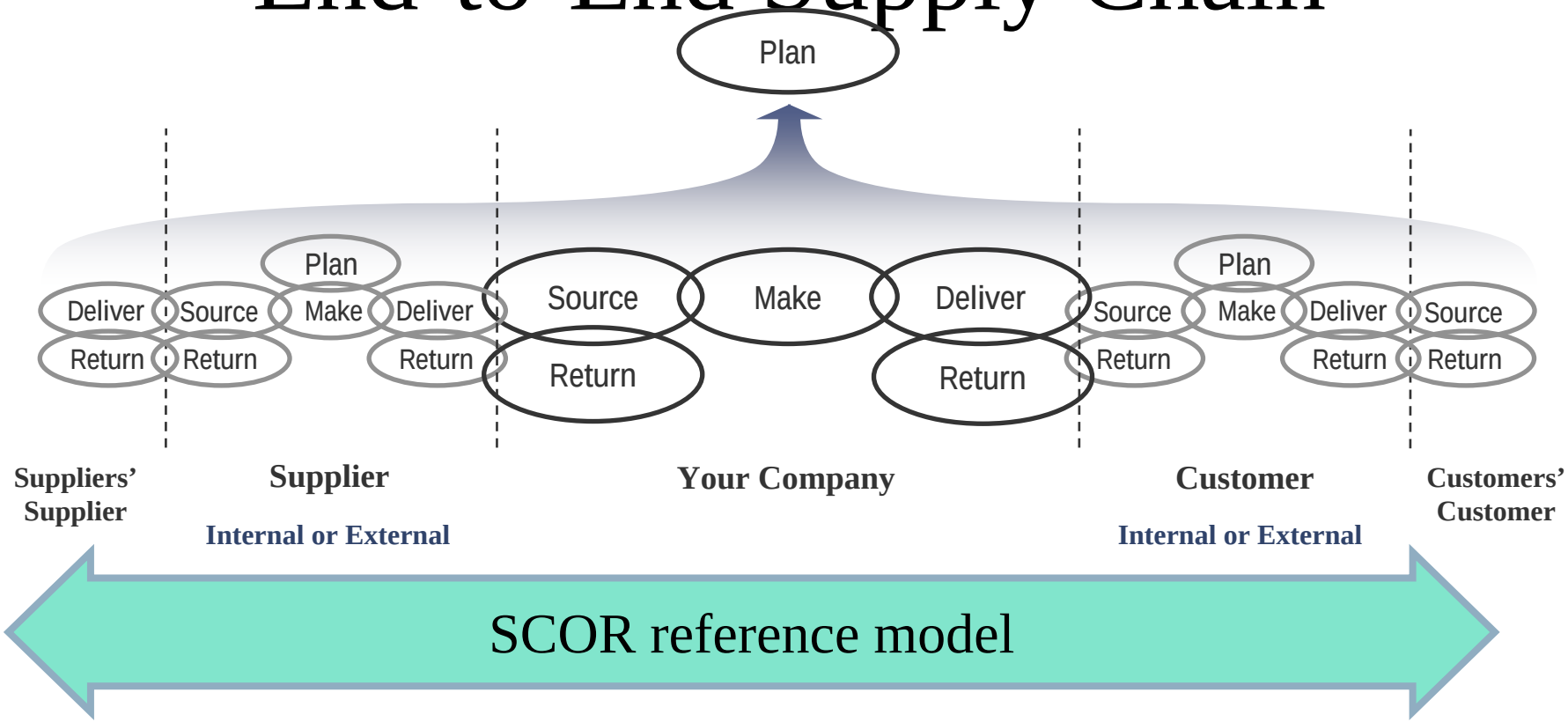
End-to-End Supply Chain



4. Use of collaboration tools for forecasting and planning

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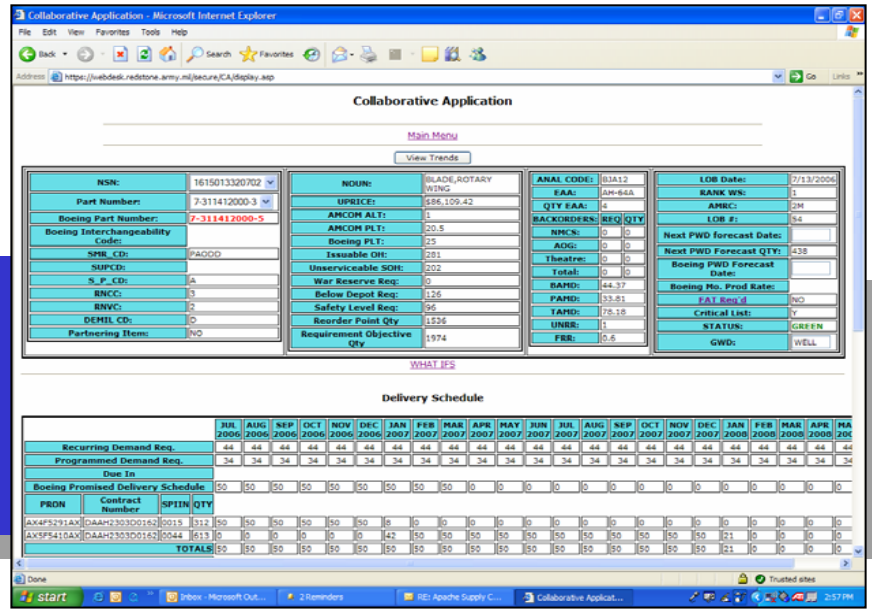
Supply Chain Collaboration

