



# Creating an Efficient & Responsive Supply Chain

Presented to the National Shipbuilding Research Program  
31 July 2007

Dr. William R. Killingsworth  
Executive Director, MIT Forum for Supply Chain Innovation  
billk@mit.edu



# MIT Forum for Supply Chain Innovation

- Formed in 2002; European Section 2006
- Led by the MIT School of Engineering & Sloan School of Management
- David Simchi-Levi, Charlie Fine, Bill Killingsworth
- Members Include Industry and Government



Hitachi Holding Co.





# Major Research Areas

MIT Forum for Supply Chain Innovation

- **Matching Products with Supply Chain**
  - Inventory Positioning/Push-Pull
  - Manufacturing & Distribution Network Design
  - Strategic Suppliers, PSM
- **Visibility, Identification, and Sensor Networks**
  - RFID, Wireless Networks
  - Interoperability
  - Sensors, GPS

# Major Research Areas

MIT Forum for Supply Chain Innovation

- **Product Development and Life-Cycle Design**
  - Integral vs. Modular Design
  - Product Clockspeed
  - Make vs. Buy
  - Portfolio Management
- **Supplier and Customer Relations**
  - Contracts: Risk and Profit Sharing
  - Collaboration in Forecasting, Planning & Execution
  - Communication; Supplier Committees
  - Purchasing and Supply Management

# Major Research Areas

MIT Forum for Supply Chain Innovation

## Risk Management in Global Supply Chains

- **Supply Risks**
- **Demand Risks**
- **Development of Mitigation Strategies**



# Today's Supply Chain Pitfalls

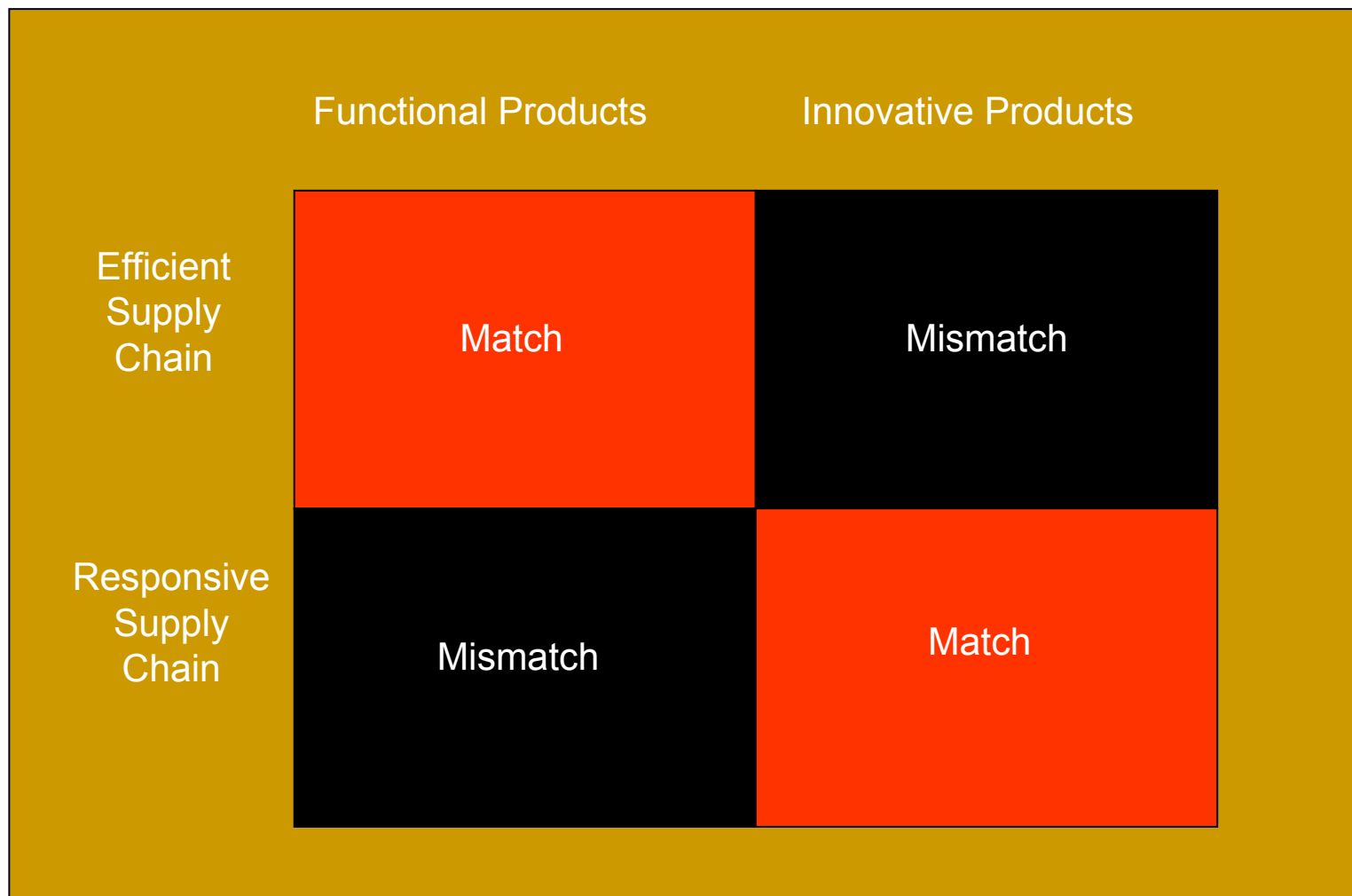
- **Long Lead Times**
- **Minimized Inventories**
- **Uncertain Demand and Supply**
- **Complex Product Offerings**
- **Component Availability**
- **Downsizing/Out-sourcing**
- **Globalization/Off- and near-shoring**
- **Shrinking Supplier Base**
- **Troubled Supplier Relations**
- **Fragile Supply Chains**



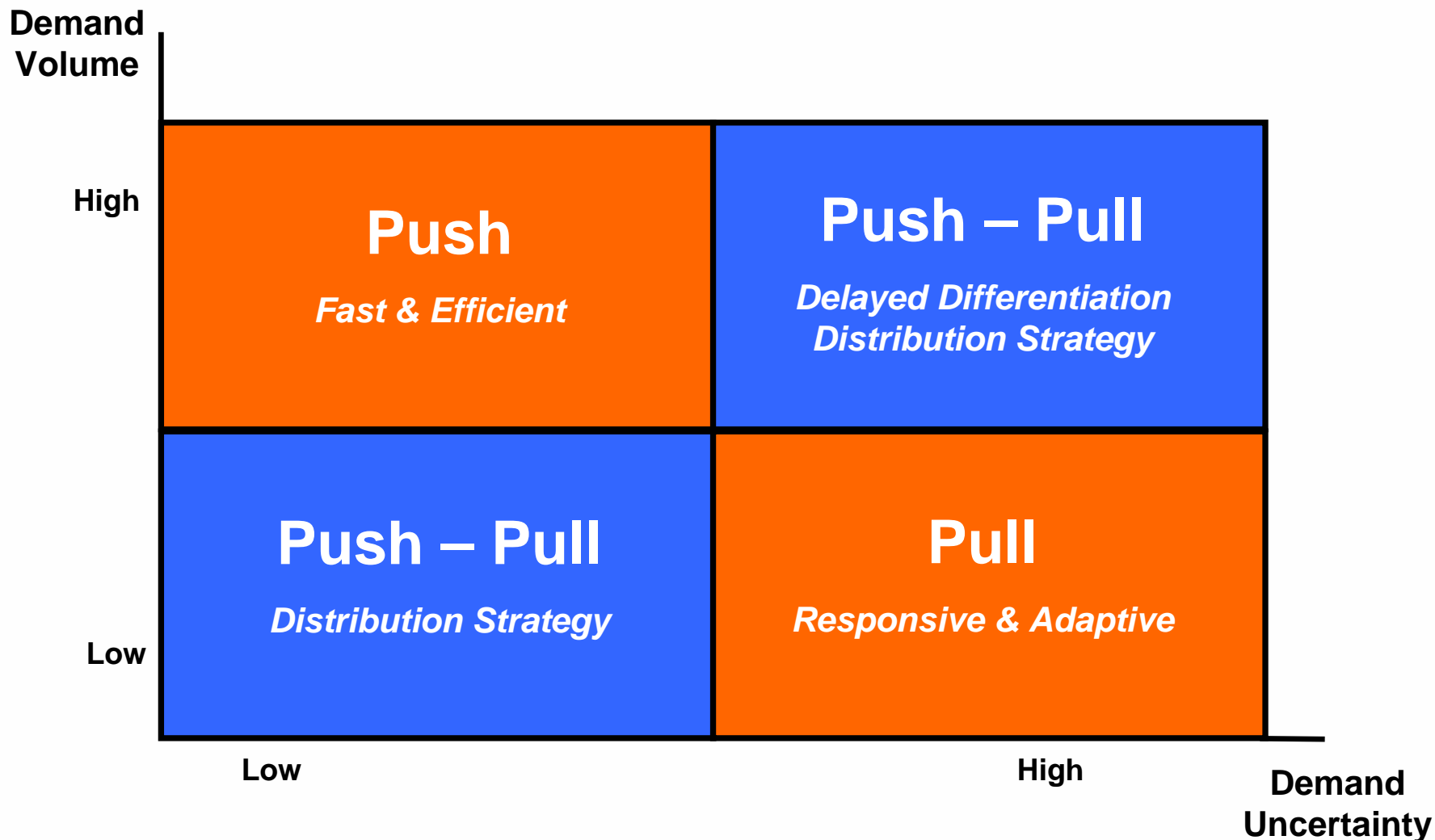
# Designing the Supply Chain for the Specific Product

