

Seminario Internacional 
de Management Logístico

10 de Mayo de 2011, Hotel Sheraton Buenos Aires.



Supply Chain Strategy
**Estrategias de Supply Chain
en un mundo volátil**

DR. DAVID SIMCHI-LEVI

*Profesor de Ingeniería en Sistemas
en el MIT y es considerado uno
de los principales pensadores en
el campo del Supply Chain Management.*

Supply Chain Strategies in a Volatile World

David Simchi-Levi

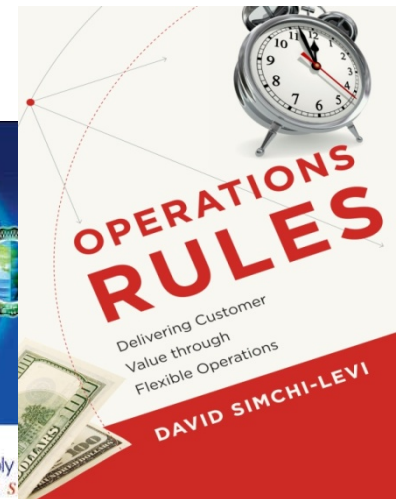
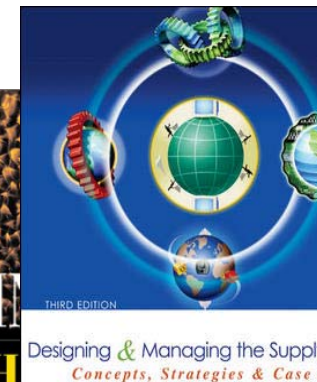
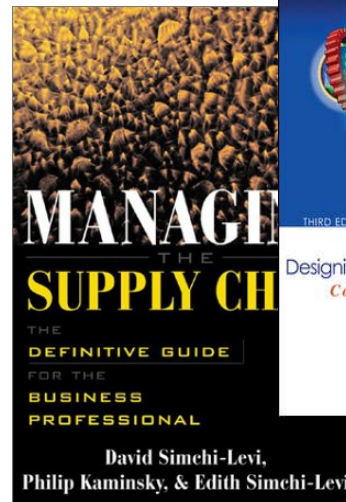
E-mail: dslevi@mit.edu



**Professor, Massachusetts
Institute of Technology**

What We'll Cover ...

- **Business and Supply Chain Challenges**
- **Supply Chain Flexibility**
 - ♦ Pepsi Supply Chain Transformation
- **Supply Chain Segmentation**
 - ♦ Dell Supply Chain Transformation
- **Managing Supply Chain Risk**
 - ♦ CPG Company
- **Summary**



Today's Business and Supply Chain Challenges

- Global supply chain with long lead times
- Rising and shifting customer expectations
- Increase in labor costs in developing countries

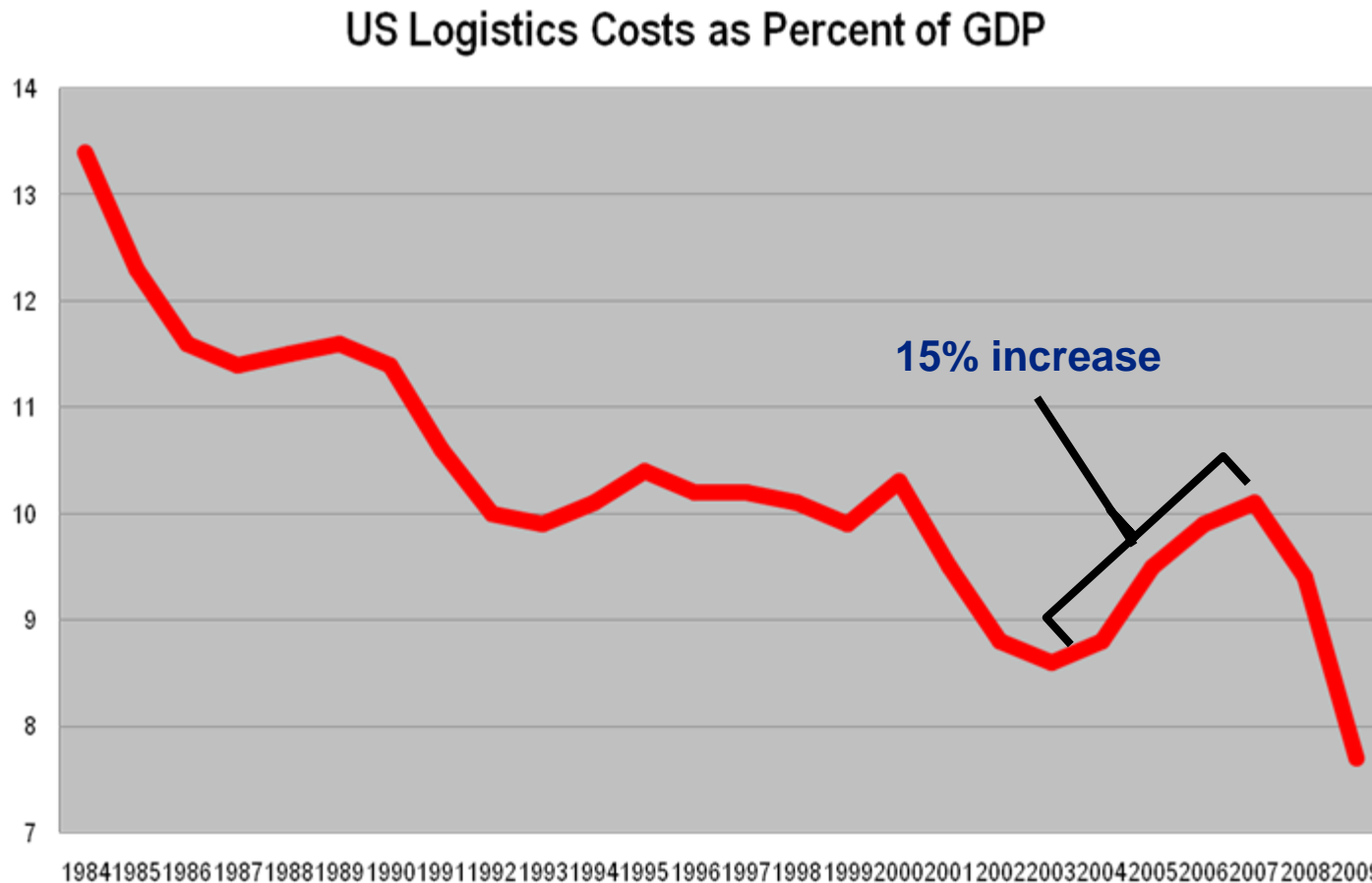
The Average Annual Wage Increase between 2003 and 2008 in different Countries

Country	Brazil	China	Malaysia	Mexico	US
Average Annual Wage Increase	21%	19%	8%	5%	3%

Today's Business and Supply Chain Challenges

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- Rising and shifting customer expectations
- Increase in labor costs in developing countries
- Changes in logistics costs

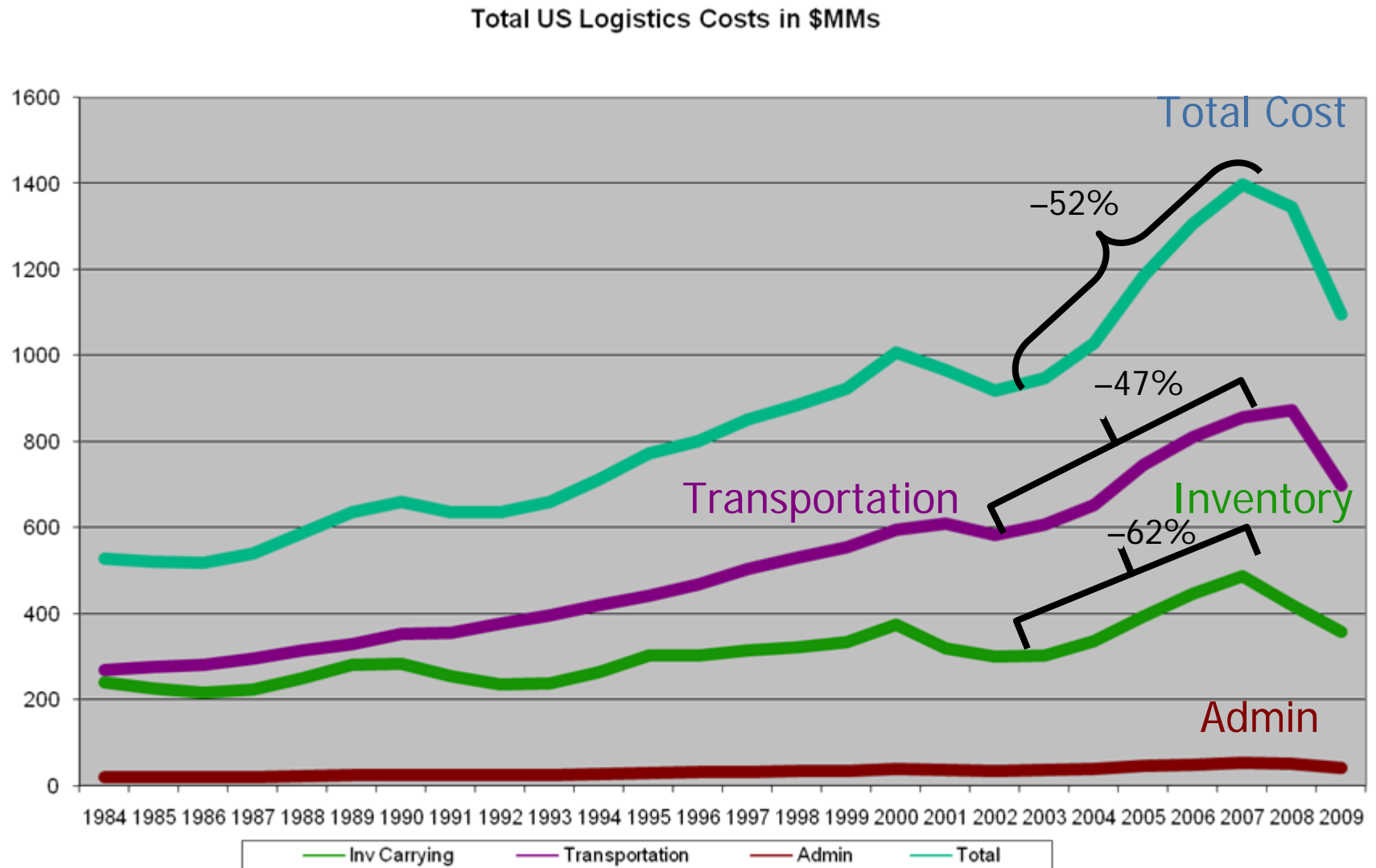
Changes in Logistics Costs between 1984 and 2009



- Rising energy prices
- Rail capacity pressure
- Truck driver shortage
- Security requirements

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Total US Logistics Costs 1984 to 2009 (\$ Billions)



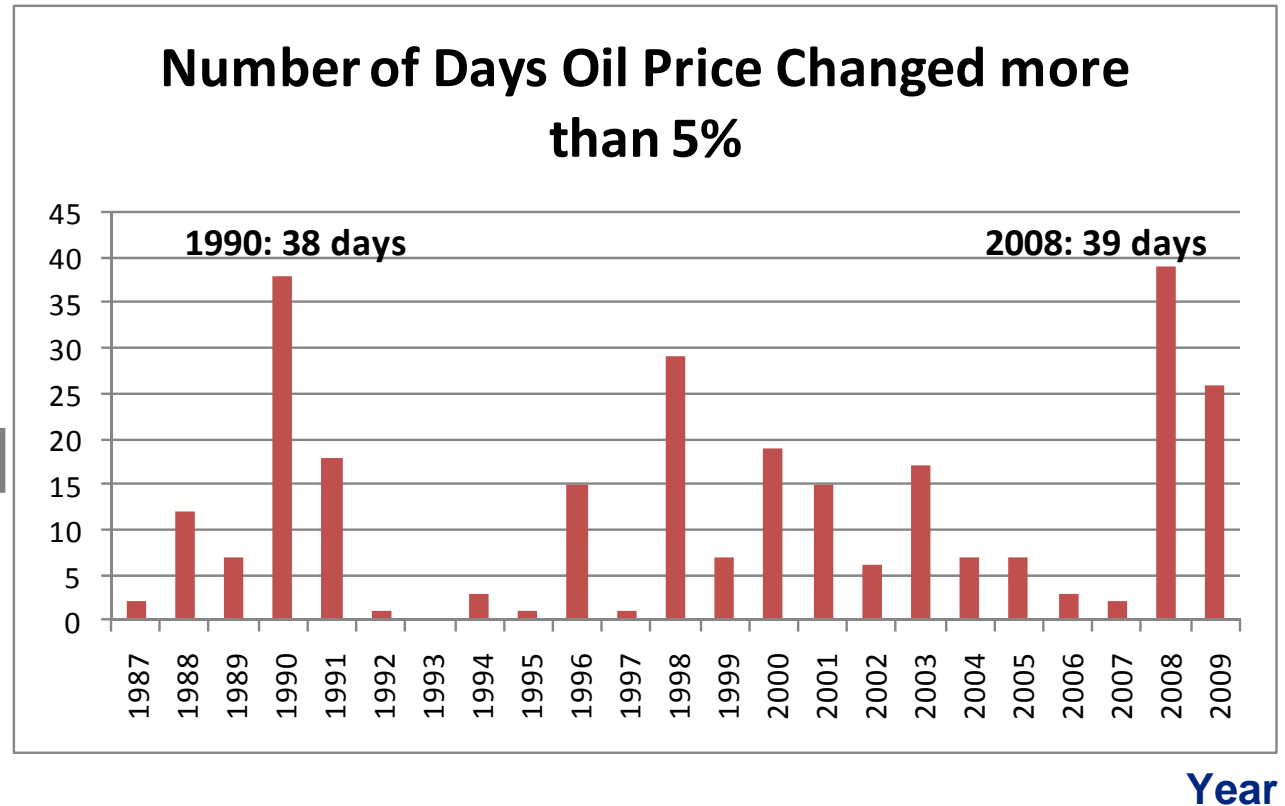
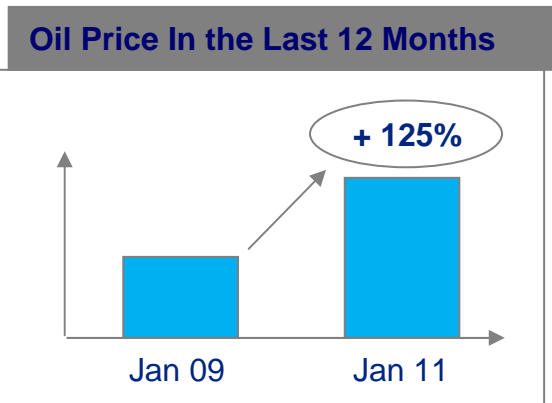
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-Source: 19th Annual Logistics Report