Improving communication



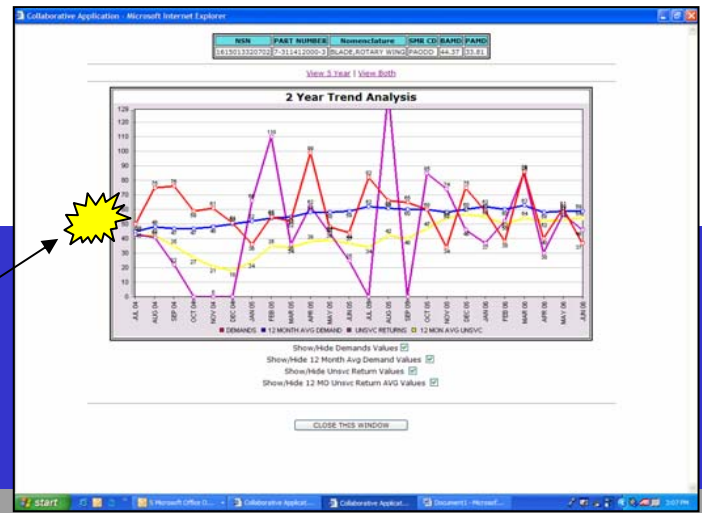
Powerful Web application that is a foundation of an Open Sharing Collaborative Environment

- Key to faster sharing of forecast, demand, Delivery data
- Performs "What-If" studies
- Creates custom reports

- Incorporates 2410 data for predictive demand analysis
- Provides analytical tools for supply management
- Aids advance posturing throughout the supply chain

Real-Time Data Sharing

Trend Data
2 yr and/or 5 yr



5. **Lean Implementation in both manufacturing and business processes**
   - **-- both within your organization and at the interfaces with other companies**

Lean . . .

A systematic approach

to identifying and eliminating waste (non-value-added activities)

through continuous improvement

by flowing the product

at the pull of the customer

in pursuit of perfection.

-- The MEP Lean Network

Lean Issues

- Lean associated with auto industry (Toyota)
- Perception it is difficult to apply in aerospace (machine shop) environment
- In reality, lean principles are applicable in all industries
- Lean principles are applicable in office environment and within supply chain
- Lean training and implementation in non-traditional production systems available
  - NIST Manufacturing Extension Partnership
  - MIT Lean Advancement Initiative
  - Customers
- Lean Tools
  - Value Stream Mapping
  - Kaizen Events

The Value Stream Mapping Objective

Document a product group's flow from raw material to finished part, and draw a visual representation using VSM symbols that represents every process and activity in the material and information flows.

Next draw a future state of the value stream using VSM symbols to create the desired flow.

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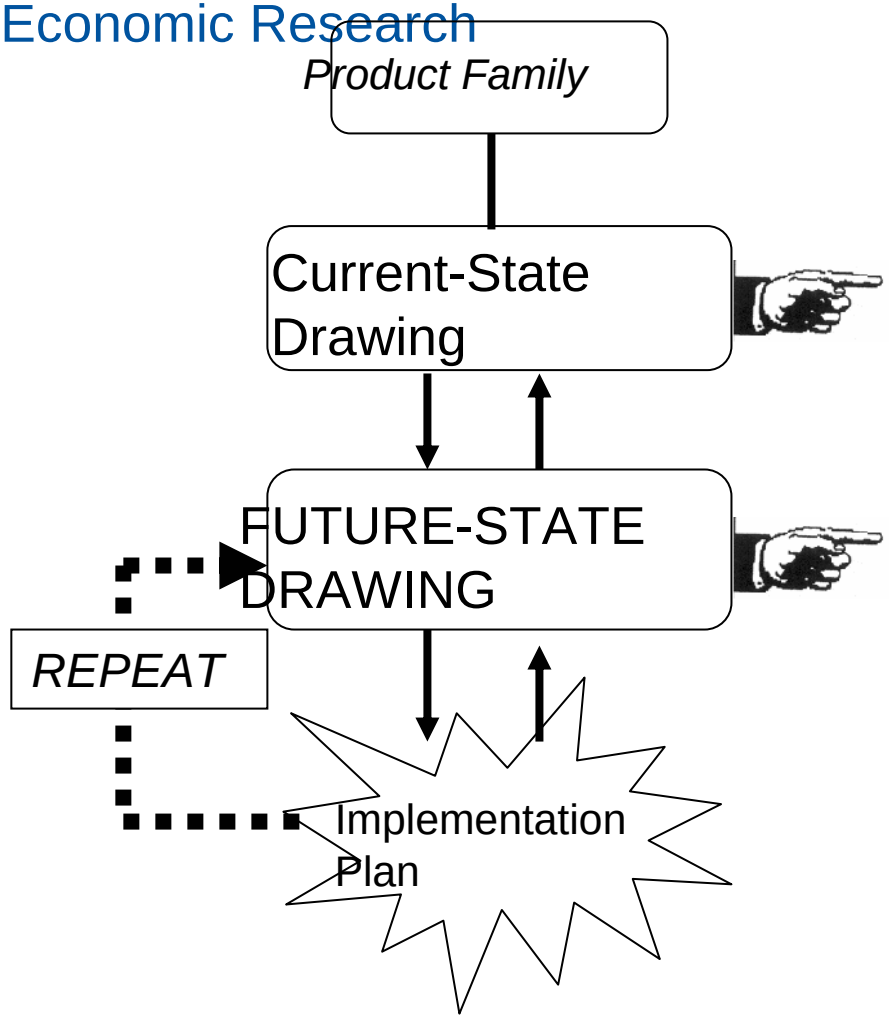
Using the Value Stream Mapping Tool



- Determining the product groupings, then for each:
- Understand how the shop floor currently operates. (Foundation for future state.)
- Design for a lean flow
- Determine how to get there!