- **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.**

# Fisher's Framework

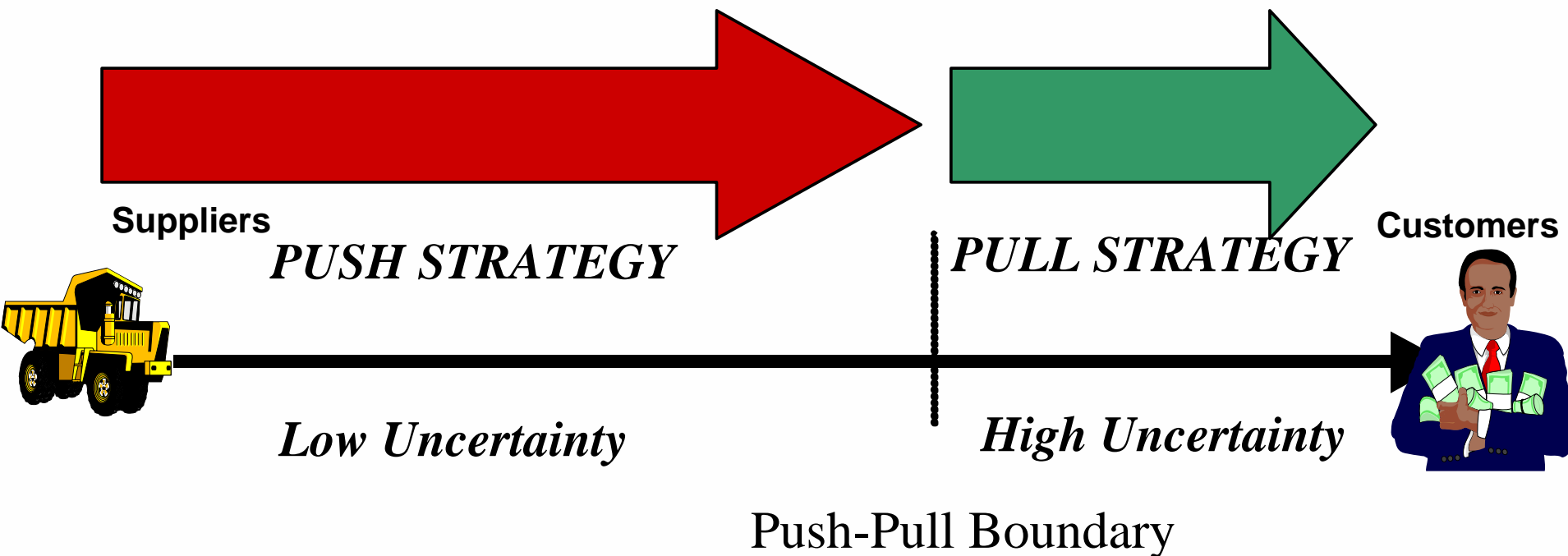


## DEMAND CHARACTERISTICS & SUPPLY CHAIN DESIGN



# A Key Design Element: Push-Pull Supply Chains

*The Supply Chain Time Line*



# Examples of Push Supply Chains

- **Automotive**

- Mercedes in Vance, Alabama

- 160,000 M and R Class vehicles per year
    - Two Shifts
    - New vehicle comes off line every 90 seconds

- Honda in Lincoln, Alabama

- 300,000 Odyssey Minivans and Pilot SUVs per year
    - Two production lines; two shifts
    - New vehicle comes off each line every 90 seconds

- **Baby Care: Over 300,000,000 packages of Pampers sold annually**

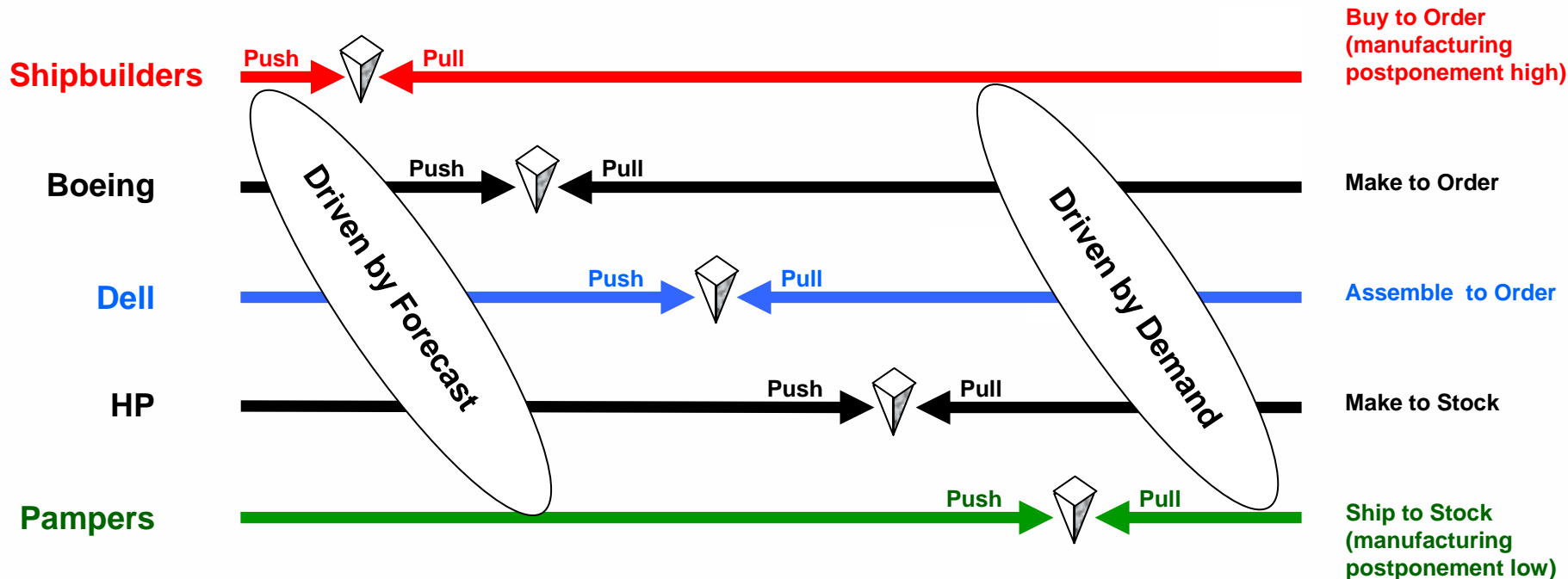
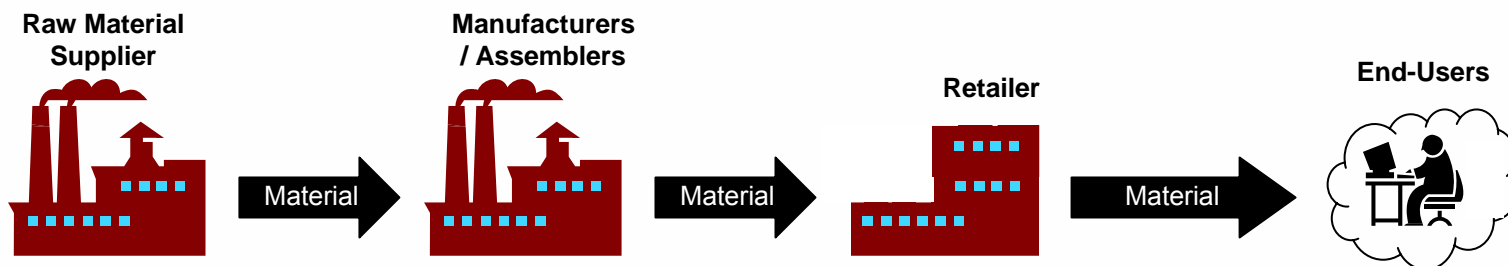
- **Key Focus: Efficiency, Just in Time, Velocity & Coordination**