Today's Business and Supply Chain Challenges

- Global supply chain with long lead times
- Rising and shifting customer expectations
- Increase in labor costs in developing countries
- Changes in logistics costs
- **Increase in risks**
- **Importance of sustainability**
- **Unprecedented Volatility**

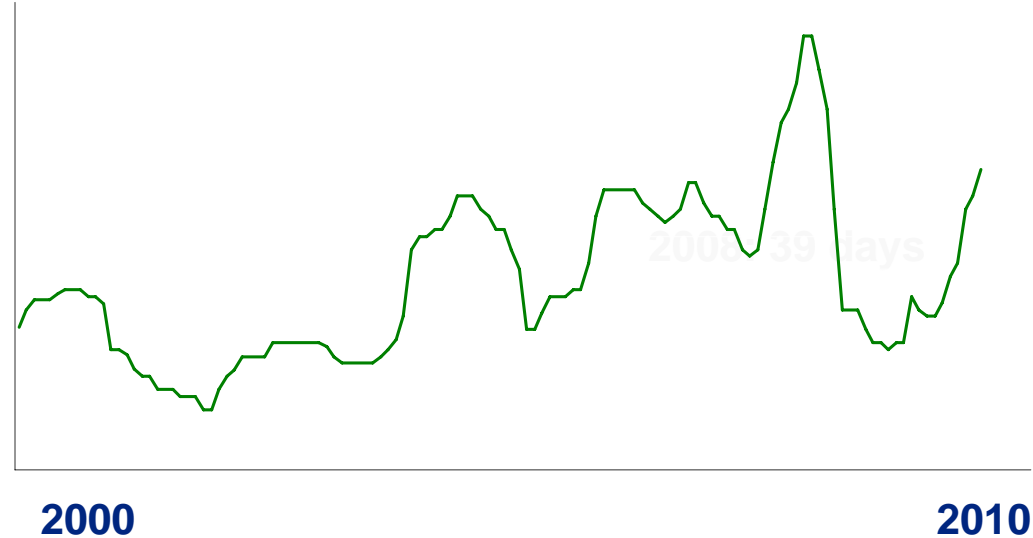
Unprecedented Volatility --- Oil Price



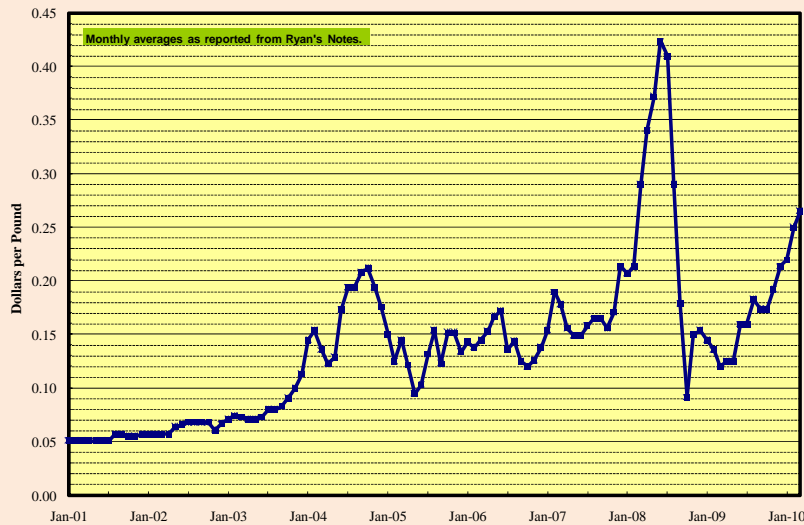
In 2008 the price of oil changed 5% or more from its previous close on 39 days making it the most volatile year since 1990.

Volatile steel market

Steel price



Iron Busheling Prices



Latrobe Specialty Steel Company

In the steel industry, lead times have decreased from 40-60 weeks in 2004-2006 to 10-15 weeks in 2008-2009 as the economy went into a recession.

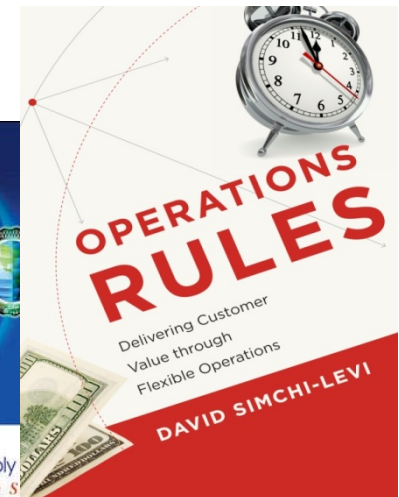
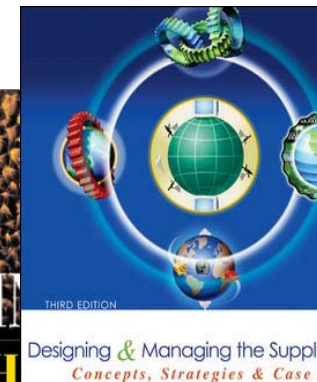
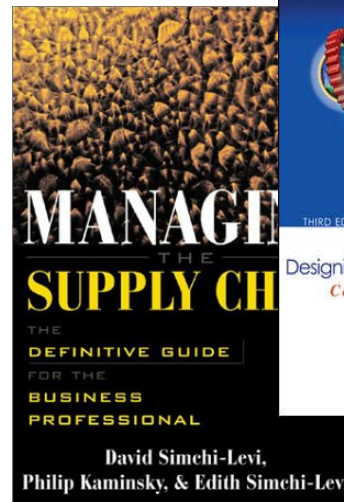
Today's Supply Chain Challenges

- Global supply chain with long lead times
- Rising and shifting customer expectations
- Increase in labor costs in developing countries
- Changes in logistics costs
- Increase in risks
- Importance of sustainability
- Unprecedented Volatility

Rule: The New Normal--Executives face competition in an environment that is complex, uncertain, dynamic and chaotic.

What We'll Cover ...

- Business and Supply Chain Challenges
- **Supply Chain Flexibility**
 - ♦ Pepsi Supply Chain Transformation
- Supply Chain Segmentation
 - ♦ Dell Supply Chain Transformation
- Managing Supply Chain Risk
 - ♦ CPG Company
- Summary



Supply Chain Flexibility: Definition

- The ability to respond, or to react, to change:
 - ♦ Demand volume and mix
 - ♦ Commodity prices
 - ♦ Labor costs
 - ♦ Exchange rates
 - ♦
- The objective is to
 - ♦ Reduce cost
 - ♦ Reduce the amount of unsatisfied demand
 - ♦ Improve capacity utilization
- With no, or little, penalty on response time

Achieving Flexibility through....

- **Product design**

- ♦ Modular product architecture, Standardization, Postponement, Substitution

- **Process design**

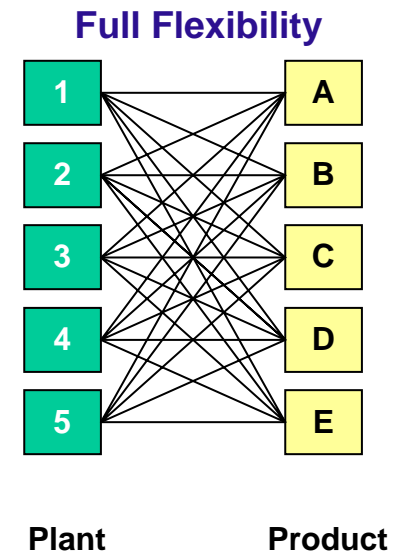
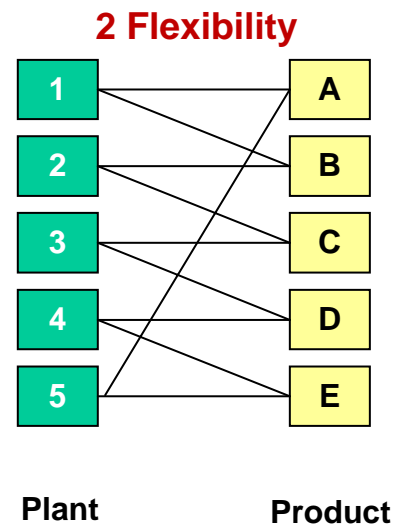
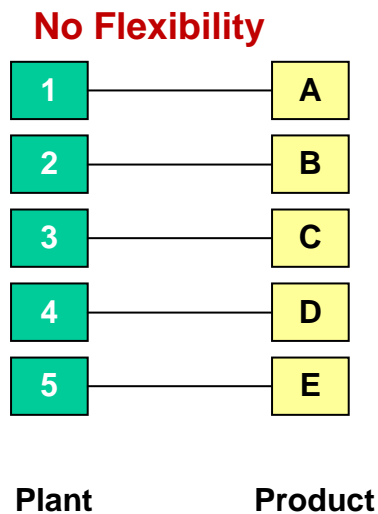
- ♦ Flexible work force, Cross-Training, Lean, Organization & Management structure, Flexible contracts, Dual sourcing, Outsourcing

- **System design**

- ♦ Capacity redundancy, Manufacturing strategy, Distribution strategy

Flexibility through System Design

- Balance transportation and manufacturing costs
- Cope with high forecast error
- Better utilize resources



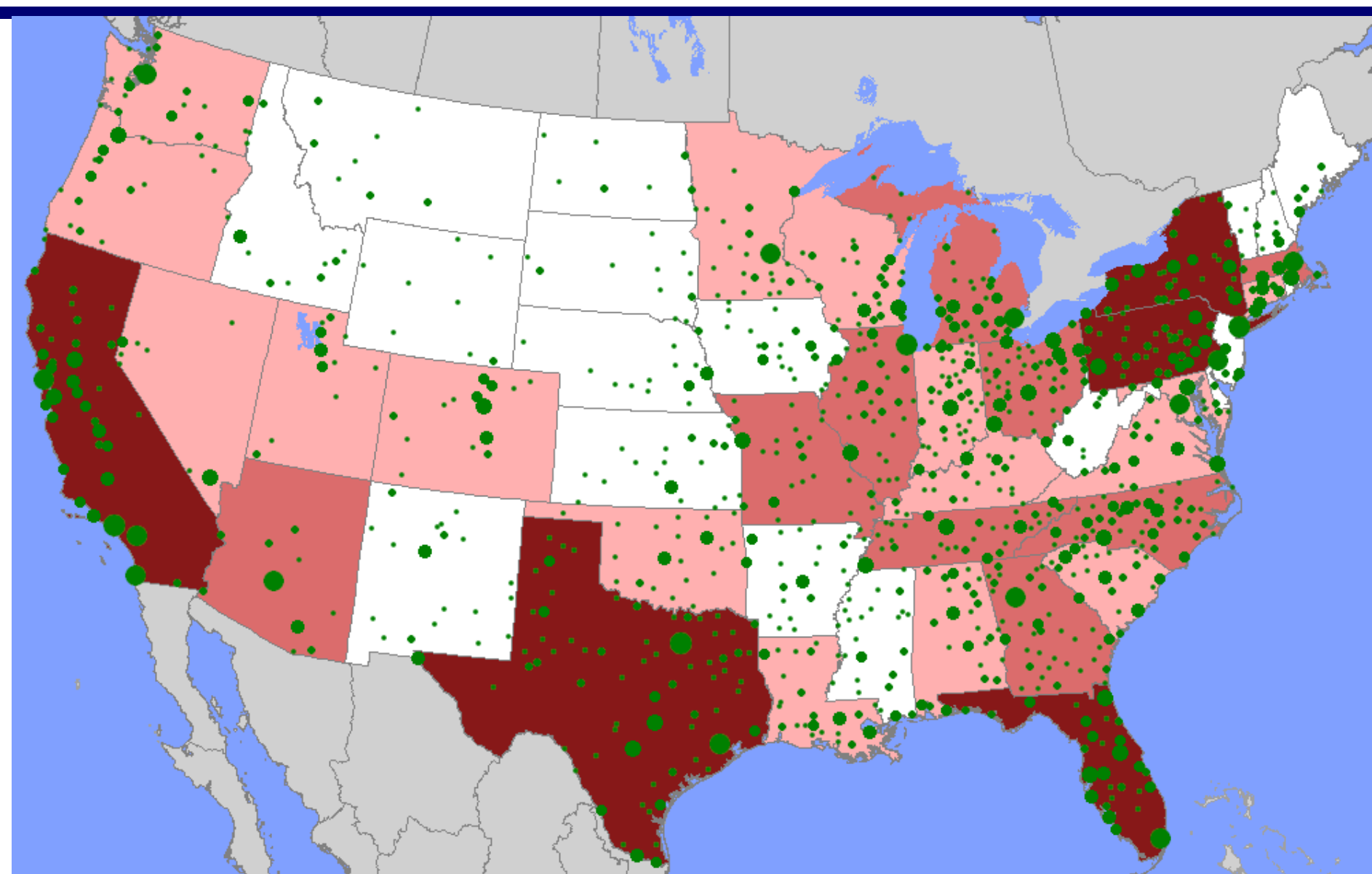
Case Study: Flexibility and the Manufacturing Network

- Manufacturer in the Food & Beverage industry.
- Currently each product family is manufactured in one of five domestic plants.
- Manufacturing capacity is in place to target 90% line efficiency for projected demand.
- Objectives:
 - ◆ Determine the cost benefits of manufacturing flexibility to the network.
 - ◆ Determine the benefit that flexibility provides if demand differs from forecast;
 - ◆ Determine the appropriate level of flexibility

Summary of Network

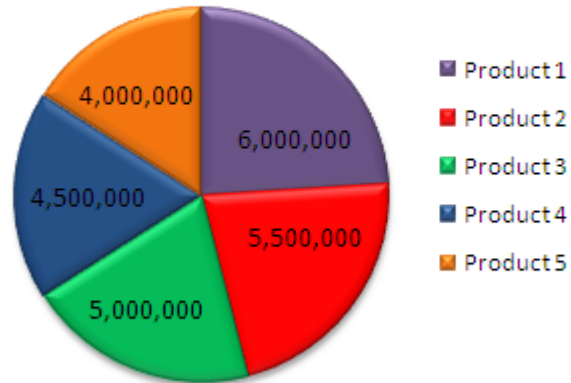
- Manufacturing is possible in five locations with the following average labor cost:
 - ♦ Pittsburgh, PA \$12.33/hr
 - ♦ Dayton, OH \$10.64/hr
 - ♦ Amarillo, TX \$10.80/hr
 - ♦ Omaha, NE \$12.41/hr
 - ♦ Modesto, CA \$16.27/hr
- 8 DC locations: Baltimore, Chattanooga, Chicago, Dallas, Des Moines, Los Angeles, Sacramento, Tampa
- Customers aggregated to 363 Metropolitan Statistical Areas & 576 Micropolitan Statistical Areas
 - ♦ Consumer product- Demand is very closely proportional to population
- Transportation
 - ♦ Inbound transportation Full TL
 - ♦ Outbound transportation LTL and Private Fleet