Current State Enterprise VSM

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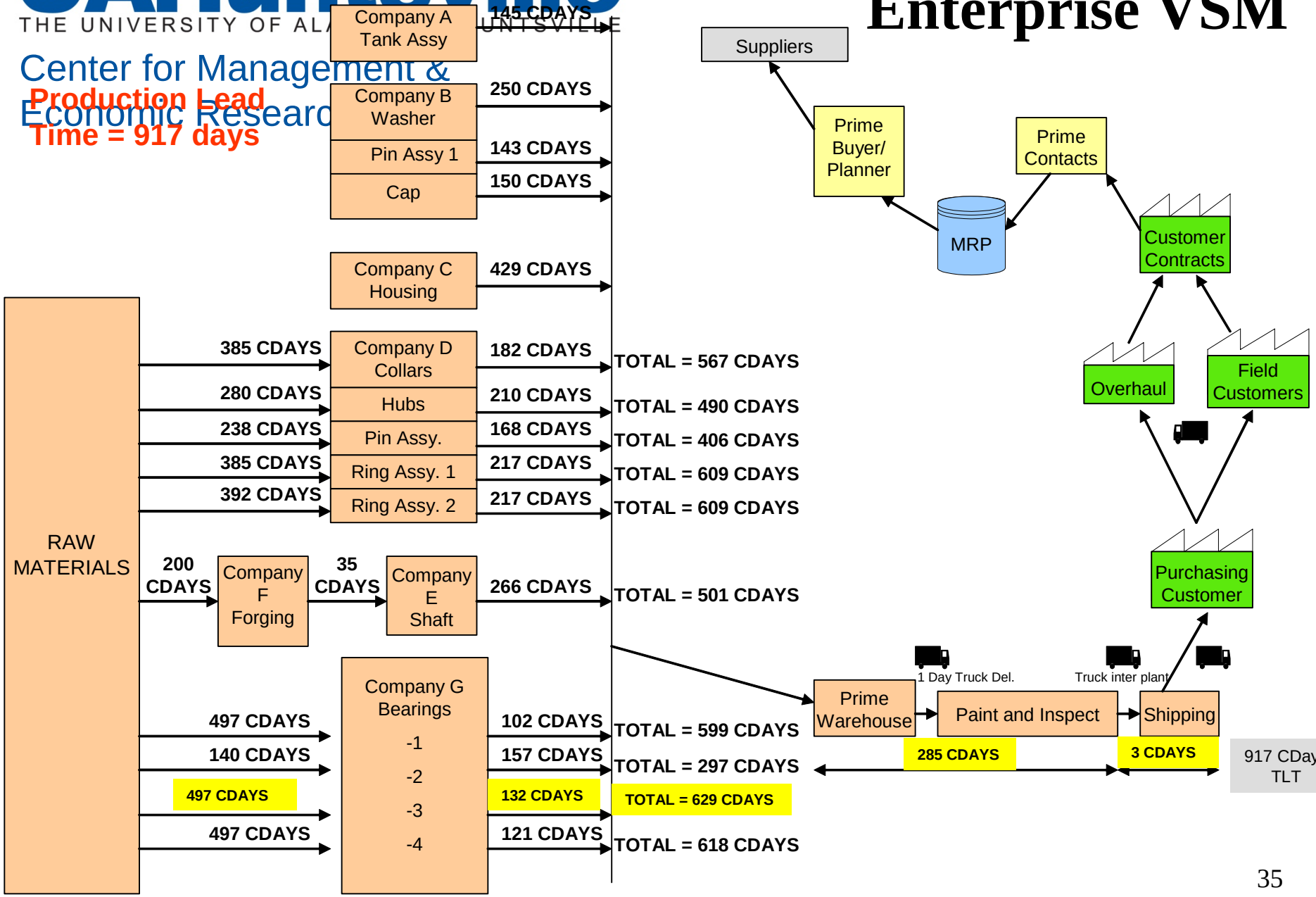
Production Lead Time = 917 days