# Examples of Push-Pull Supply Chains

- **Dell**
  - Buys to Forecast; Makes to Order
  - Modular Product Design
  - Delayed Differentiation
  - Dynamic Pricing to Correct for Forecast Errors
- **Furniture**
  - Make to Order ... Pull
  - Hold and accumulate for regional shipment ... Push
  - What About Ikea?
- **Key Focus for Push-Pull are Responsiveness to “Market of One”, then efficiency**

# PUSH – PULL SUPPLY CHAINS

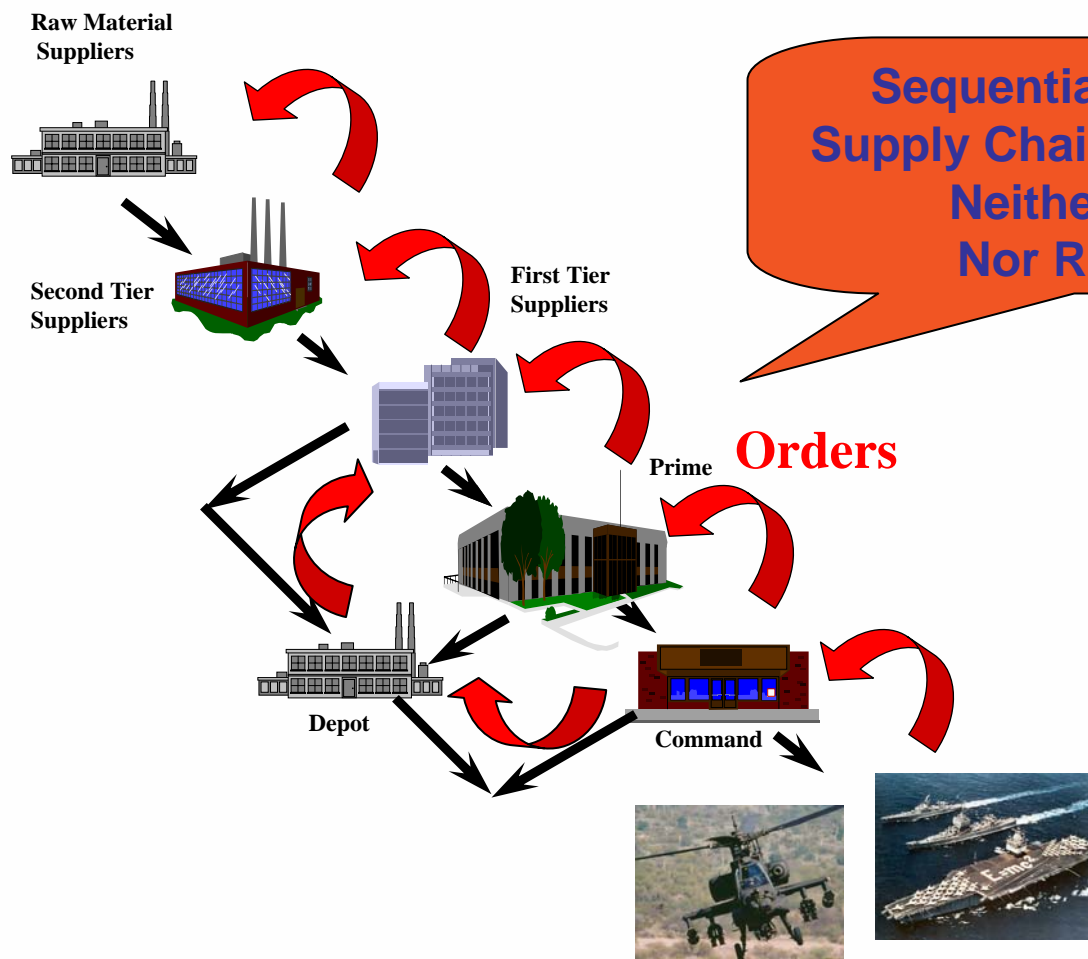


 Denotes a Stockholding Decoupling Point

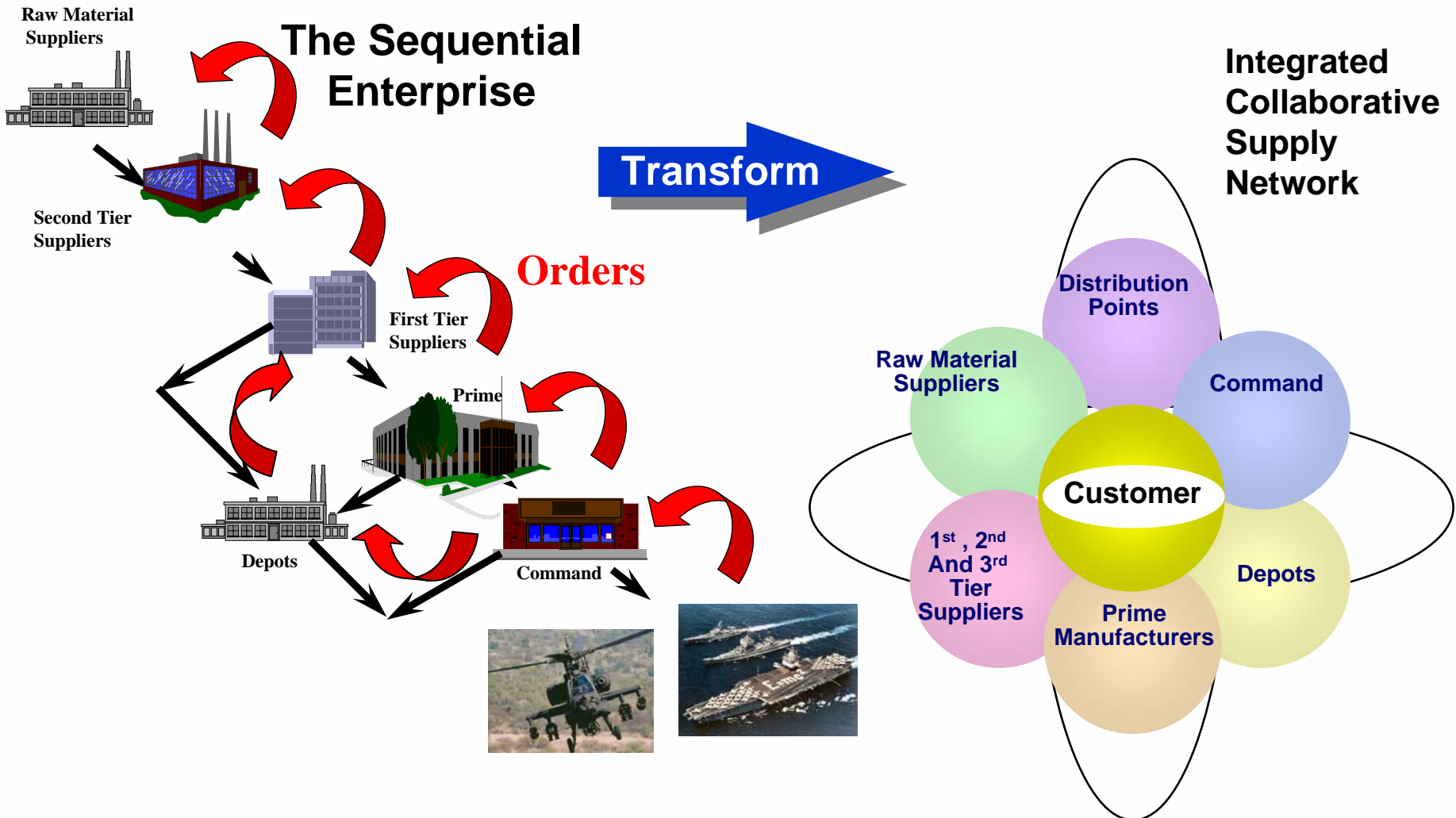
Source: Towill (2005) "Decoupling for Supply Chain Competitiveness"