Network Visualization- Customer Demand



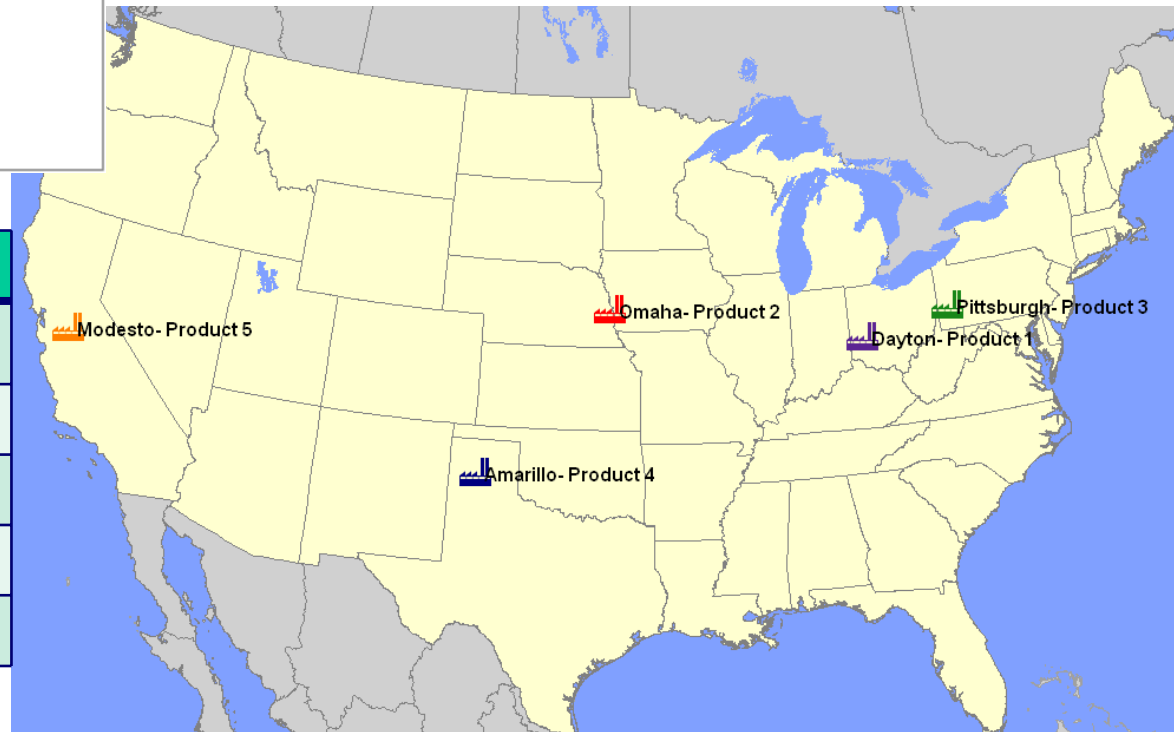
Baseline Summary

Mean National Forecast



Cost Description	Baseline
Production Cost	34,960,649
Plant to Whse Shipping Cost	20,264,858
Whse to Cust Shipping Cost	11,751,467
Warehouse Fixed Costs	8,400,000
TOTAL COST	75,376,974

Plant	Labor Rate
Pittsburgh, PA	\$12.33/hr
Dayton, OH	\$10.64/hr
Amarillo, TX	\$10.80/hr
Omaha, NE	\$12.41/hr
Modesto, CA	\$16.27/hr



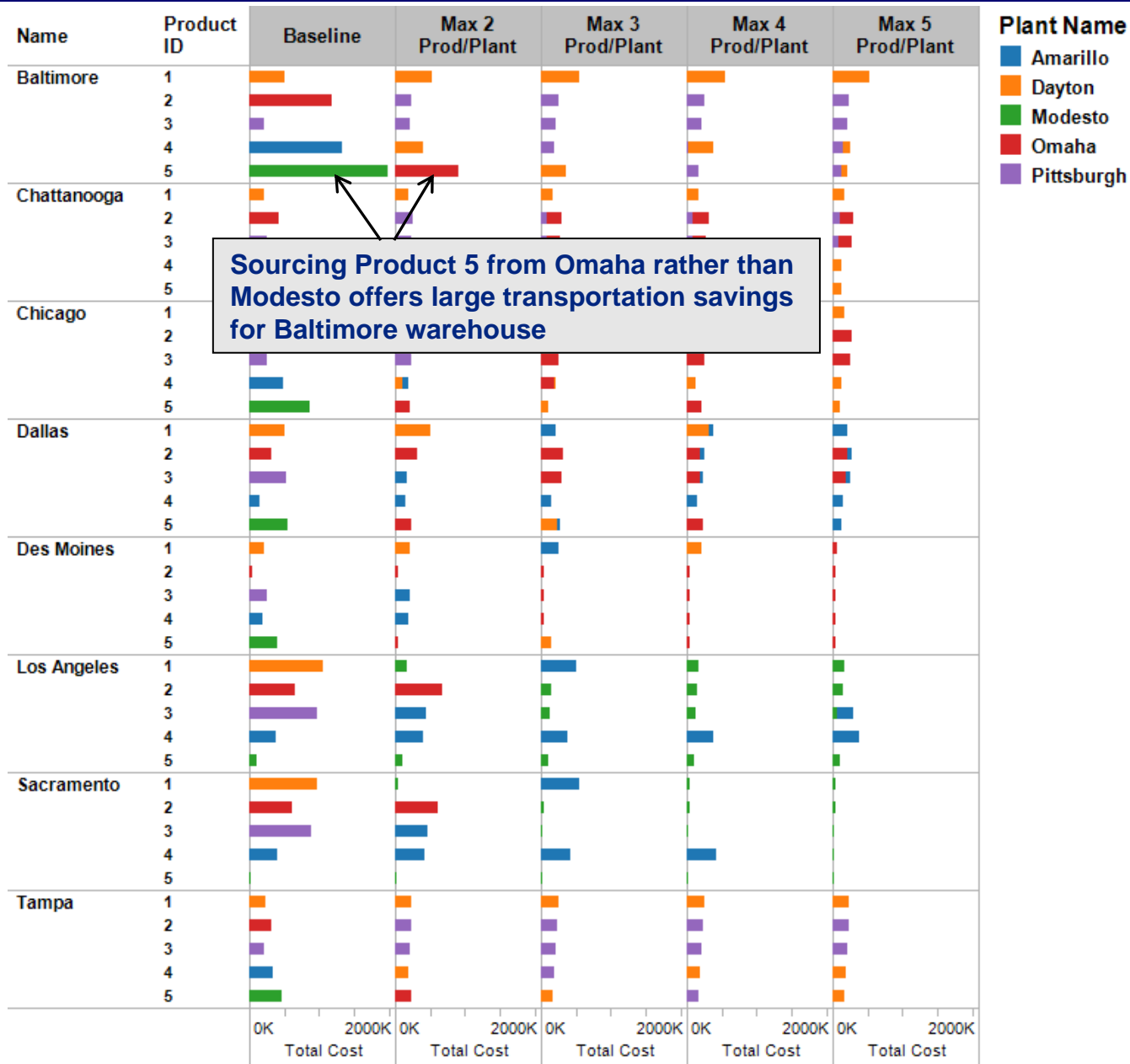
Introducing Manufacturing Flexibility

- To analyze the benefits of adding manufacturing flexibility to the network, the following scenarios were analyzed:
 1. **Base Case:** Each plant focuses on a single product family
 2. **Minimal Flexibility:** Each plant can manufacture up to two product families
 3. **Average Flexibility:** Each plant can manufacture up to three product families
 4. **Advanced Flexibility:** Each plant can manufacture up to four product families
 5. **Full Flexibility:** Each plant can manufacture all five product families

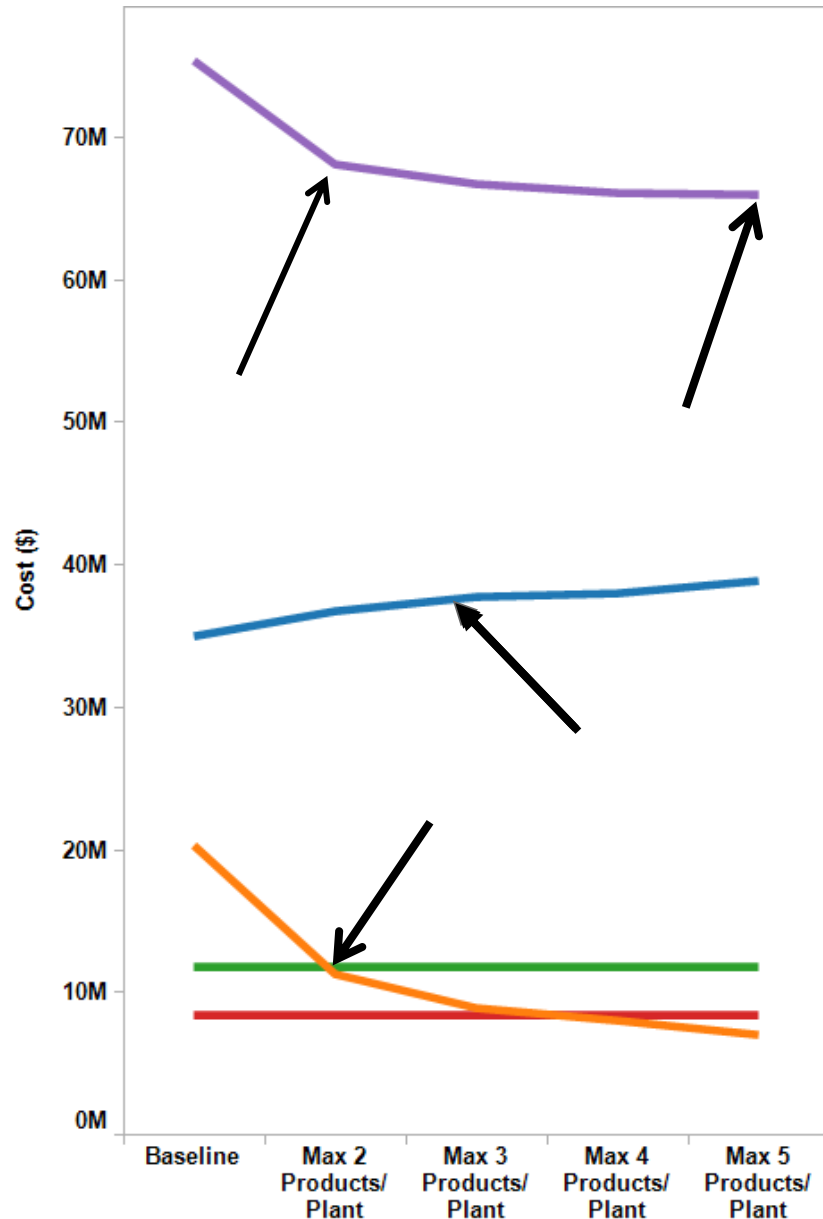
Plant to Warehouse Shipping Comparison



Plant to Warehouse Shipping Comparison



Total Cost Comparison



Cost Description

- TOTAL COST
- Production Cost
- Plant to Whse Shipping Cost
- Whse to Cust Shipping Cost
- Warehouse Fixed Costs

Cost Description	Baseline	Max 2 Products/Plant	Max 3 Products/Plant	Max 4 Products/Plant	Max 5 Products/Plant
Production Cost	34,960,649	36,730,087	37,639,959	37,913,955	38,830,279
Plant to Whse Shipping Cost	20,264,858	11,225,563	8,895,809	8,006,541	6,908,562
Whse to Cust Shipping Cost	11,751,467	11,692,662	11,722,858	11,743,225	11,773,756
Warehouse Fixed Costs	8,400,000	8,400,000	8,400,000	8,400,000	8,400,000
TOTAL COST	75,376,974	68,048,313	66,658,625	66,063,721	65,912,597

- Significant reduction in transportation cost
- Significant increase in manufacturing cost
- The maximum variable cost savings with full flexibility is 13%
- 80% of the benefits of full flexibility is captured by adding minimal flexibility

Impact of Changes in Demand Volume

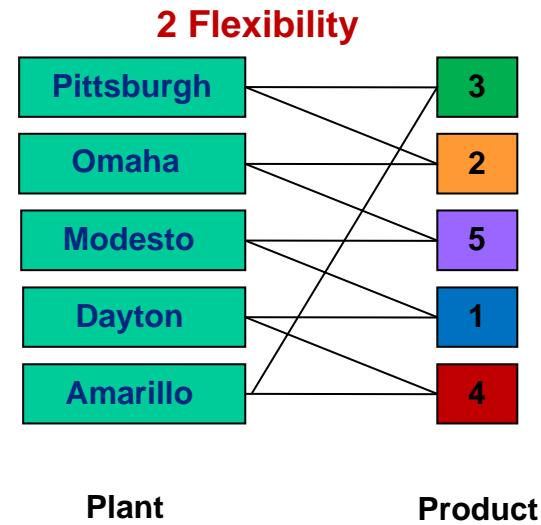
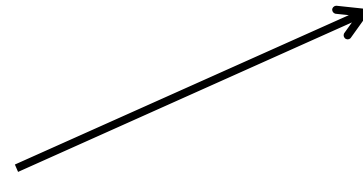
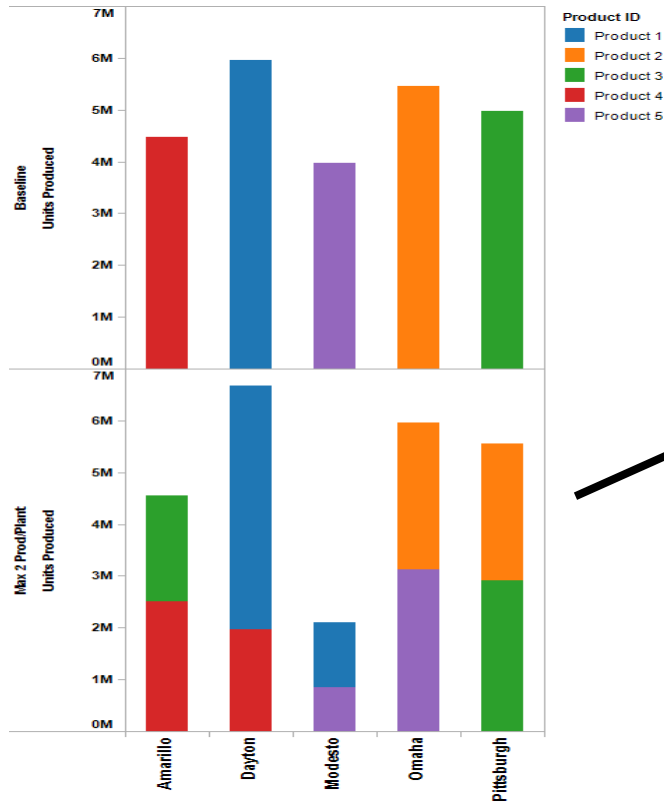
Sensitivity analysis to changes above and below the forecast:

- 1. Growth for leading products (1 & 2) by 25% and slight decrease in demand for other products (5%).**
- 2. Growth for the lower volume products (4 & 5) by 35% and slight decrease in demand for other products (5%).**
- 3. Growth of demand for the high potential product (3) by 100% and slight decrease in demand for other products (10%).**

Impact of Changes in Demand Volume

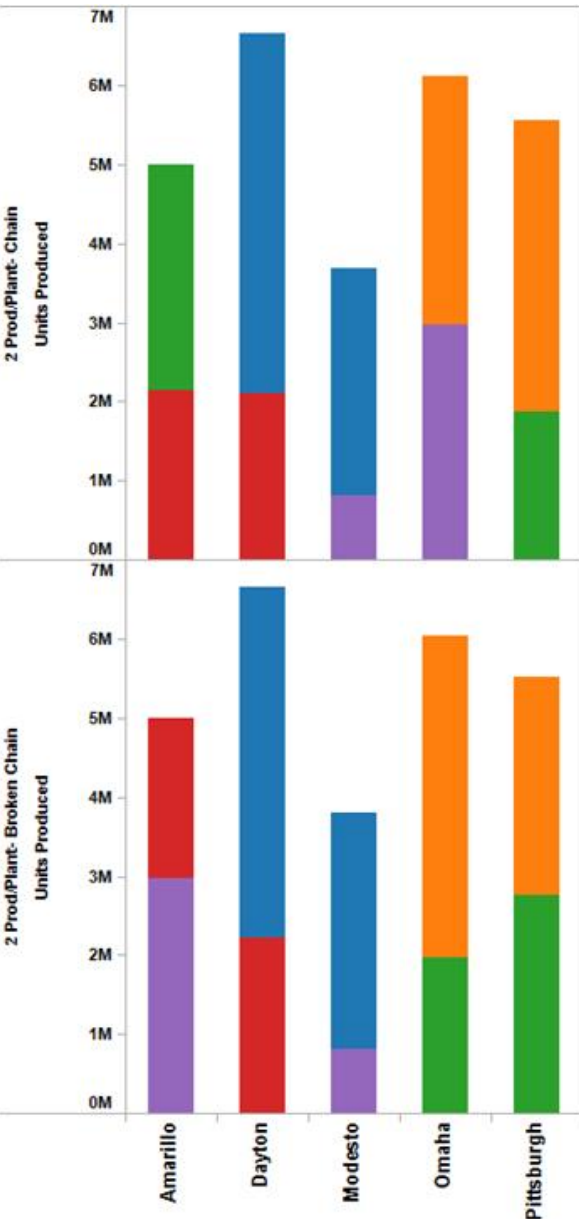
	Design	Demand Satisfied	Shortfall	Cost/ Unit	Avg Plant Utilization
Demand Scenario 1	Baseline	25,520,991	1,505,542	\$ 2.94	91%
	Min Flexibility	27,026,533	0	\$ 2.75	97%
Demand Scenario 2	Baseline	25,019,486	1,957,403	\$ 2.99	91%
	Min Flexibility	26,976,889	0	\$ 2.75	96%
Demand Scenario 3	Baseline	23,440,773	4,380,684	\$ 2.93	84%
	Min Flexibility	27,777,777	43,680	\$ 2.79	100%

Why is 2-Flexibility so powerful?

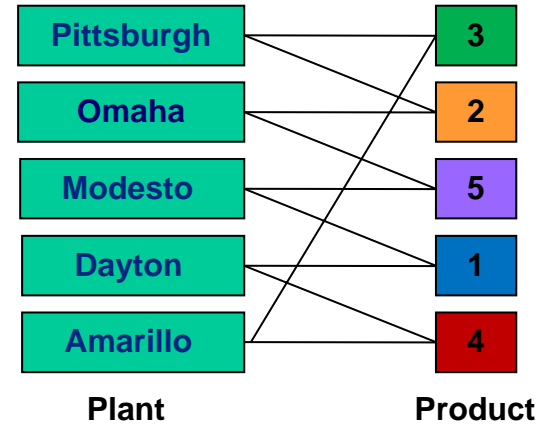


- 2 Flexibility provides the benefits of full flexibility through the creation of a chain

Alternatives to 2-Flexibility



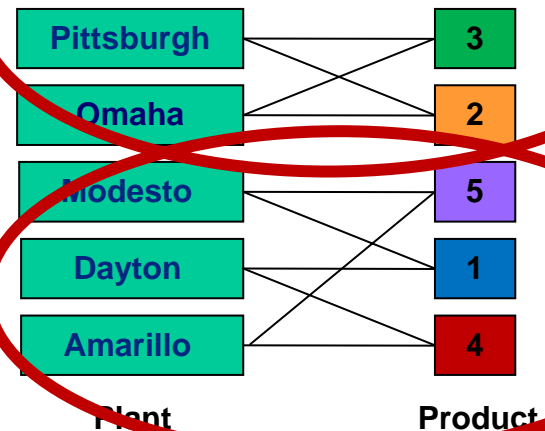
2 Flexibility



- 2 Flexibility provides the benefits of full flexibility through the creation of a chain



2 Products/Plant- No Chain



- Although the same total number of connections are made, breaking the chain reduces flexibility considerably

Impact of Changes in Demand Volume

	Design	Demand Satisfied	Shortfall	Cost/ Unit	Avg Plant Utilization
Demand Scenario 1	2-Flexibility/Long Chain	27,026,533	0	\$2.75	97%
	2-Flexibility/Short Chains	27,026,533	0	\$ 2.76	93%
Demand Scenario 2	2-Flexibility/Long Chain	26,976,889	0	\$2.75	96%
	2-Flexibility/Short Chains	26,022,490	954,399	\$ 2.79	94%
Demand Scenario 3	2-Flexibility/Long Chain	27,777,777	43,680	\$2.75	100%
	2-Flexibility/Short Chains	24,633,440	3,188,017	\$ 2.66	86%

Impact of Changes in Demand Volume

	Design	Demand Satisfied	Shortfall	Cost/ Unit	Avg Plant Utilization
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	2-Flexibility/Long Chain	27,777,777	43,680	\$2.75	100%

Rule: A Long Chain is preferred when designing the manufacturing network for flexibility.

Case Study: Flexibility at Pepsi Beverages Company

Make

**Operates 57
Plants in the U.S.
and 103 Plants
Worldwide**

Sell

**7 Business units
in the U.S. each
responsible for
local demand**

Deliver

**240,000 Miles are
Logged Every Day to
Meet the Needs of
Our Customers**

Service

**Strong Customer
Service Culture**

The Challenge:

- **Shifting consumer preference**
 - **From carbonated to non-carbonated drinks**
 - **From cans to bottles**
- **Produced these products in limited plants**
- **Service problems during periods of peak demand**

Implementation: A Three-Step Process

- Step 1: Focus on Central Business Unit (3 plants, 22 warehouses in MI, MN, WI)
 - ♦ Start small to understand the intricacies of the process
 - ♦ Build confidence in model assumptions
- Step 2: Move on to more complicated regions (East Coast – 20 plants, 125 warehouses)
- Step 3: Implement across all business units

The Impact of Sourcing Flexibility

- Creation of regular meetings bringing together Supply chain, Transport, Finance, Sales and Manufacturing functions to discuss sourcing and pre-build strategies
- Reduction in raw material and supplies inventory from \$201 to \$195 million
- A 2 percentage point decline in in growth of transport miles even as revenue grew
- An additional 12.3 million cases available to be sold due to reduction in warehouse out-of-stock levels

To put the last result in perspective, the reduction in warehouse out-of-stock levels effectively added one and a half production lines worth of capacity to the firm's supply chain without any capital expenditure.

The Impact of Sourcing Flexibility

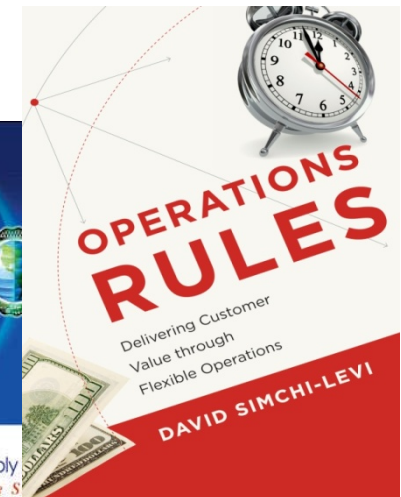
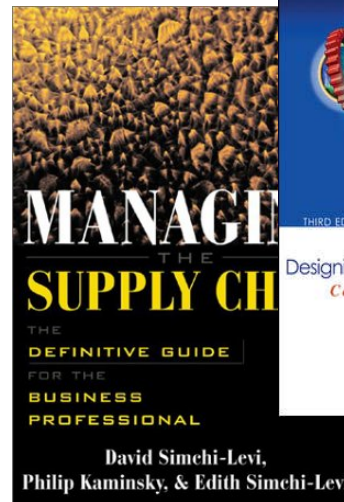
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To put the last result in perspective, the reduction in warehouse out-of-stock levels

Rule: A small investment in flexibility can make a significant impact on supply chain performance.

What We'll Cover ...

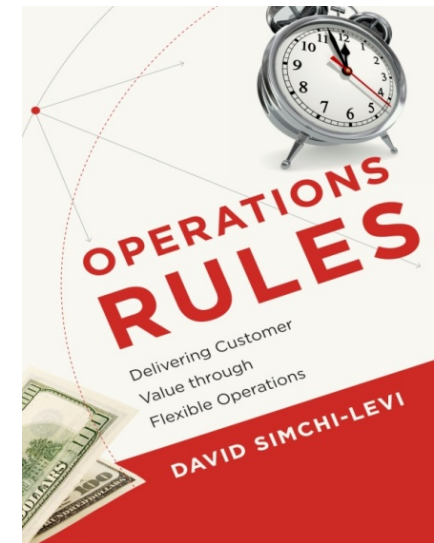
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David Simchi-Levi
Philip Kaminsky
Edith Simchi-Levi

Supply Chain Segmentation

- **The Customer Value Proposition**
 - ◆ Product Innovation
 - ◆ Product Selection and Availability
 - ◆ Price and Brand
 - ◆ Value Added Services
 - ◆ Customer Experience
- **Product characteristics**
- **Channels to market**



Customer Value and Operations Strategy

Customer Value Proposition	Example	Operations Strategy
High Fashion content at a reasonable Price	Zara	Speed to Market
Everyday Low Pricing	Wal-Mart	Cost Efficiency
Product Selection and Availability	Amazon	Efficient and reliable Order Fulfillment
Product Innovation	Apple	Efficiency through outsourced manufacturing and logistics
Customer Experience	Dell Direct	Responsiveness through Configure-to-Order

The Challenges

- Mismatch between the strategies suggested by different customer value proposition & product characteristics
 - ◆ Push vs Pull
- Different products, channels and customer types require different supply chain strategies
 - ◆ Stores vs. Online
 - ◆ Individual vs. Corporate Clients
- Need to take advantage of synergies across different segments
 - ◆ Reduce Complexity
 - ◆ Benefit from Economies of Scale

Channel Type: Retail vs. Online

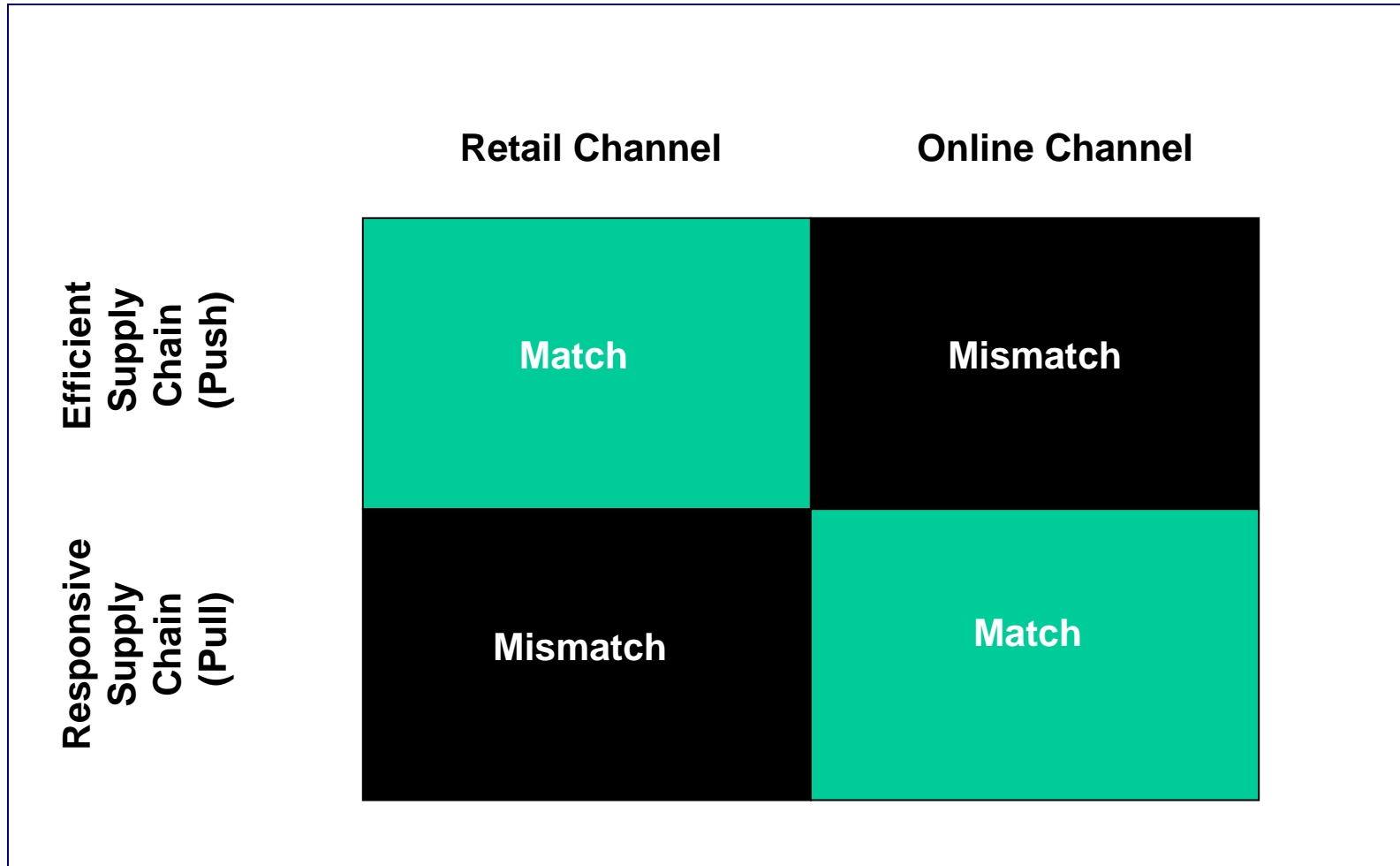
	Retail	Online
Product Variety	Low	High
Customization	Limited	High
Forecast Accuracy	High	Low
Volume by Configuration	High	Low
Cost of Lost Sale	Low	High