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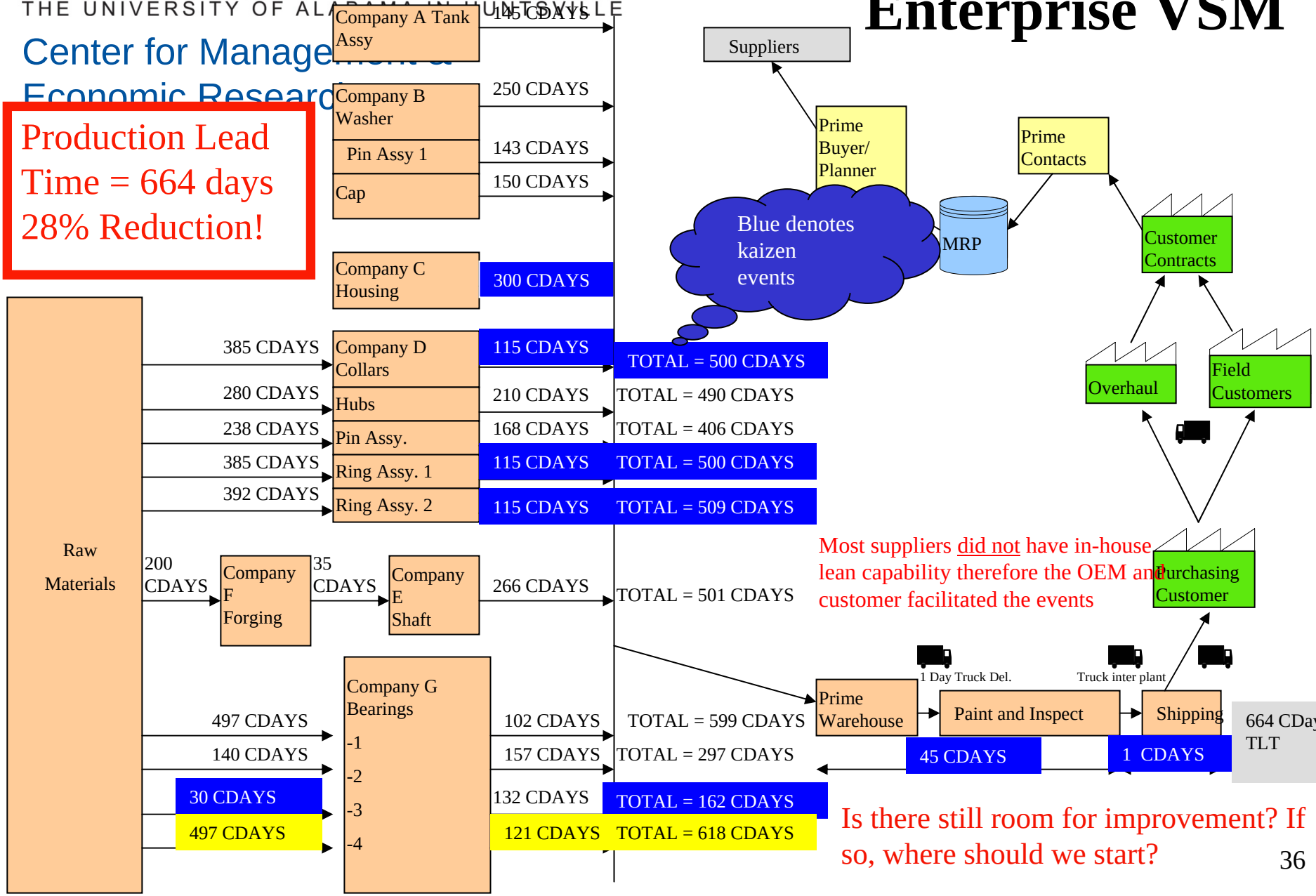
Future State Enterprise VSM

Production Lead Time = 664 days
28% Reduction!



Is there still room for improvement? If so, where should we start?

Kaizen Events

- Kaizen is the process of:
  - Identifying & eliminating waste
  - as quickly as possible
  - at the lowest possible cost
- Kaizen requires:
  - Continuous, gradual, persistent improvement
  - by all employees and management
- Kaizen utilizes:
  - Cross functional team
  - Focused scope
  - Aggressive goal

6. Innovative strategies for increasing value added

Adding Value

- More parts purchased = more oversight (overhead) cost required by prime contractors
- Suppliers can produce subassemblies or kits for prime
  - Cost savings to Prime: Supplier labor and overhead cost are probably lower than that of prime
  - Advantageous if supplier produces more than one part of the subassembly
  - Requires supplier to have/develop ability to manage multiple suppliers and perform subassembly QA
- Serve as prime on small projects
  - Avoids “bid busts”
  - Traditional primes serve as first tier supplier

Aircraft Assembly Suppliers

Company A
Bolt 134 Days

Company B
Shaft 176 Days

Company C
Rev Spring 155 Days

Company D
Bolt 210 Days

Company E
Bushing 080 Days

Company F
Bushing

Company G
Seal 120 Days
Seal 120 Days
Sleeve 120 Days
Seal 120 Day
Seal 189 Days

Company H
Rev Limiter 197 Days

Company I
ID Plate 120 Days
ID Plate 110 Days

Company J
Stop 210 Days
Nut Plain 239 Days
Nut 170 Days
Bracket Assembly

Company K
Shim 075 Days
Shim

Company L
Washer 167 Days

Company M
Support 119 Days

Company N
Weight

Company O
Sleeve Bushing 231 Days
Sleeve 120 Days
Washer 168 Days
Nut 155 Days
Key

Company P
Hub 300 Days
Hub-Class 320 Days
Pin-Class 290 Days
Pin 250 Days

Company Q
Pitch Housing

Company R
Cover 180 Days
Retainer 180 Days

Company RR
Cover 170 Days

Prime/LCMC

Company S
Bearing 180 Days
Bearing 170 Days
Bearing 230 Days
Bearing 250 Days
Bushing Sleeve 275 Days