- Specify *value*: Value is defined by customer in terms of specific products and services
- Identify the *value stream*: Map out all end-to-end linked actions, processes and functions necessary for transforming inputs to outputs to identify and eliminate waste
- Make value *flow* continuously: Having eliminated waste, make remaining value-creating steps “flow”
- Let customers *pull* value: Customer’s “pull” **cascades** all the way back to the lowest level supplier, enabling just-in-time production
- Pursue *perfection*: Pursue continuous process of improvement striving for perfection

# “The Typical Sequentially Cascading Supply Chain”



# The Goal: Transform the Enterprise



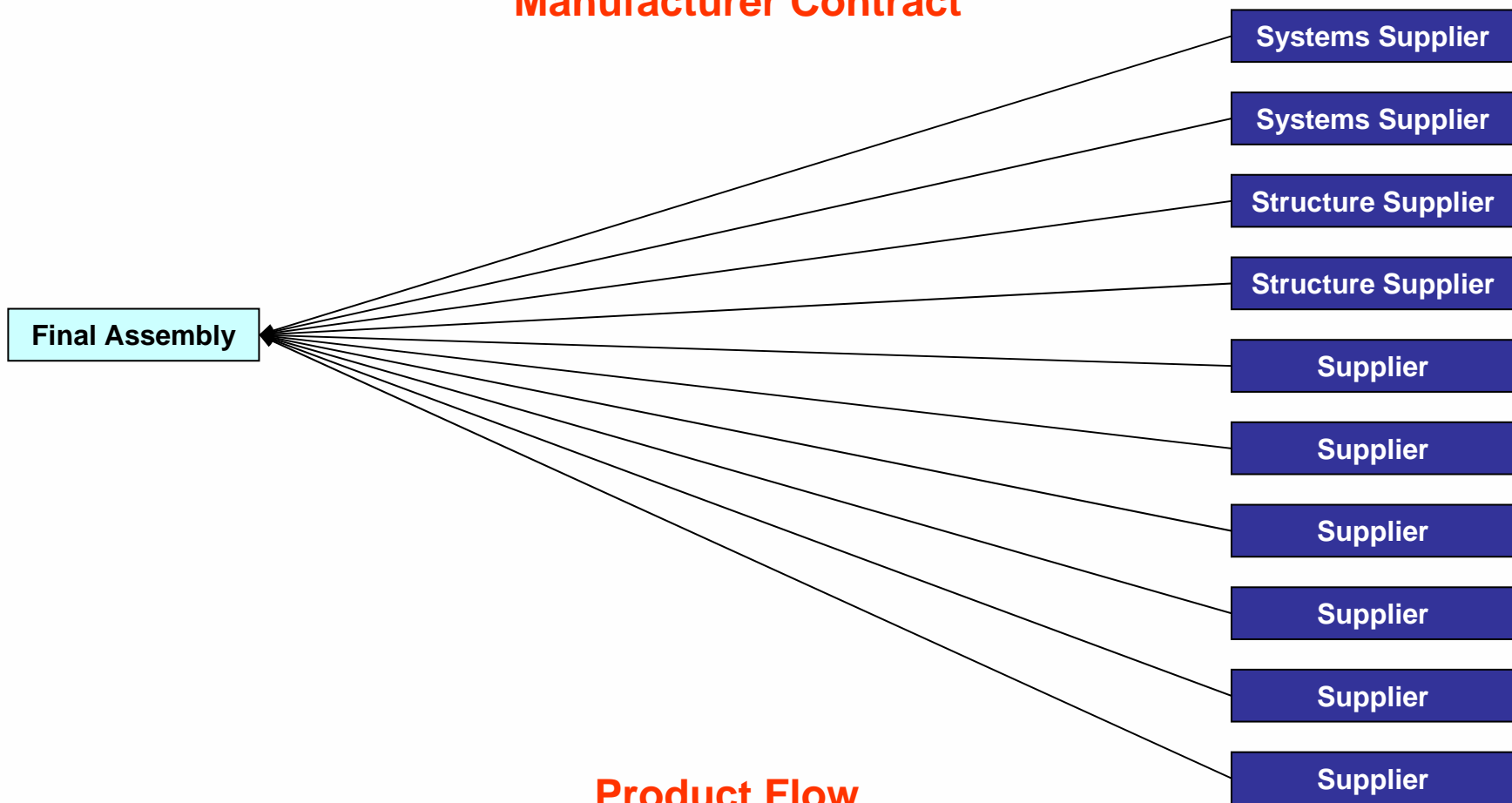


# Steps in the Transformation

- **Define and Map the Nature of the Supplier Network**
- **Identify Strategic Partners**
- **Enable Visibility, Collaborative Forecasting, Planning and Execution**
- **Maintain Positive Supplier Relations**

# Traditional Supply Chain Structure

**Manufacturer Contract**



**Product Flow**

# Rotor Head Suppliers

<b>Company A</b>	Bolt	134 Days
<b>Company B</b>	Shaft	176 Days
<b>Company C</b>	Rev Spring	155 Days
<b>Company D</b>	Bolt	210 Days
<b>Company E</b>	Bushing	080 Days
<b>Company F</b>	Bushing	
<b>Company G</b>	Seal	120 Days
	Seal	120 Days
	Sleeve	120 Days
	Seal	120 Day
	Seal	189 Days
<b>Company H</b>	Rev Limiter	197 Days
<b>Company I</b>	ID Plate	120 Days
	ID Plate	110 Days
<b>Company J</b>	Stop	210 Days
	Nut Plain	239 Days
	Nut	170 Days
	Bracket Assembly	
<b>Company K</b>	Shim	075 Days
	Shim	
<b>Company L</b>	Washer	167 Days
<b>Company M</b>	Support	119 Days
<b>Company N</b>	Weight	

<b>Company O</b>	Sleeve Bushing	231 Days
	Sleeve	120 Days
	Washer	168 Days
	Nut	155 Days
	Key	

<b>Company P</b>	<b>Hub</b>	<b>300 Days</b>
	<b>Hub-Class</b>	<b>320 Days</b>
	<b>Pin-Class</b>	<b>290 Days</b>
	Pin	250 Days

<b>Company Q</b>	Pitch Housing	
------------------	---------------	--

<b>Company R</b>	Cover	180 Days
	Retainer	180 Days

<b>Hydroform</b>	Cover	170 Days
------------------	-------	----------

**Prime/LCMC**

<b>Company S</b>	Bearing	180 Days
	Bearing	170 Days
	Bearing	230 Days
	Bearing	250 Days
	<b>Bushing Sleeve</b>	<b>275 Days</b>

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

<b>Company U</b>	Base	
	Shield	

<b>Company V</b>	<b>Boot</b>	<b>260 Days</b>
------------------	-------------	-----------------