PC-Retail **PC-Direct**

Corporate Clients vs. Individual Consumers

	Corporate	Individual
Product Variety	Low	High
Product Design for	Client	Market
Forecast Accuracy	High	Low
Volume by Product	High	Low
Customer Relationship	Tight	Loose

The PC Industry -- Retail vs. Online

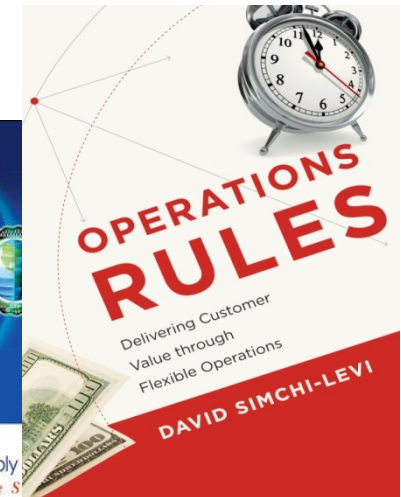
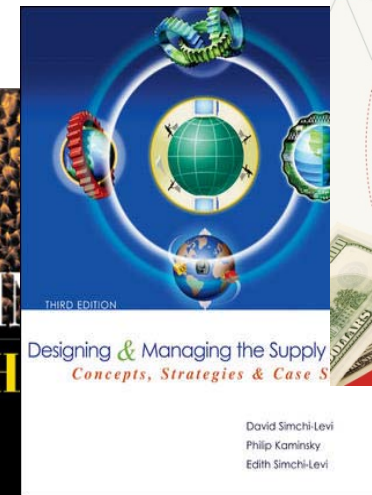
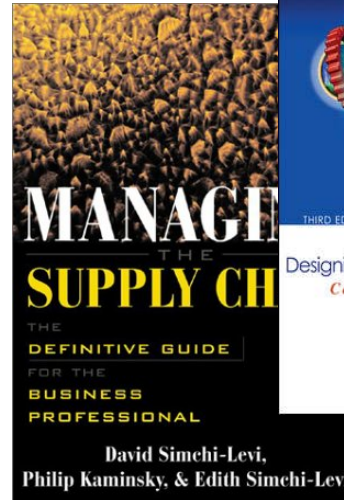


Characteristics of Push and Pull Supply Chains

Supply Chain	Push	Pull
Objective	Minimize cost	Maximize responsiveness
Product Design Strategy	Reduce product cost	Modular product design
Pricing Strategy	Compete on price	High margins
Lead time	Long	Short
Processes	Supply chain planning	Order fulfillment

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Dell by the numbers

- **Fortune 40 Company**

- ♦ \$52.9 billion in FY10 revenues

- **On-line Leader**

- ♦ 65 customer interactions per second; 5.4 million discussions per day; 2 billion interactions annually

- **Global Reach**

- ♦ Shipping 1 system per second to 180 countries

- **IT Service Leader**

- ♦ #1 healthcare service provider; support 50% of US hospitals; top provider to US colleagues and universities

Changes in the PC Industry

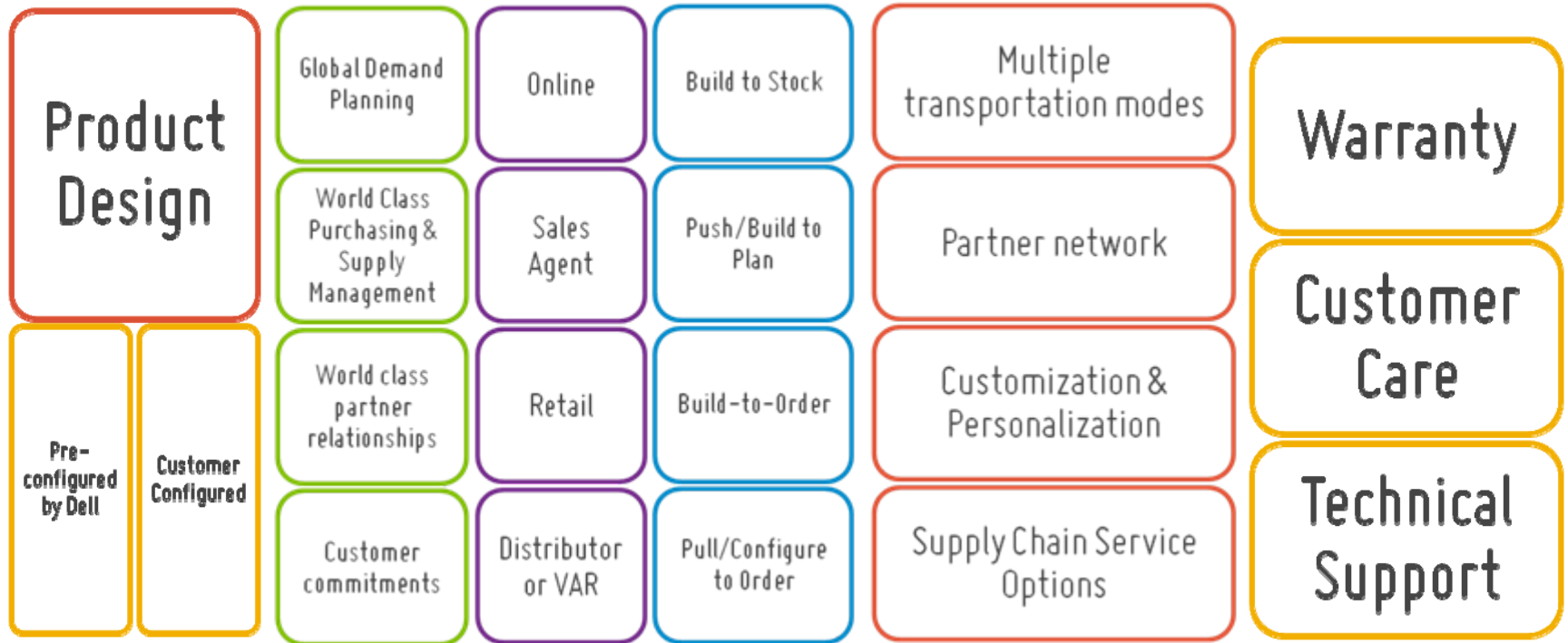
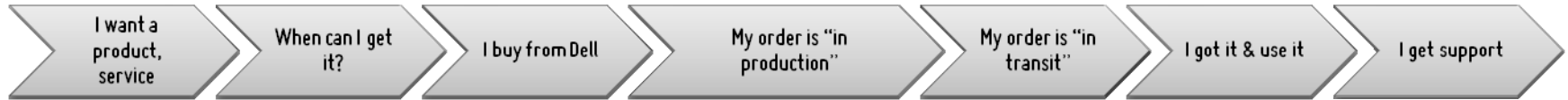
- **Demand for continuous connectivity**
 - ♦ Shift from Desktops to Notebook products and handheld devices
 - ♦ Tablets are starting to make an impact on low-end laptop sales
- **Commoditization of Products**
 - ♦ Sub \$500 products will approach 50% of total systems sold in 2013
 - ♦ Reduced importance of customization in certain markets
 - ♦ Shift from online to retail
- **Data Explosion leads to Pervasive computing**
 - ♦ The need of corporate clients is changing from purchasing bulk PCs to complete solutions
- **Globalization**
 - ♦ Growth is coming from developing countries

Dell Requirements for its Supply Chain Transformation

- Provide customers choice they value
- Transform end-to-end
- Simplify products and Eliminate complexity
- Regain cost leadership
- Relentless focus on continuous improvement