Company T
Adapter 100 Days
Weight 113 Days
Liner 210 Days
Spacer 176 Days
Lower Liner 197 Days
Tank 281 Days
Bolt 260 Days

Company U
Base
Shield

Company V
Boot 260 Days

Company W
Weight 126 Days
Weight 100 Days

Company X
Collar
Cover Assembly

Company Y
S him 150 Days

Company Z
Ring 150 Days

Company AA
Shaft
Sleeve

Company BB
Washer 110 Days

Company CC
Washer 100 Days
Retainer 100 Days

Company DD
Droop Stop 250 Days
Arm 250 Days
Plate-Class 250 Days
Liner 197 Days
Block 275 Days
Stop 250 Days
Washer 280 Days
Pin Assembly 173 Days
Pin Assembly 210 Days
Plug 176 Days
Tank Assembly
Beam
Cap

Company EE
Washer 120 Days

Company FF
Tank

Company GG
Cover 080 Days

Company HH
Tank Assembly

7. Understanding requirements and challenging status quo

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What are the real requirements?

- Sources of Requirement?
  - Legislation
  - Government and/or Industry Policies and Procedures
  - Folklore
  - Interpretation of roadblocks (FAR)
  - "Not invented here" mentality?
  - "We have always done it that way"
  - Proactive versus reactive

“ The FAR is the most misquoted and misinterpreted book second only to the Bible!”

Kenneth Sullivan

Circa 2005

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Challenge the Status Quo

- Do the requirements make sense?
- Are you using the wrong requirements?
- Does Value Engineering support change? (Note: must work through primes)
- Historical failure rate data?

8. New and emerging contract structures

Long Term Contracts

- How do you want the supply chain to behave?
  - Customer and owner of supply chain must define this!
  - ***Contracts drive supply chain behavior!***
  - Are we rewarding Outcome A while hoping for Outcome B?

- Balance long term contracts with flexibility and adaptability;
- Incorporate provisions for volatile energy and commodity prices
  - Reduce risk to small businesses with long term contracts
  - Reduce risk of late deliveries due to funding
- Delivery Performance Incentives

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Performanced Based Logistics

- Buying performance – not parts
- Power by the hour
- Shifting risk to the supply chain
- Potential for higher profit margins
- All parties must understand the requirements and metrics

9. Economic, industrial and demographic trends

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Economic, industrial and demographic trends

- Shrinking Industrial Base in the US
- Some manufacturing returning to the US
  - Higher energy prices have changed the business model of off shore manufacturing
  - Rate of inflation in developing countries can quickly negate labor cost advantage
- Looming retirements
- Workforce development

10. Supply Chain Innovations such as incentivized Work in Process

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Strategic Inventory

Logic

- In Aerospace/DoD, most of the long-lead items have the least amount of value added to them
- Long lead-times require customer to invest large amounts of working capital in "pipe line"

Pilot Project

- A joint AMCOM and DLA task is performing an analysis of four CH-47 parts to develop modeling methodology for strategically placing WIP
- Upon completion, the model findings will be used to develop pilot contracts to validate the strategic placement of inventory

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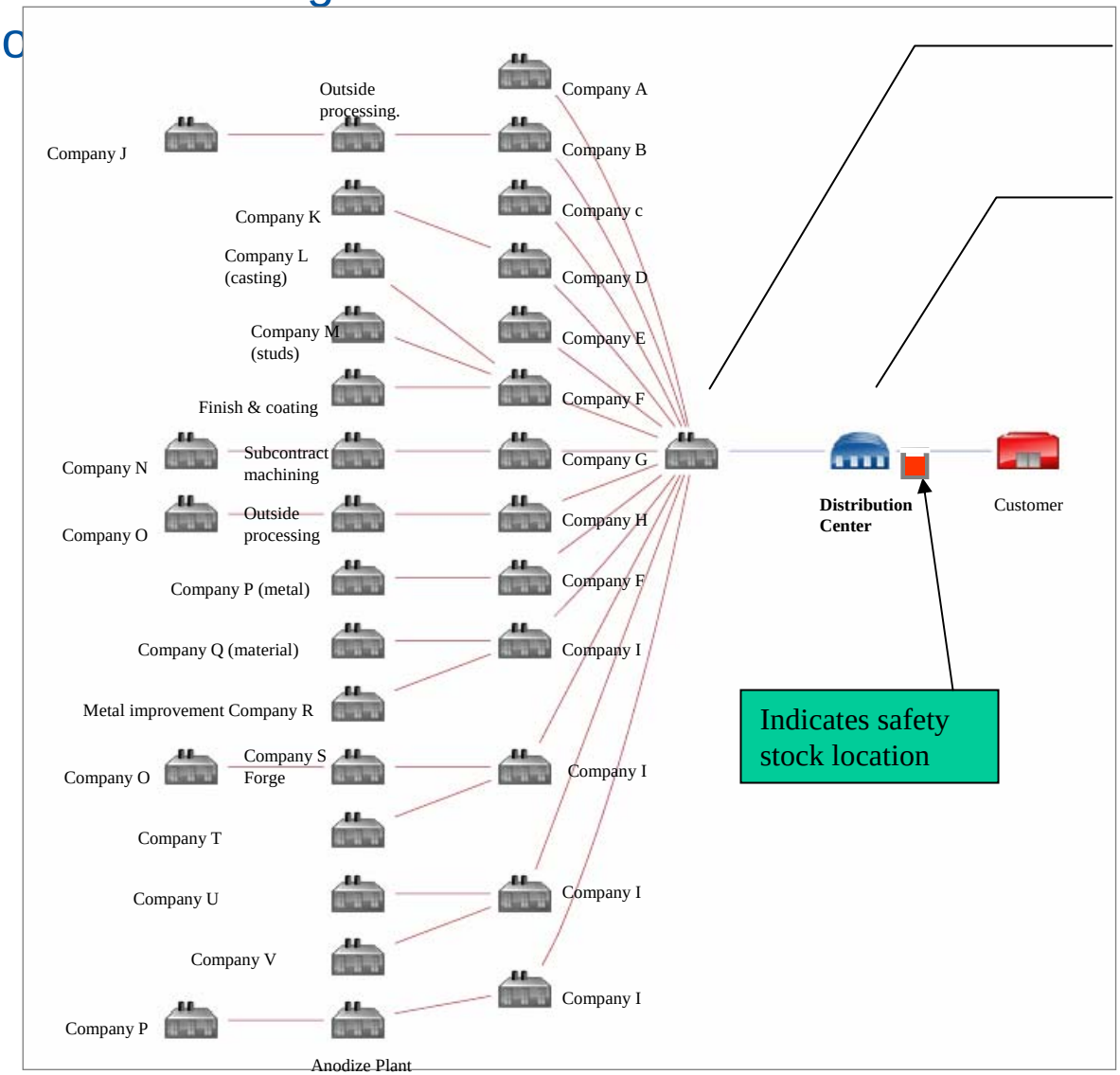
Modeling and Optimization
Overview of Base Case