<b>Company W</b>	Weight	126 Days
	Weight	100 Days

<b>Company X</b>	Collar	
	Cover Assembly	

<b>Company Y</b>	Shim	150 Days
------------------	------	----------

<b>Company Z</b>	Ring	150 Days
------------------	------	----------

<b>Company AA</b>	Shaft	
	Sleeve	

<b>Company BB</b>	Washer	110 Days
-------------------	--------	----------

<b>Company CC</b>	Washer	100 Days
	Retainer	100 Days

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

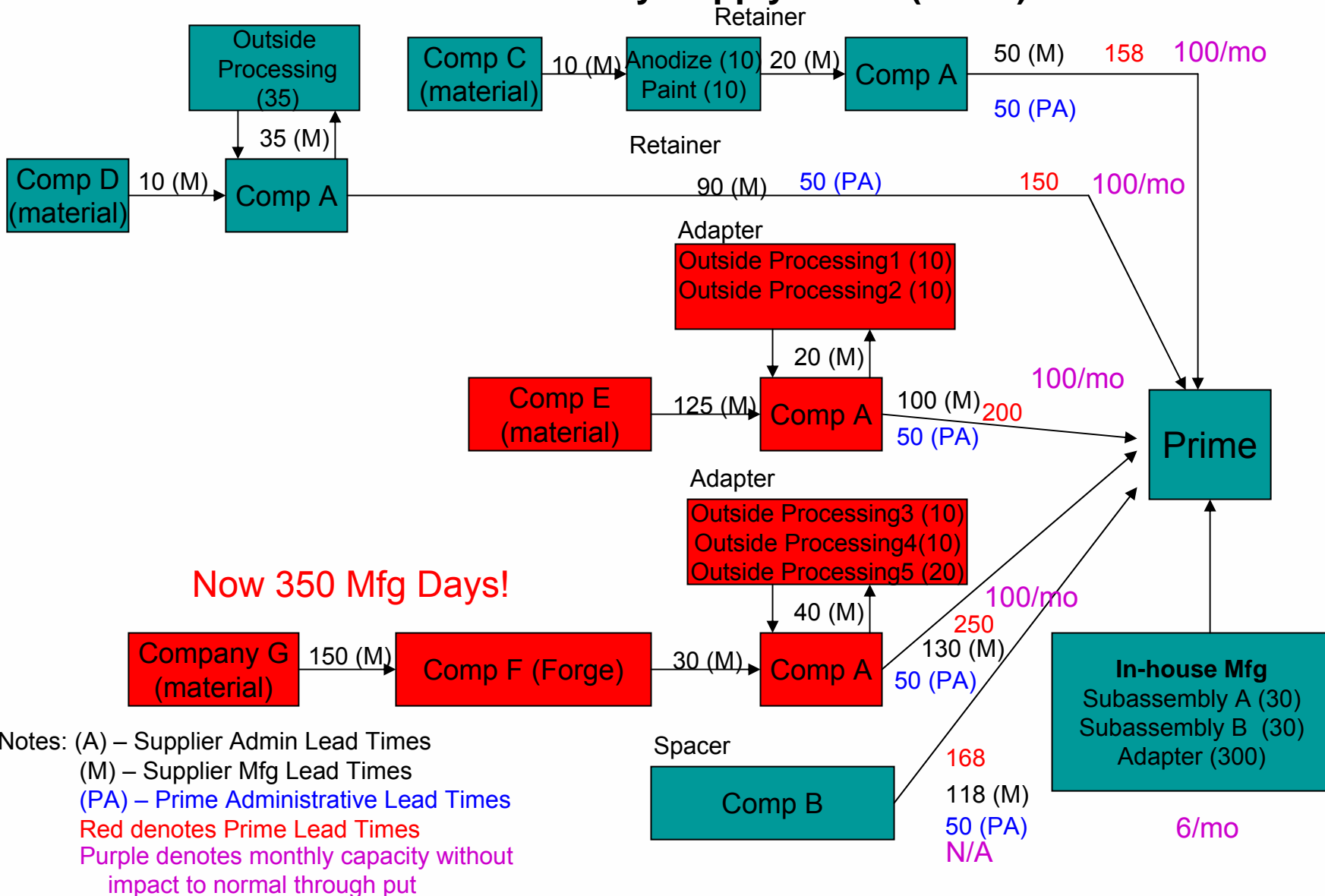
<b>Company EE</b>	Washer	120 Days
-------------------	--------	----------

<b>Company FF</b>	Tank	
-------------------	------	--

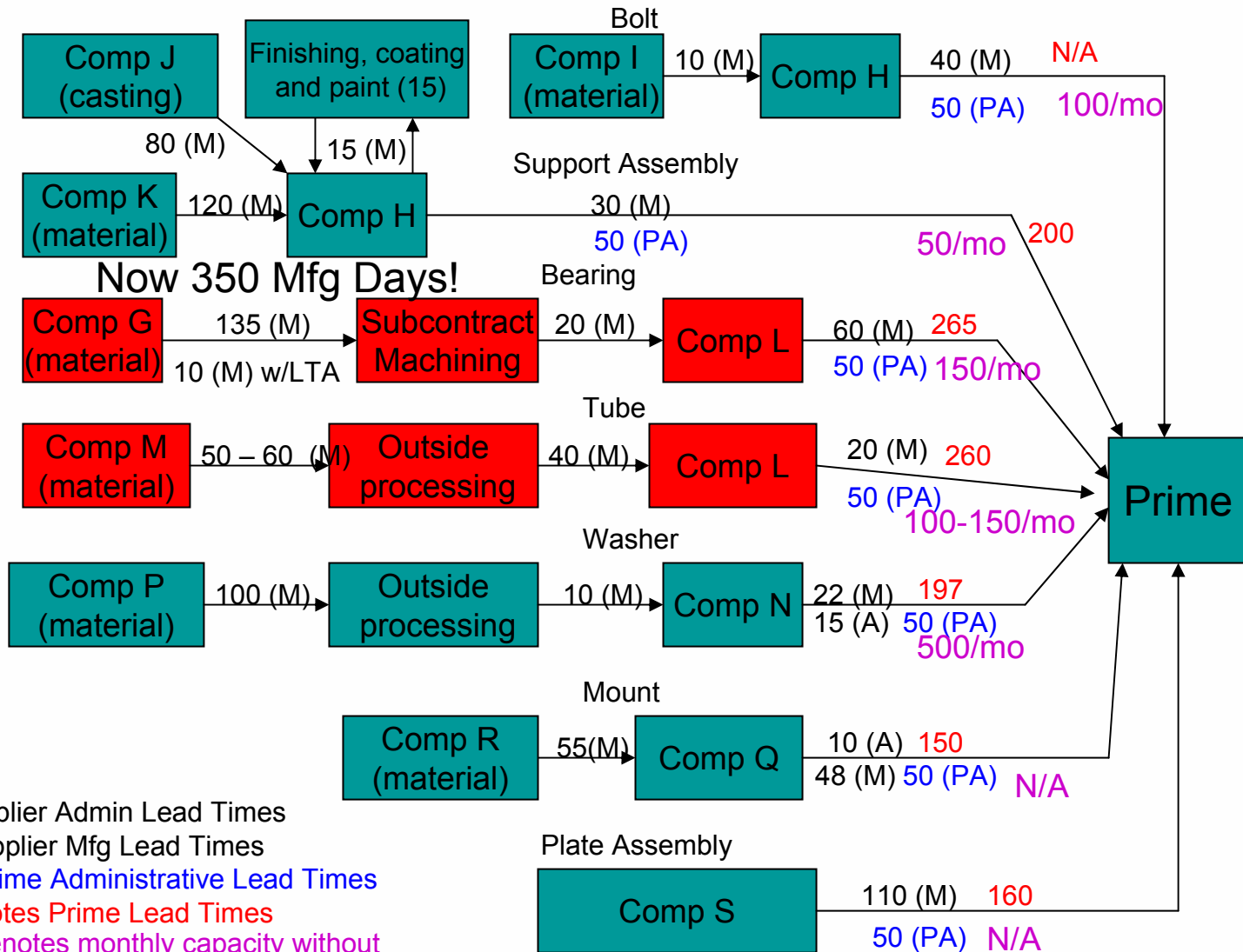
<b>Company GG</b>	Cover	080 Days
-------------------	-------	----------