ENGAGE THE ENTIRE ORGANIZATION— Transformation is end-to-end

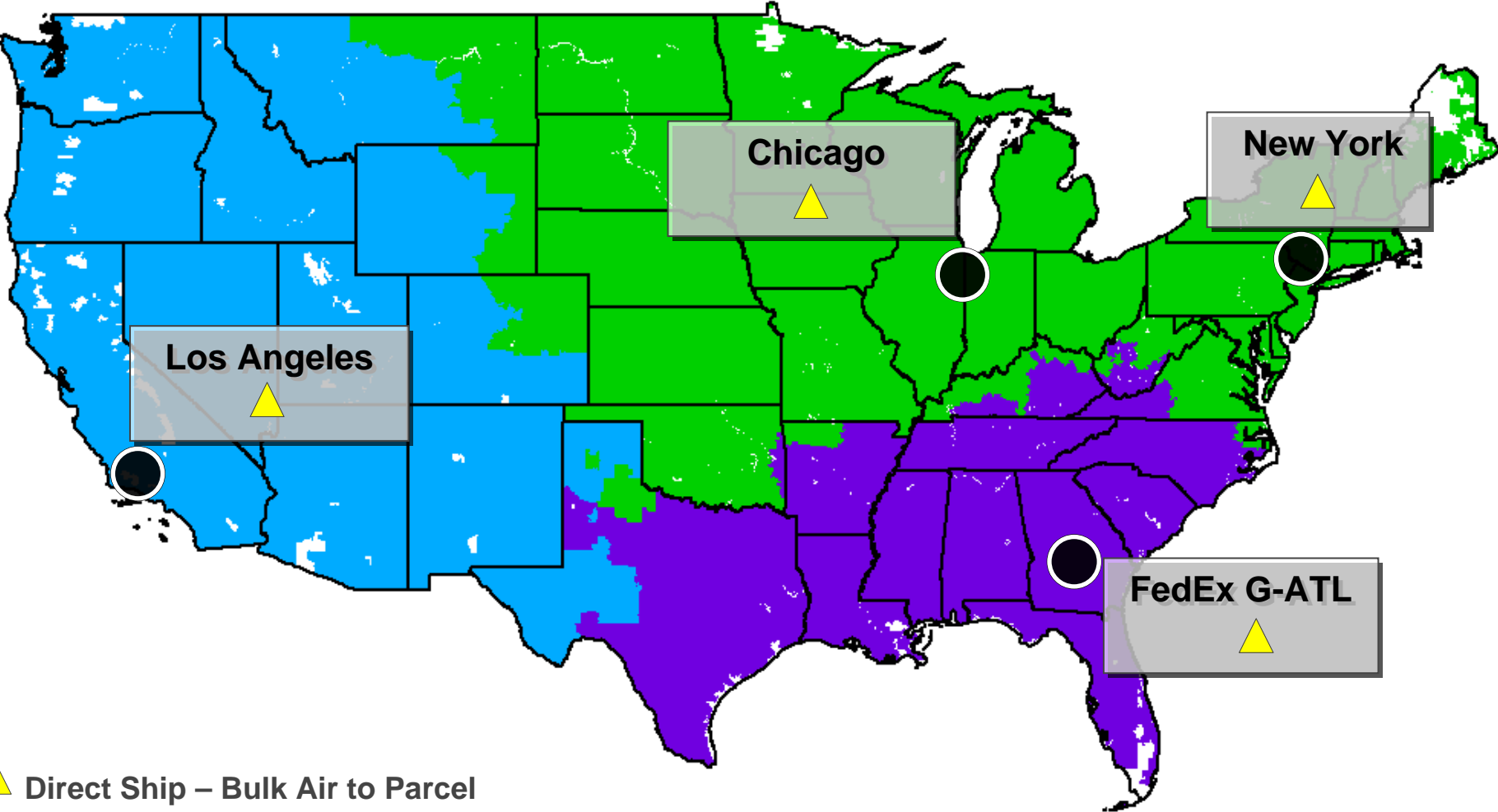
Voice of the Customer



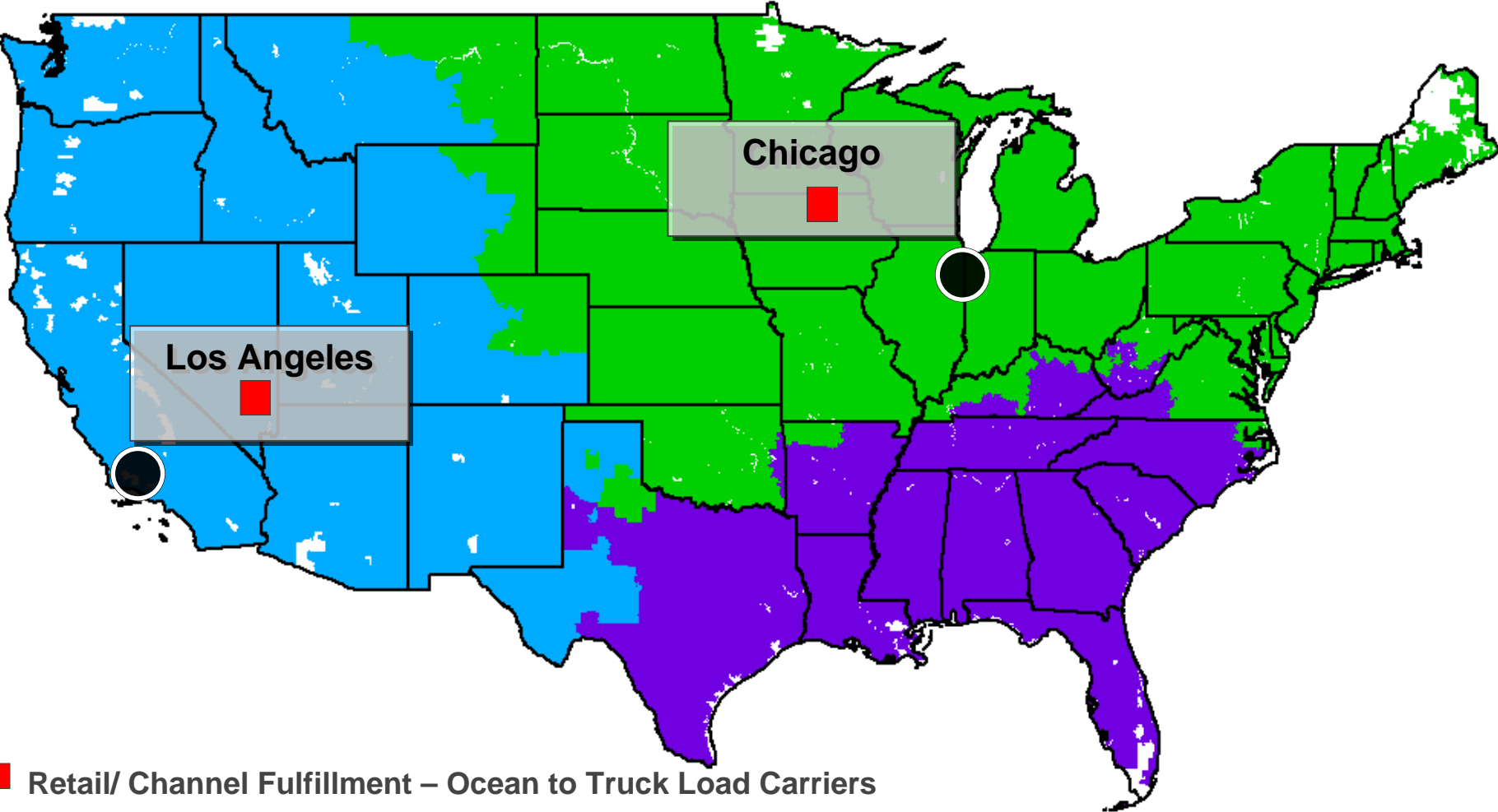
Cost to Serve Financials

Data and Tools

Americas Fulfillment Nodes- Direct Ship



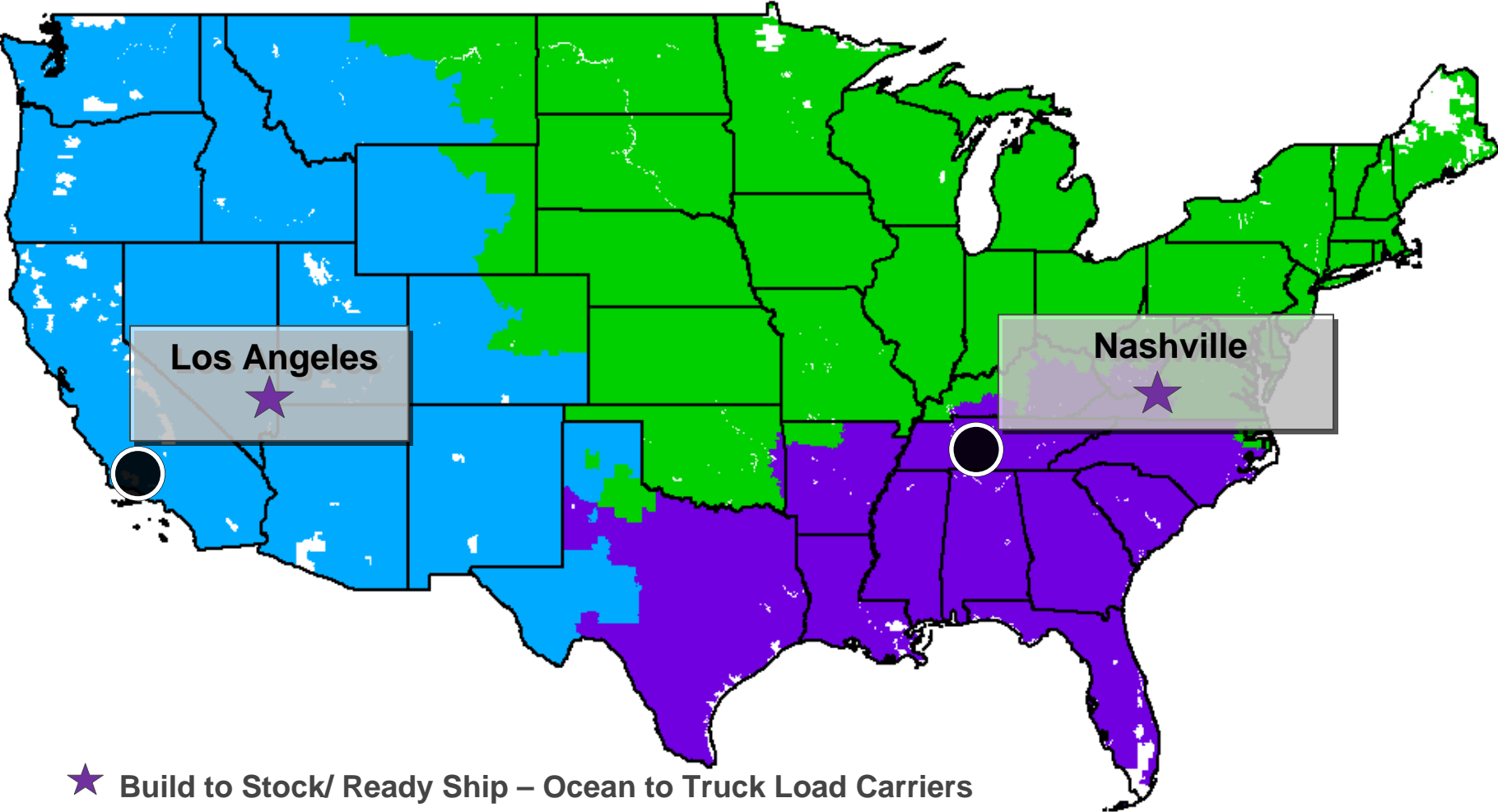
Americas Fulfillment Nodes- Retail/ Channel



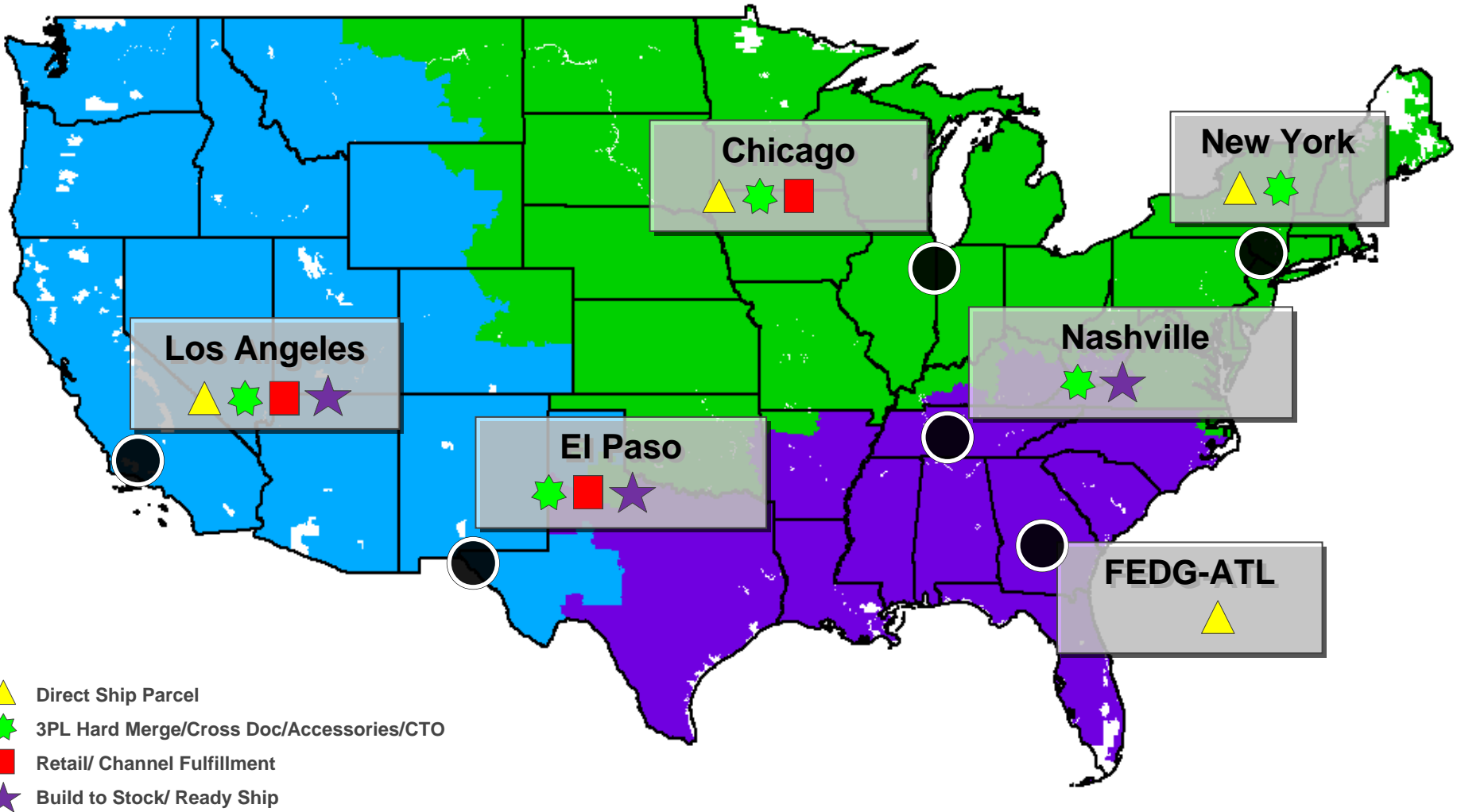
■ Retail/ Channel Fulfillment – Ocean to Truck Load Carriers



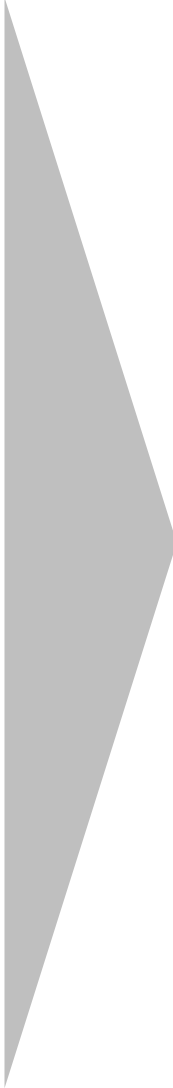
Americas Fulfillment Nodes- Build to Stock



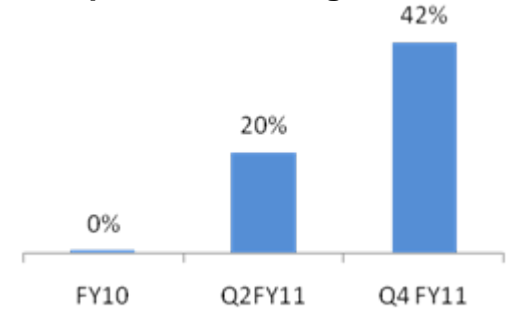
Americas Fulfillment Nodes- Current State



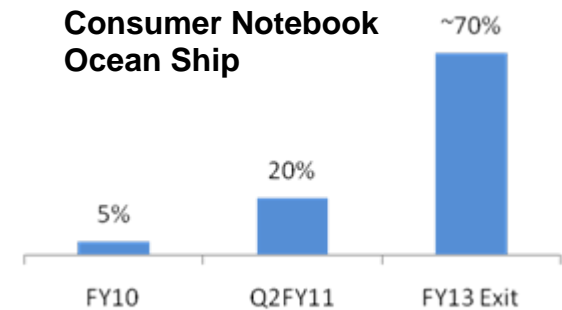
Transformation Results

- >99% fewer configurations
 - 3X improvement in forecast accuracy
- 
- >30% freight cost reduction on notebooks
 - >30% manufacturing cost reduction

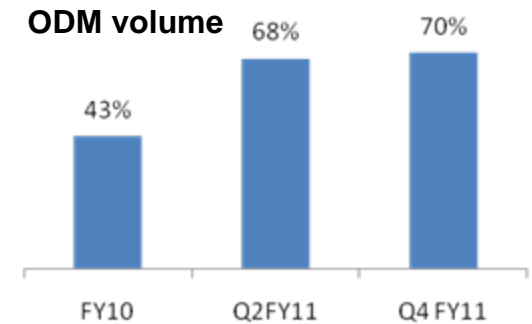
Popular, Pre-configured offers



Consumer Notebook Ocean Ship

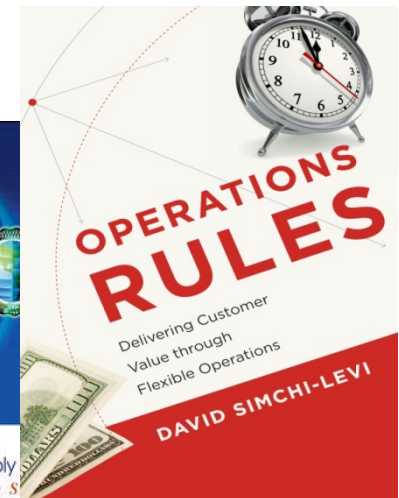
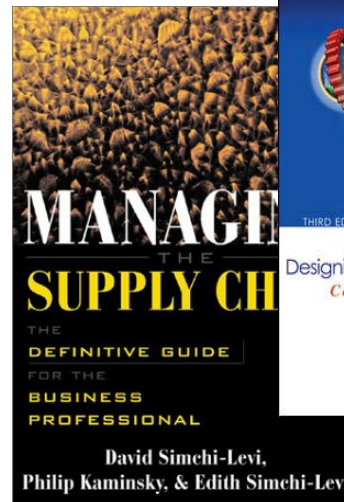


ODM volume



What We'll Cover ...

- Business and Supply Chain Challenges
- Supply Chain Flexibility
 - ♦ Pepsi Supply Chain Transformation
- Supply Chain Segmentation
 - ♦ Dell Supply Chain Transformation
- **Managing Supply Chain Risk**
 - ♦ CPG Company
- Summary



Risks in Today's Supply Chains

- Significant increase in supply chain risk
 - ♦ Outsourcing and offshoring
 - ▶ Supply chain is geographically more diverse
 - ♦ Lean manufacturing
 - ▶ Just-in-time (JIT) manufacturing and low inventory levels
- Executives are concerned
 - ♦ Managing risks is the number one concern of CEOs and COOs ("Executive Issues Survey", April 2006, Accenture)
 - ♦ Financial Executives in north America and Europe saw supply chain disruption as the second biggest threat to their operations (FM Global, May 2007)

Natural and Man-Made Disasters Have a Tremendous Impact

P&G sees “holes on the shelves”

Hurricane Katrina affected supply to P&G coffee manufacturing. Six months after Katrina, a P&G executive told the NY Times “there are still holes on the shelves” where P&G’s brand should be.

New York Times, 2006

General Motors truck plant was shutting down

General Motors truck plant in Louisiana announced that it was shutting down temporarily for lack of Japanese-made parts because of the earthquake and tsunami had struck Japan.

New York Times, 2011

Chiron vaccine in doubt for 2005

Chiron said Wednesday that it had written off \$91 million in flu vaccine inventory and warned in its most pointed language yet that it may not be able to supply the USA next year either.