Prime Plant:
Avg. Working capital value: $ 3,916,232
(material tied up in production)

Prime Distribution Center:
Avg. Safety stock holding cost: $ 89,774 / yr
Avg. Cycle stock holding cost: $ 7,252 / yr
Avg. Working capital value: $ 970,264

Avg. Safety Stock level: **55.1 units**
(on average, distribution center carries 3 months' of demand as safety stock)

Avg. Cycle Stock level: **4.45 units**

System-wide:
Total working capital: $ 5,315,086
(includes safety & cycle at the Distribution Center, and the materials tied in production at all plants)

COGS: $ 3,519,504 / yr

Inventory turns: 0.66 / yr

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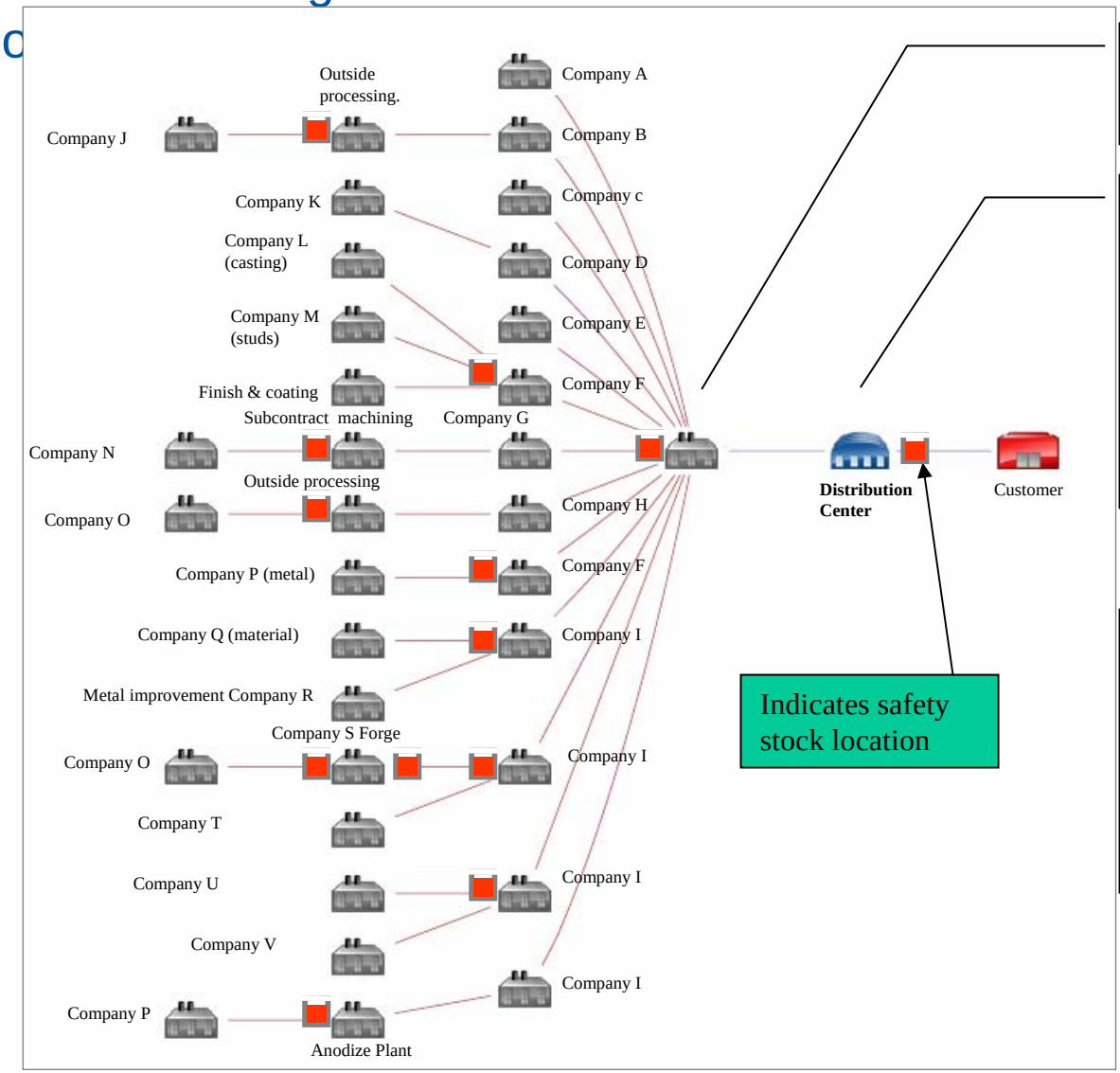
Using Strategic Inventory throughout the Supply Chain