<b>Company HH</b>	Tank Assembly	
-------------------	---------------	--

## Shaft Assembly Supply Chain (1 of 2)

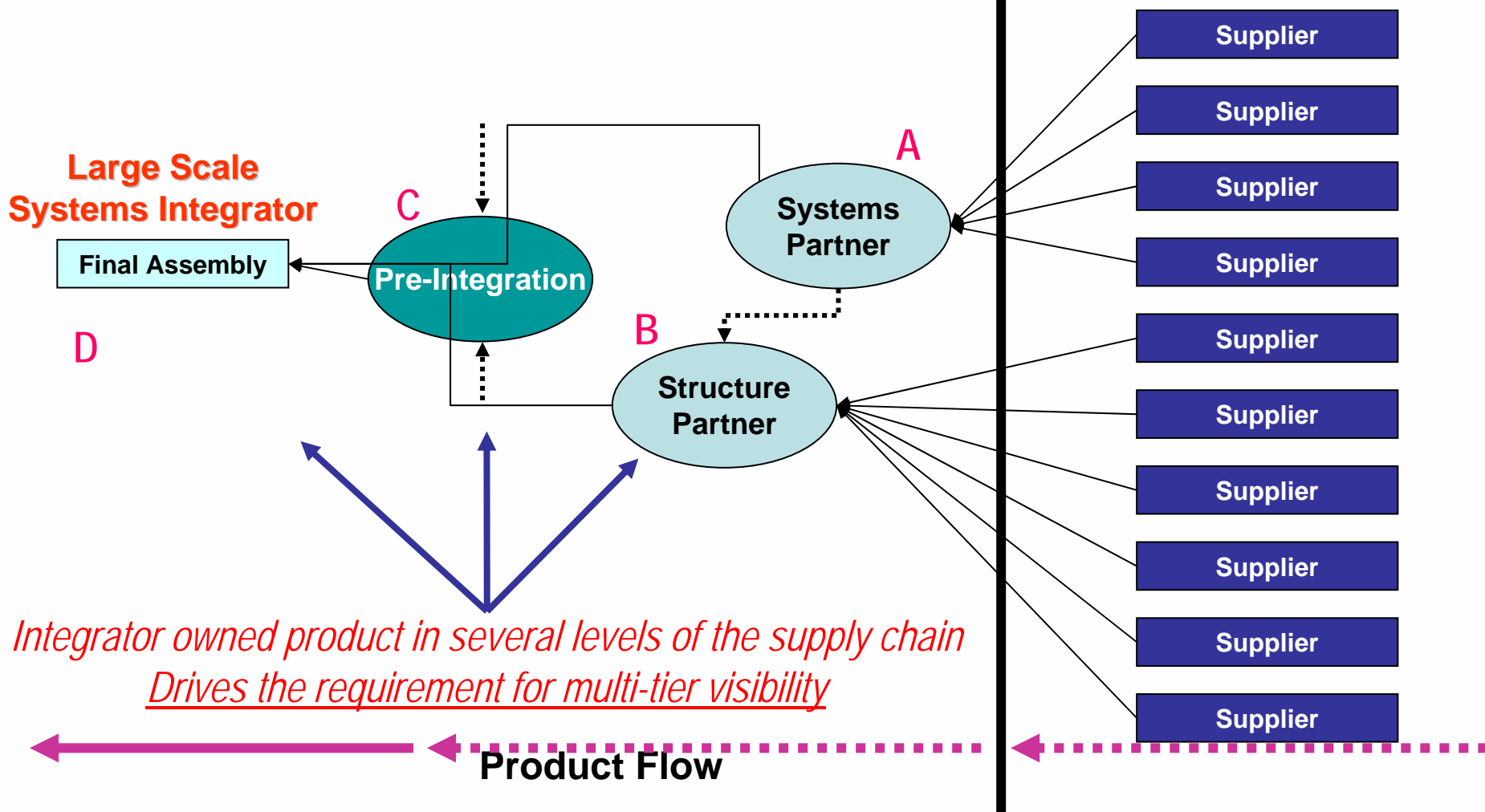


## Shaft Assembly Supply Chain (2 of 2)



# Strategic Partner Structure

Partner/Supplier Contract

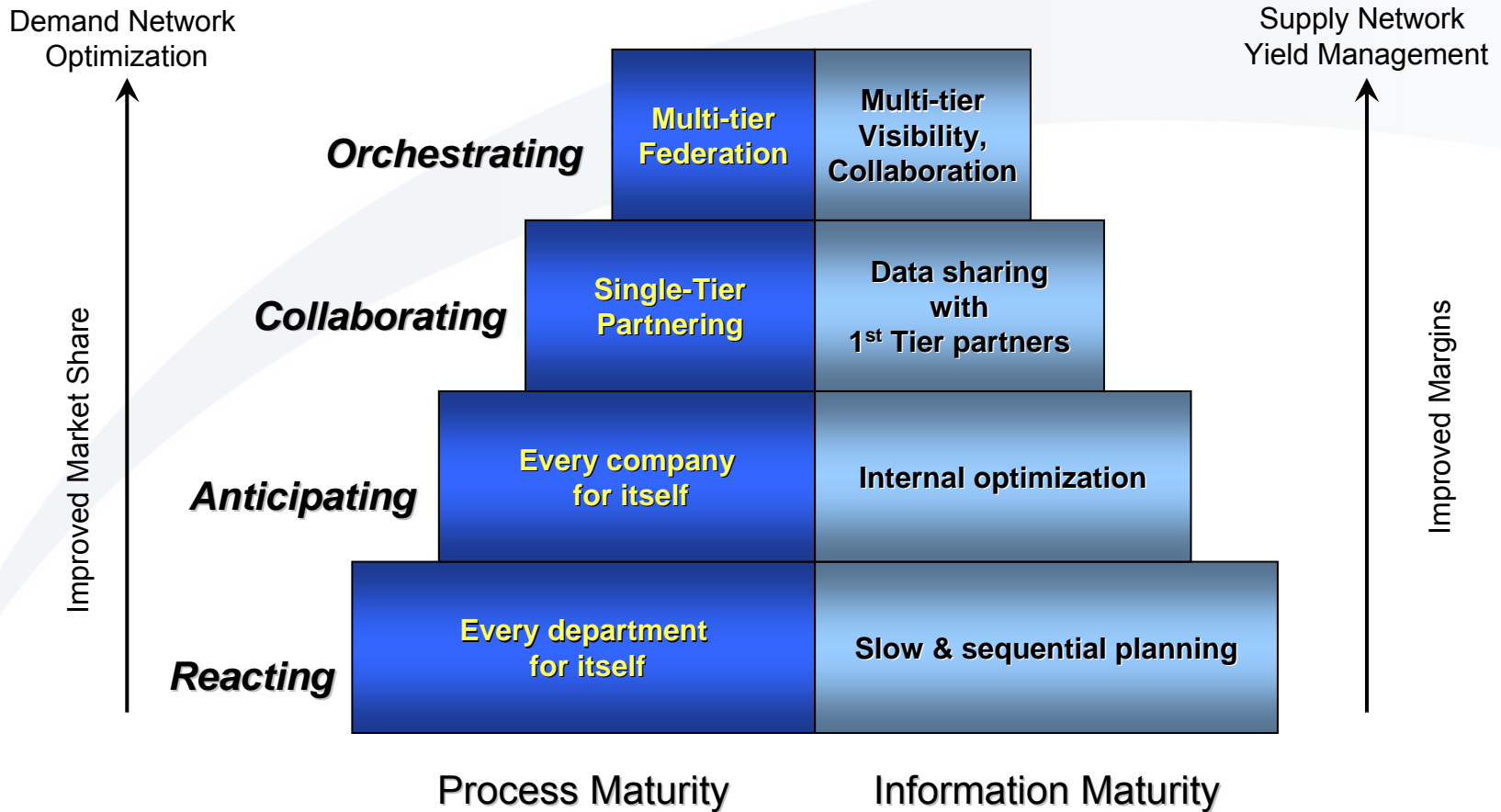


# Improvements Via PSM Analysis & Strategic Sourcing

## Typical Benefits of Procurement & Supply Management (PSM)

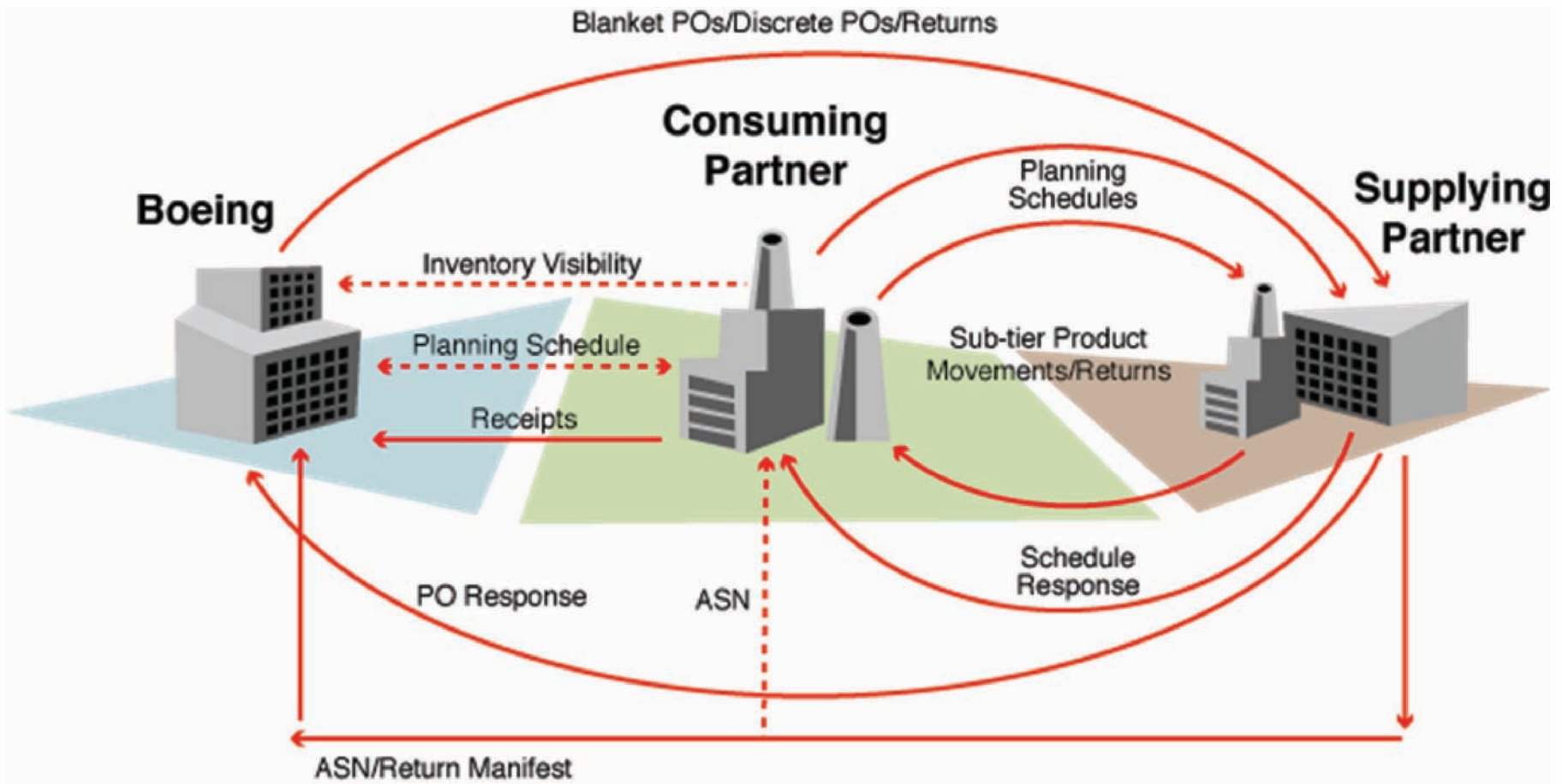
- **More Effective Buying Techniques**
- **Spend Analysis – Who buys what from whom with what funds**
- **Market Intelligence – What is happening in the market, raw material trends**
- **Logistical Efficiencies – Enhancing PLT, ALT, Asset Management**
- **Savings Opportunities – Opportunities to save money**
- **Process Efficiencies – Streamline current supply chain processes & integrate**