USA TODAY, 2004

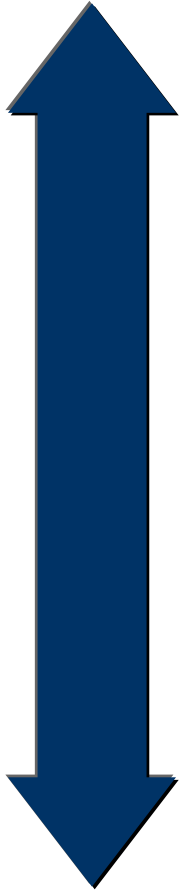
Mattel product recall

Mattel ordered 18m toys made for it in China be recalled because of hazards such as lead paint

Financial Times, 2007

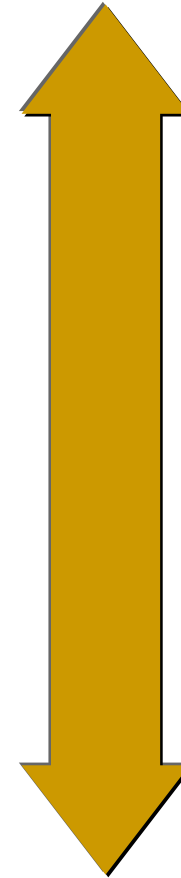
Many Sources of Risks

Unknown-Unknown



- Natural disasters
- Geopolitical risks
- Epidemics
- Terrorist attacks
- Environmental risks
- Volatile fuel prices
- Rising Labor costs
- Currency fluctuations
- Counterfeit parts and products
- Port delays
- Market changes
- Suppliers' performance
- Forecasting accuracy
- Execution problems

Uncontrollable

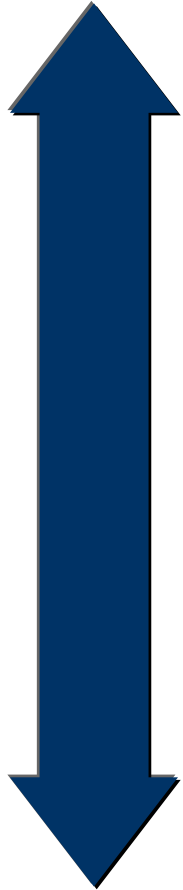


Known-Unknown

Controllable

Many Sources of Risks

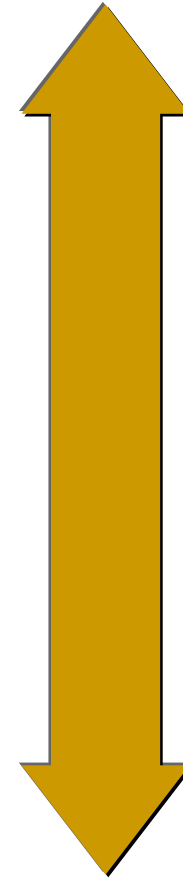
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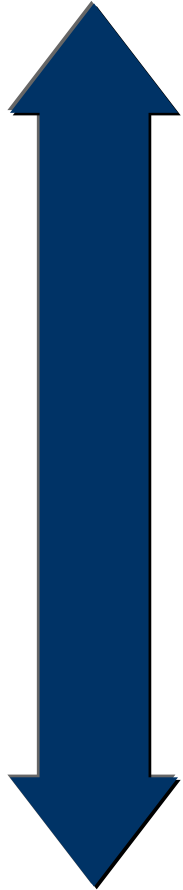
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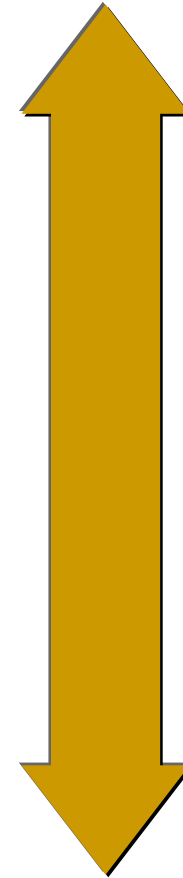
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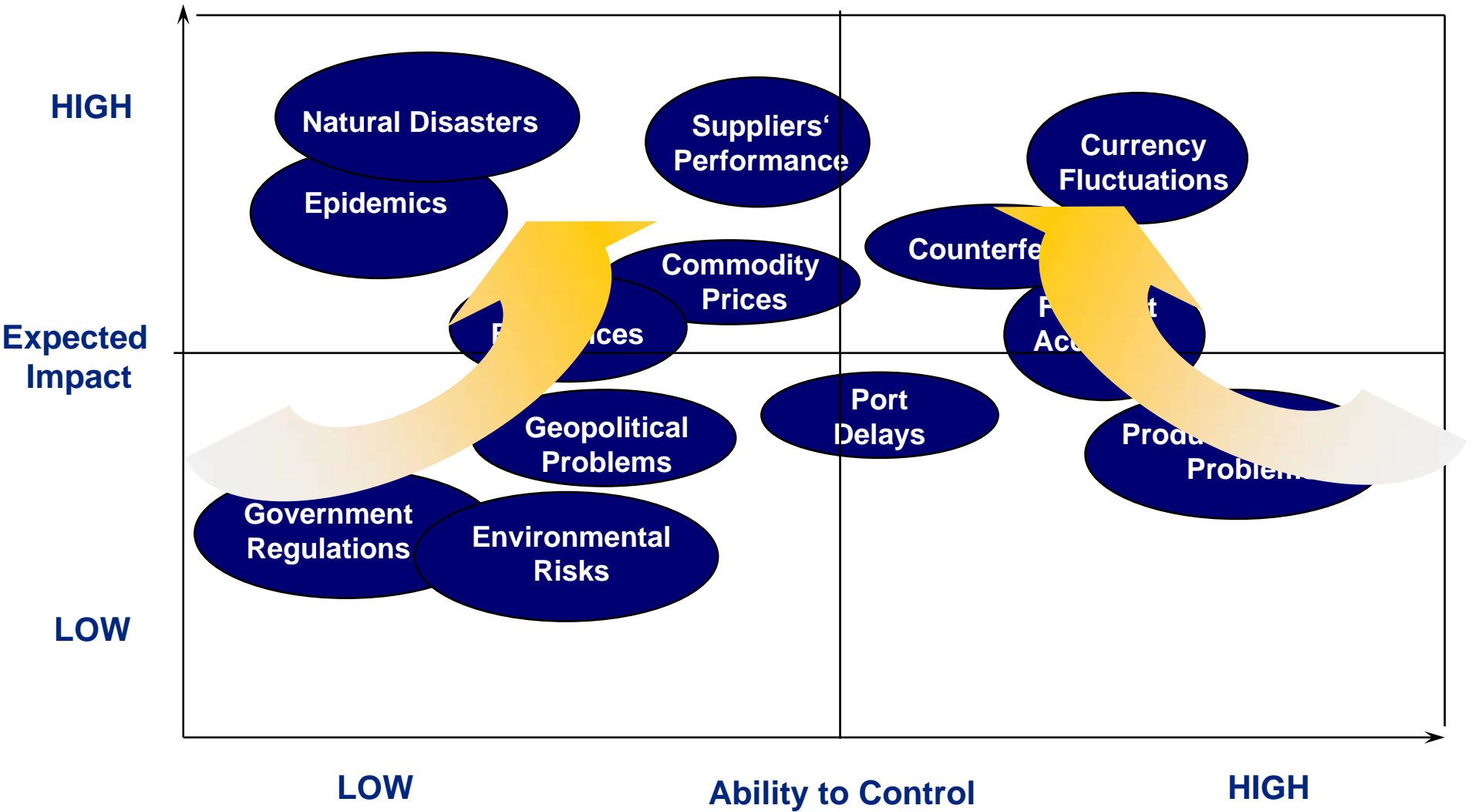
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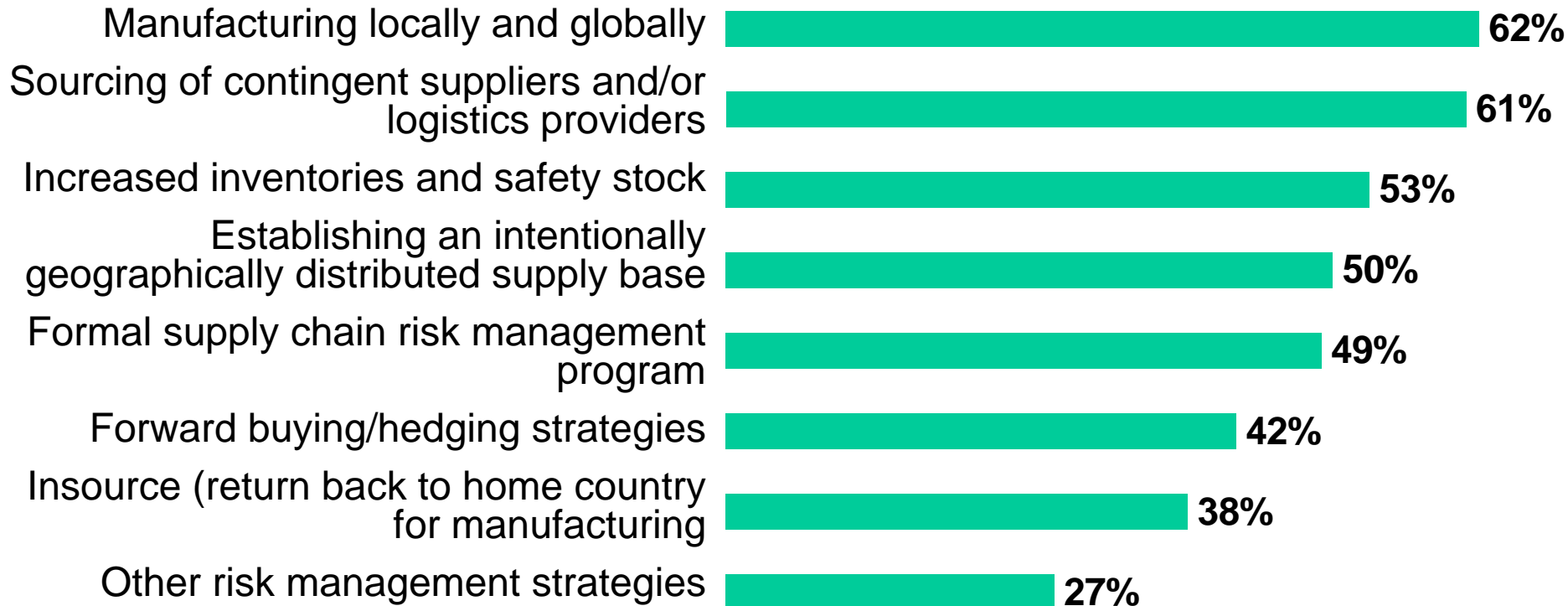


Controllable

The Risk Framework



How does industry respond?