Prime Plant & Vendors:
Avg. Working capital value: $ 1,503,484
(WIP + Safety Stock+ Cycle Stock)

Prime Distribution Center:
Avg. Safety stock holding cost: $ 25,880 / yr
Avg. Cycle stock holding cost: $ 7,252 / yr
Avg. Working capital value: $ 331,324

Avg. Safety Stock level: **15.88 units**
(on average, distribution center carries 3 months' of demand as safety stock)

Avg. Cycle Stock level: **4.45 units**

System-wide:
Total working capital: $ 1,834,808
(includes safety & cycle at the Distribution Center, and the materials tied in production at all plants)

COGS: $ 3,519,504 / yr

Inventory turns: 1.92 / yr

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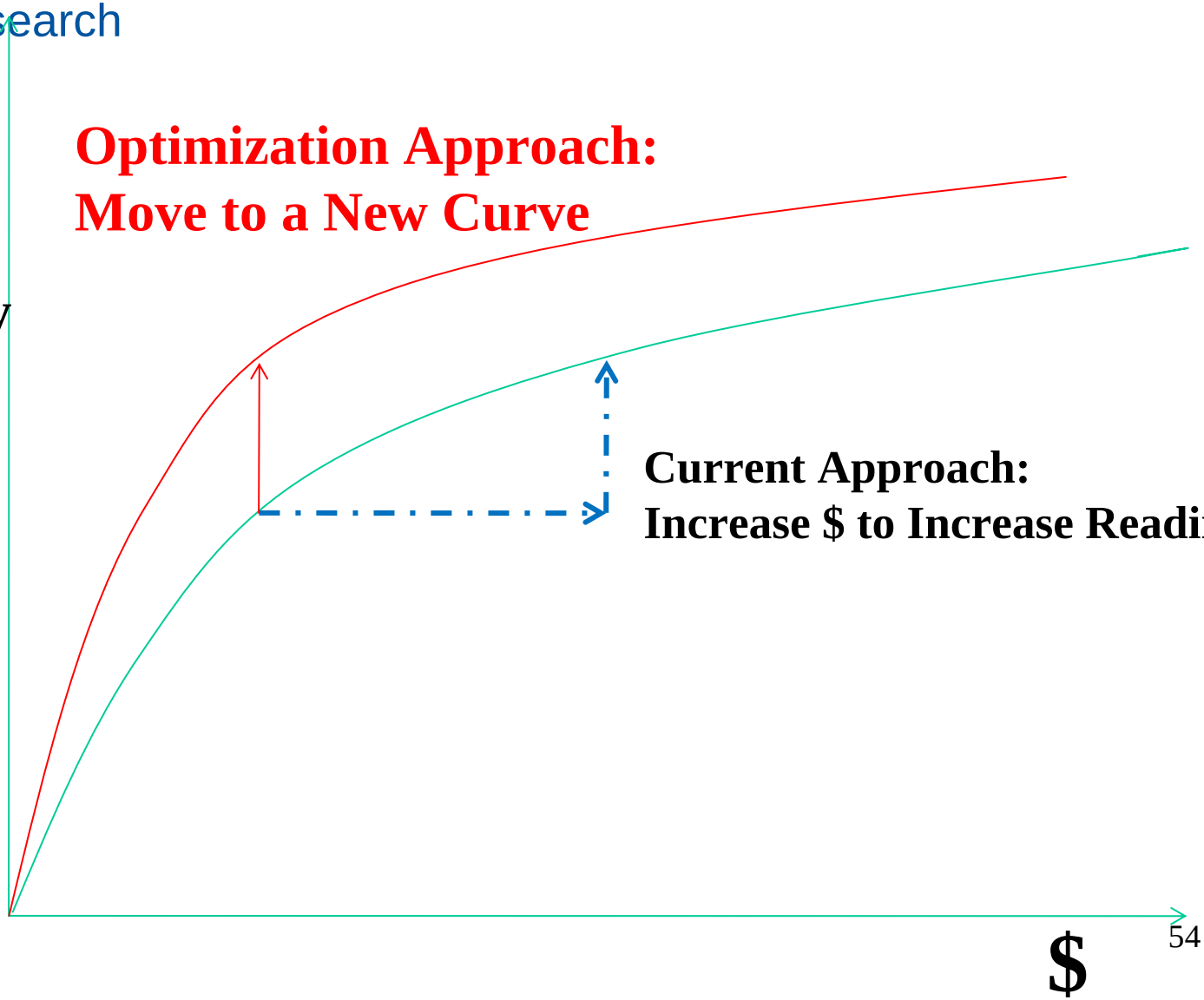
Move to New Performance Curve Through Optimization