# Maturity Model for Collaboration and Process Interoperability



\* Source: AMR Research, "Inter-Enterprise Supply Chain Coordination Needs a Platform," 2003

# Exostar Solution: Multi-tier visibility



Exostar Conference: October 9, Washington DC

# Gain Consolidated Visibility Across Tiers

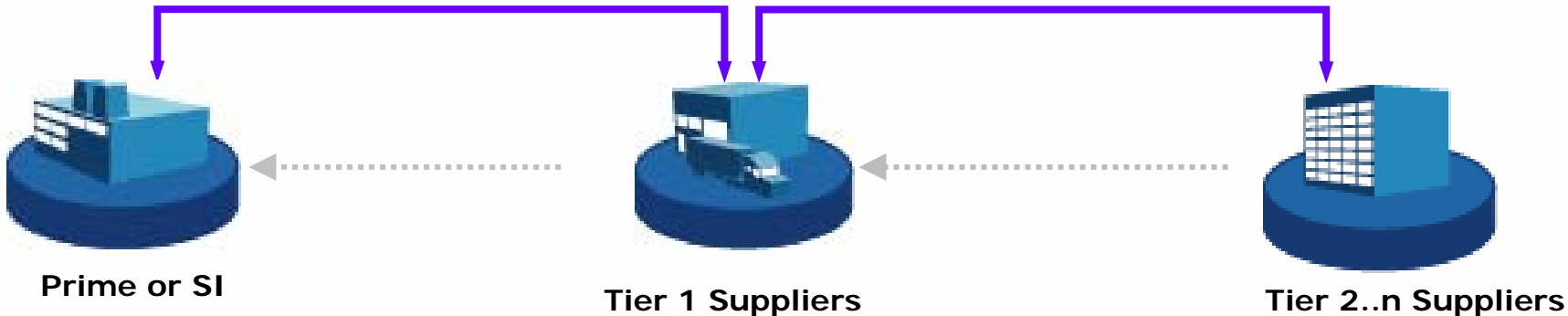


	08/28/03	08/29/03	08/30/03	08/31/03	09/01/03	09/02/03	09/03/03
Forecast	25	30	30	30	25	30	
Commit	25	30	35	30	25	30	35
Pull Request	25	30	35	0	0	0	0
In-Transit to Mfg Site	0	30	0	0	0	0	0
Goods Receipt at Mfg Site	25	0	0	0	0	0	0
Replenishment to Hub	45	20	20	0	0	0	0
In-Transit to HUB	25	0	0	0	0	0	0
Goods Receipt at Hub	20	0	0	0	0	0	0
Projected Available Inventory	125	95	100	100	95	100	105
Projected Available DOS	4.2	3.2	3.5	3.6	3.5	3.43	3.55
Projected Inv. Excess							
Projected Inv. Shortage							
Recommended Replenishment	0	5	0	0	0	0	0

	08/28/03	08/29/03	08/30/03	08/31/03	09/01/03	09/02/03	09/03/03	09/04/03
Forecast	25	30	30	30	25	30	25	
Commit	25	30	35	30	25	30	35	25
Pull Request	25	30	35	0	0	0	0	0
In-Transit to Mfg Site	0	30	0	0	0	0	0	0
Goods Receipt at Mfg Site	25	0	0	0	0	0	0	0
Replenishment to Hub	45	20	20	0	0	0	0	0
In-Transit to HUB	25	0	0	0	0	0	0	0
Goods Receipt at Hub	20	0	0	0	0	0	0	0
Inventory	125	95	100	100	95	100	105	105
Projected Available DOS	4.2	3.2	3.5	3.6	3.5	3.43	3.55	3.47
Projected Inv. Excess								
Projected Inv. Shortage								
Recommended Replenishment	0	5	0	0	0	0	0	0

COMPONENTS

WHERE USED

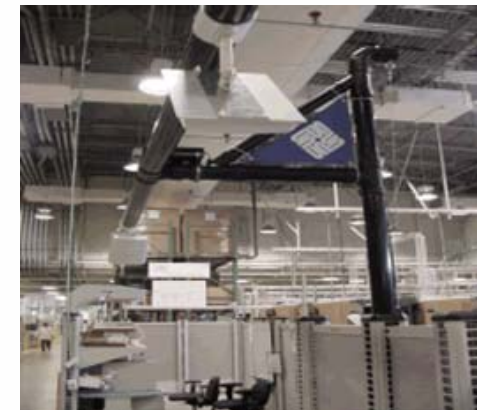
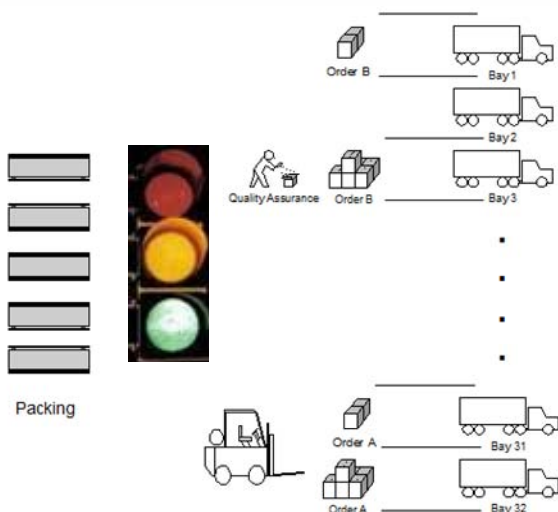