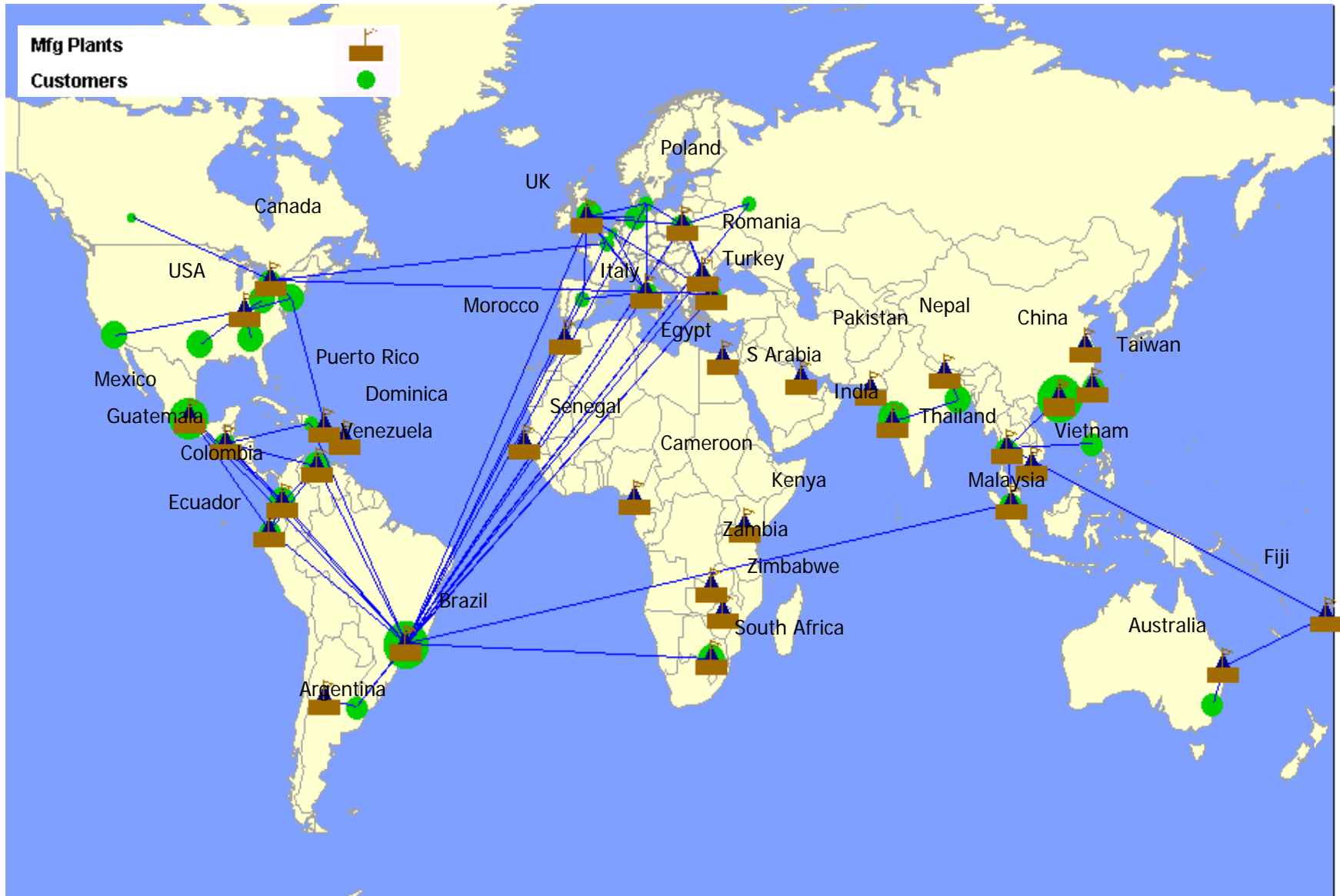


Source: Global Operations Survey, November 2006, Accenture

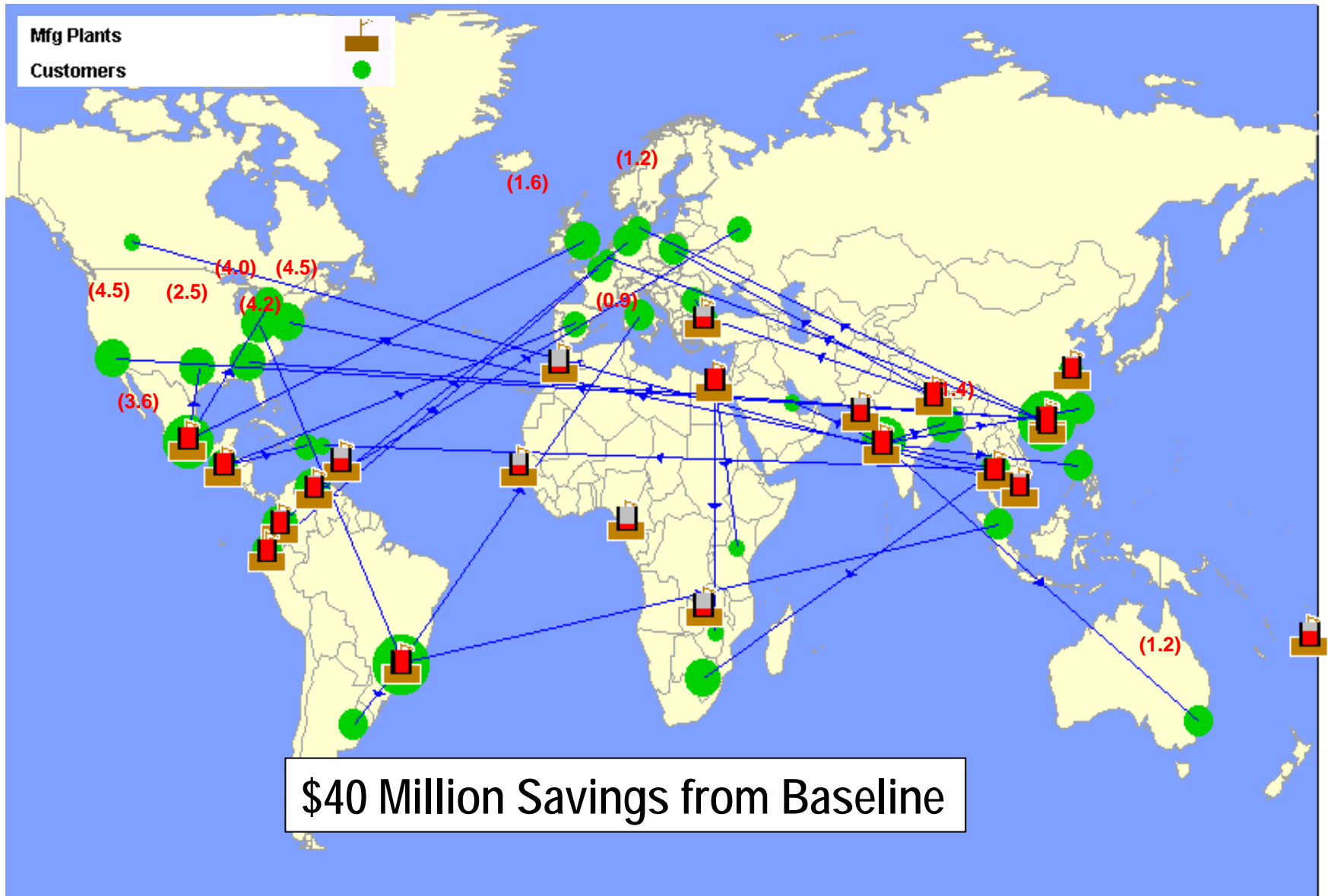
Case Study: Supply Chain Design

- **Manufacturer of consumer packaged goods**
 - ◆ Household goods
- **Global network**
 - ◆ About 40 manufacturing facilities
- **Two objectives:**
 - ◆ Plant rationalization
 - ◆ Risk management

Global CPG Plant Location Study: Baseline



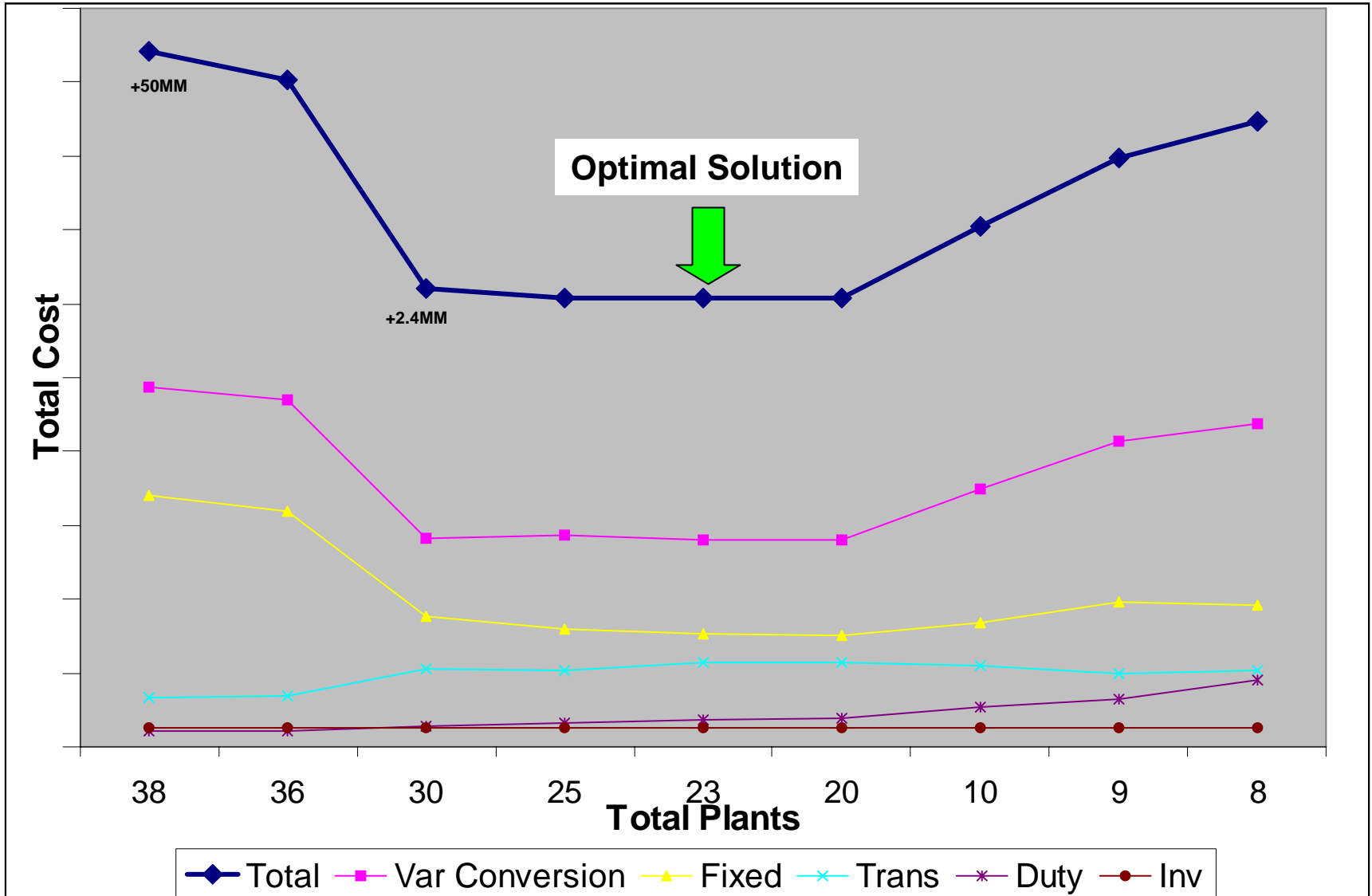
Optimized Network



Trade-Off Curve

Current Number of Plants

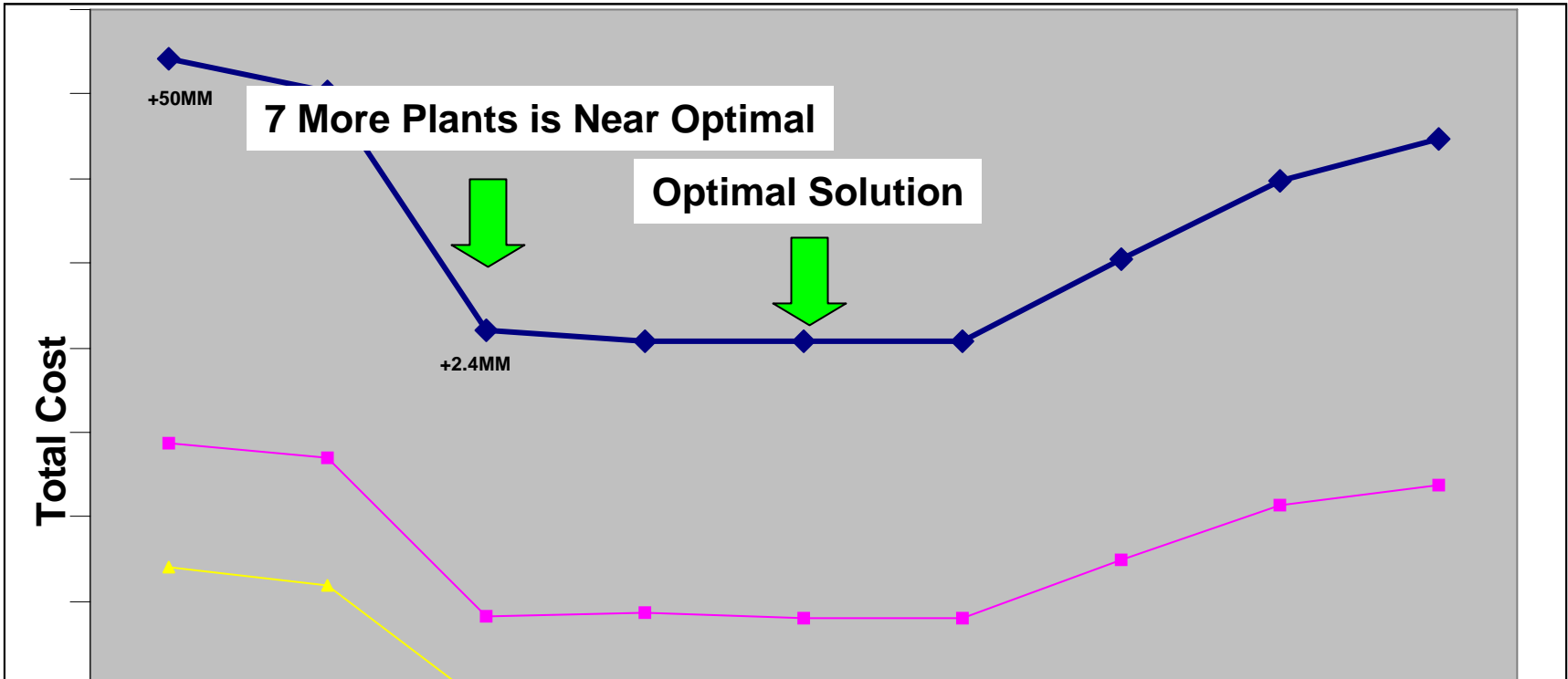
Below 8 plants there is not enough capacity



Trade-Off Curve

Current Number of Plants

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Rule: Supply chain cost is always flat around the optimal strategy

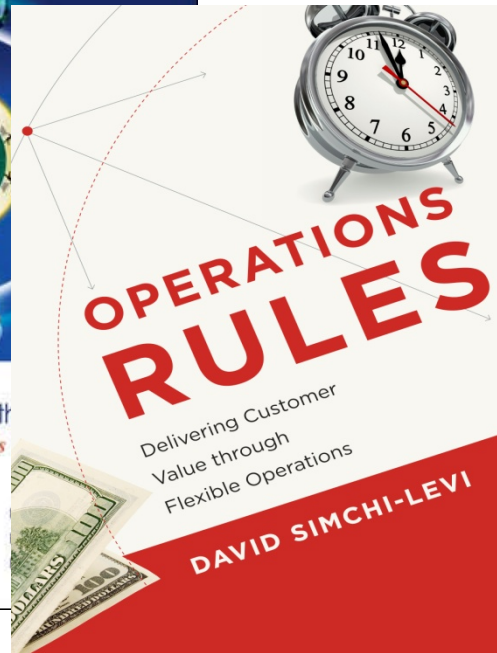
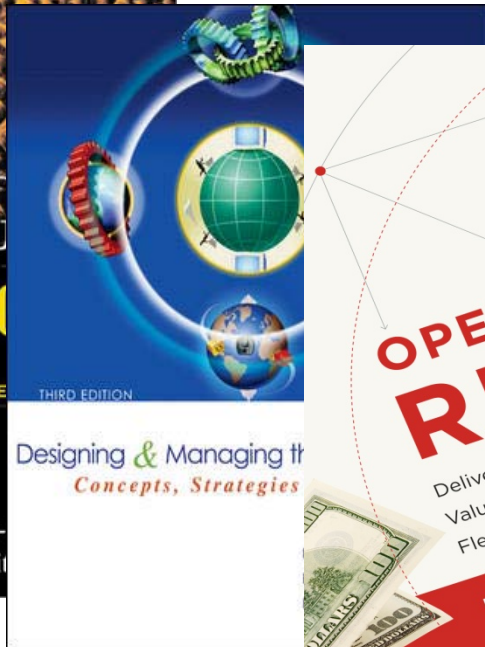
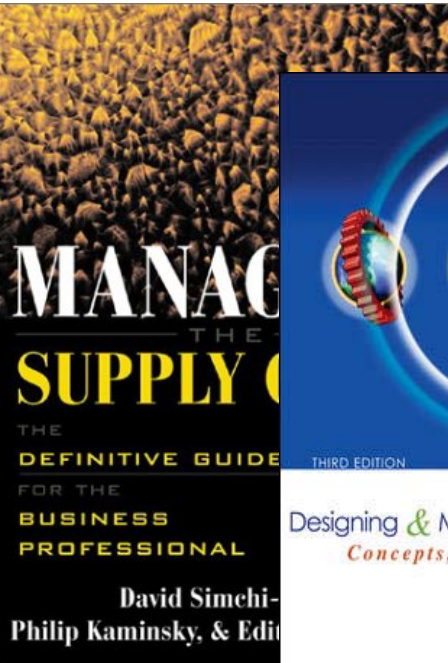
◆ Total ■ Var Conversion ▲ Fixed ✕ Trans * Duty ● Inv

Key Observations

- The age of Flexibility has arrived
 - ♦ **The Decade of the 80's:** Significant disappointment in industry with flexibility (Jaikumar, 1986)
 - ♦ **The Decade of the 90's and the beginning of 2000:** Higher flexibility in the automotive industry (Van Biesebroeck, 2004)
 - ♦ **Today:** More and more companies in diverse industries invest in various types of flexibility (Simchi-Levi, 2010)
- Supply chain Segmentation
 - ♦ **Different value propositions, channels, and product**

Follow the rules and you will steer yourself away from predictable problems and toward an operations strategy that drives real business value.

Your Turn!



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