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Summary and Conclusions

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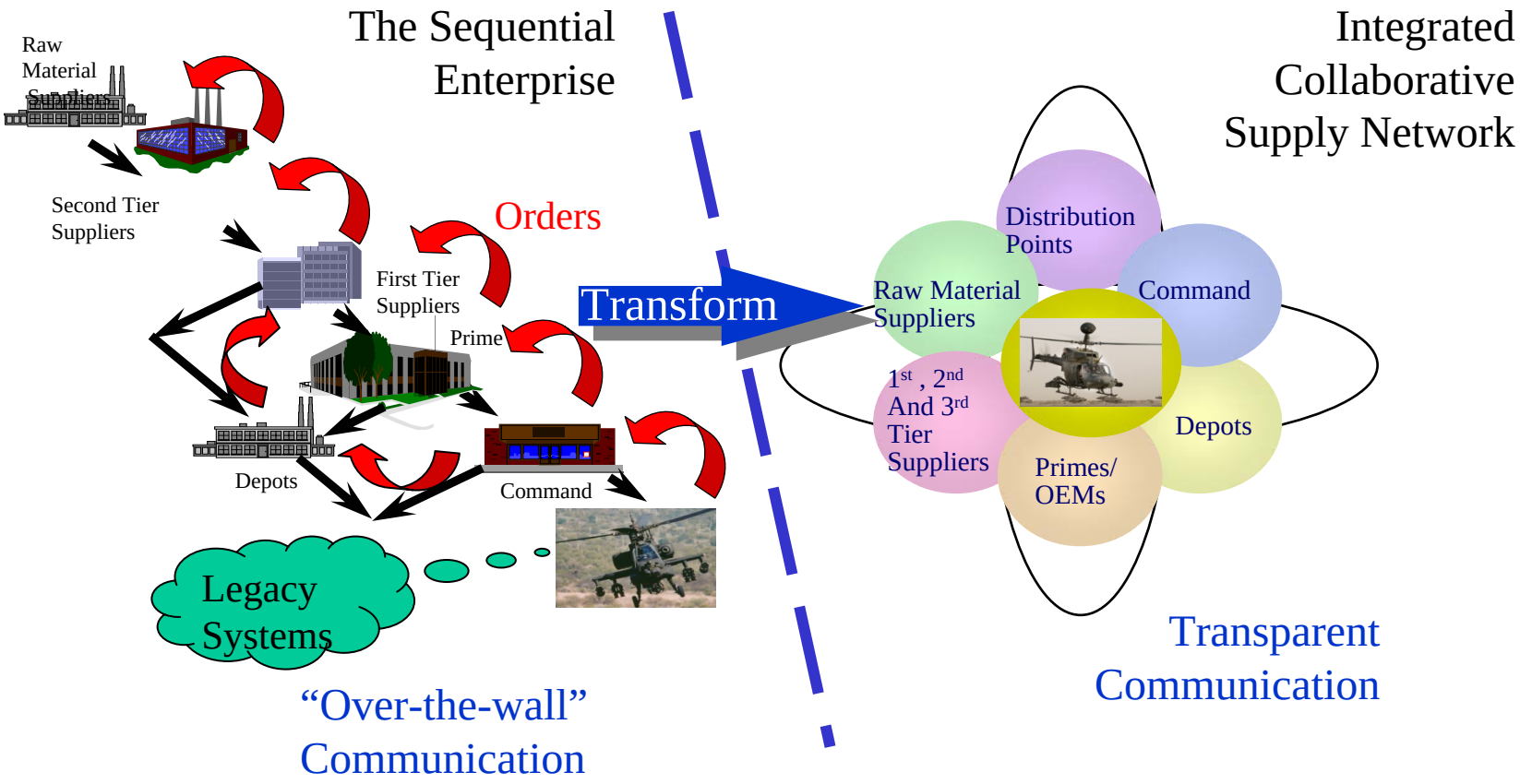
The Goal: Transform the Enterprise



Summary

- Small businesses are critical in the Aviation and Defense Supply Chain
- Be more involved!
  - Communication and collaboration
  - YCDBBSOYA
  - Challenge requirements
- Strategically expand your core competencies
  - Sub-assembly manufacture
  - Supply Chain and Program Management
  - Process transformation
- Invest in innovations
  - Processes
  - Systems
  - Technologies

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NDIA Mfg Division Survey

- Supply Chain Network Committee is performing a study of small to mid-sized suppliers that are or have been suppliers to the aerospace/defense industry
- Study is interested in identifying those factors that influence supplier involvement in this industry
- Short web-based survey is available on the NDIA web-site (www.ndia.org/Divisions/Divisions/Manufacturing)
- Participation is voluntary and all responses will be kept confidential
- Your participation is welcomed and needed.

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