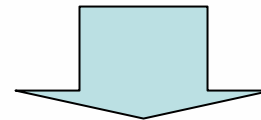
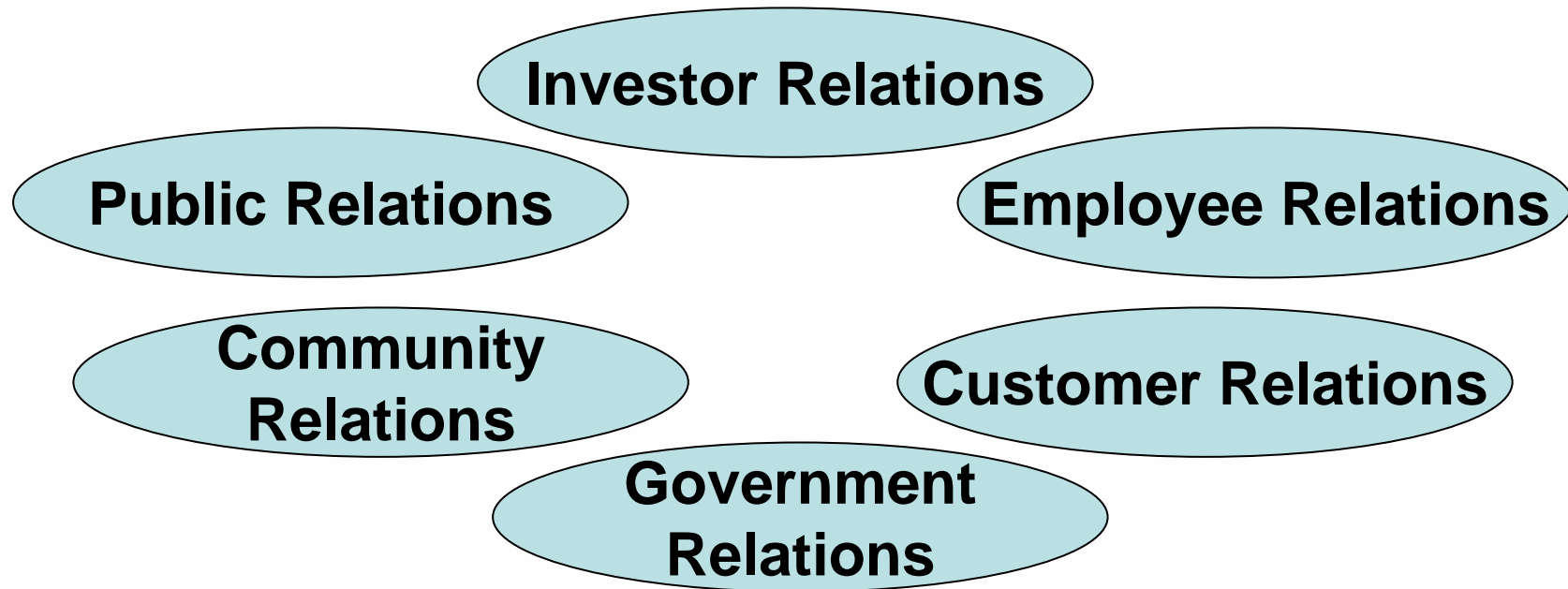
# RFID Industry Transformations -- CapGemini

RFID Enabled Supply Chain Transformation Opportunities	Retail & CPG				Distribution		Manufacturing & Packaging	Life Sciences / Pharma	Healthcare	Aviation	Automotive	Energy / Utilities	Defense	Government	Financial Documents & Securities
	Textiles	Food	Hightec & White Goods	Luxury Items	Courier & Postal	International Logistics									
DC / Warehouse Operations	X	X	X	X	X	X	X	X				X			
International Trade / Customs / Security						X				X	X		X	X	X
Pedigree / Track / Trace / Theft / Counterfeit	X	X	X	X				X		X	X		X		X
Cold Chain Logistics	X	X	X	X	X	X		X	X						
Inventory Management / Real-Time Optimization	X	X	X	X	X	X	X				X		X		X
Mobile (Returnable) Asset Management / Utilization	X	X	X	X	X	X			X	X	X		X	X	
Store Operations / Consumer Driven Replenishment	X	X	X	X											
Asset Maintenance & Monitoring (MRO / SPL)									X	X	X	X	X	X	
Mission Demand Planning													X		
Managed Service Provision	X	X	X	X	X	X		X		X	X				
Information Sharing (EDI, GDS, EPCIS)	X	X	X	X	X	X	X	X						X	X
Manufacturing (Work in Progress)	X	X	X	X			X	X		X	X				
Reverse Logistics (Returns / Recalls / Waste)	X	X	X	X	X	X	X	X		X	X			X	

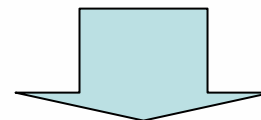
# DC / Warehouse Operations

- Improved In-Bound / Receiving
- Improved Out-Bound / Loading
- Improved Staging
- Improved Picking
- Improved Packaging
- Improved Miss-placed Items
- Improved Cross Docking





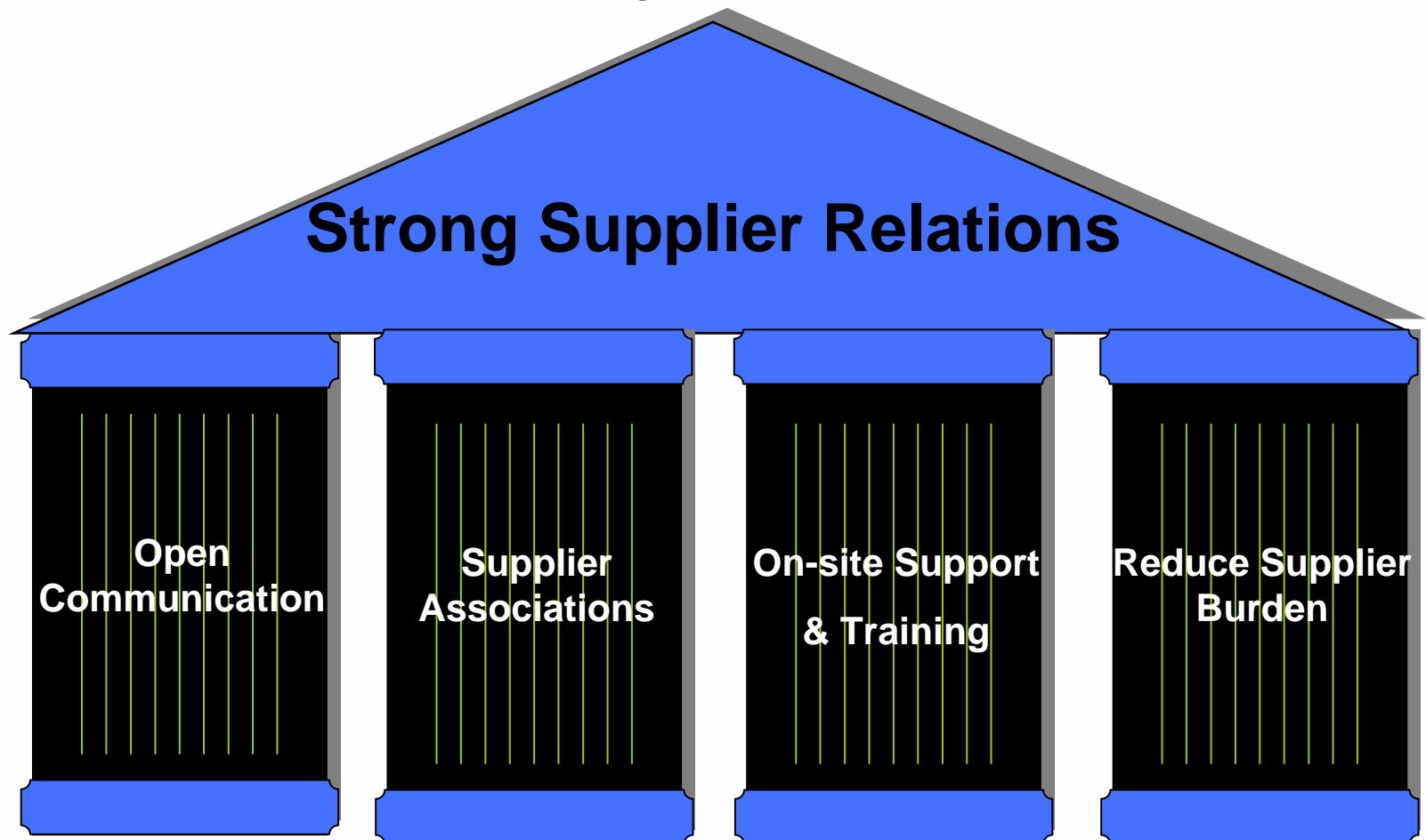
Where is “Supplier Relations?”



What is “Supplier Relations?”

# Four Columns of Collaboration

## *The Toyota Model*





# Conclusions

- **Think Globally;**
- **Act Globally; and**
- **Do Not Stop With Local Islands of Optimization**



## Summary: Enabling Both Efficiency and Responsiveness in a Pull Supply Chain

- **Streamline supply chain through the use of strategic partners;**
- **Involve strategic partners in design and development process;**
- **Identify critical bottlenecks and lead time drivers; develop corrective actions;**
- **Enable visibility, collaborative planning and forecasting; and**
- **Strengthen supplier relations.**



# Coming Events – You Are Invited

- **14-15 November 2007 – Road Trip for Forum!**
  - To Be Held at GE Global Research Labs
  - Schenectady, New York
  - Real Time Global Tracking and Logistics
  - Wireless Sensors and Networks
  
- **29-30 November 2007 – European Road trip!**
  - To Be Held at the Newly Opened DHL Innovation Center near Bonn, Germany
  - Sponsored by the European Section of the MIT Forum for Supply Chain Innovation, Hasso Plattner Institute