Global Adaptive Technology Collaboration

- Smoke and Mirrors
- Joint and Collaboration – Enabling Interchange
- Time Precision Velocity – Cycle Time as Proxy
- Time and Money
- SMED – OODA Lo
- Connectivity – d
  - Hardening targ
- Preserving capa
- No choice

Time to deployment and supply net velocity are meaningless statistics unless linked to effects.

Without velocity and precision in both demand and design loops, there is no Right Time or Right Cost for the Wrong Stuff.

Changing the game

Yale vs. Columbia

1913: The Notre Dame-Army game marked a turning point in football history 📬

Passing was legalized in 1906.

For years, few passes were thrown. Most coaches felt that passing was a Hail Mary play, to be used only in desperate situations.

At Notre Dame, Knute Rockne and Gus Dorais realized that passing could change the game – particularly against larger, stronger, experienced opponents.

After Rockne and Dorais practiced passing all summer, Notre Dame met an Army team thought to be unbeatable, threw the unheard-of total of 17 passes, and beat Army 35-13.

Old-fashioned mass formations were out. The game had a new dimension.

Growing Interest and Government Investment

Significant effort and government investment directed at velocity enhancement activities on the military side of the value stream.

Discussions, plans, experimentation, deployment of:

- enhanced logistics networks

- efforts at consolidation

- autonomic systems

- collapse of hierarchical wholesale/retail distribution chains

Undoubtedly, significant improvements in velocity can be achieved.

Limited Impact

Think about:
180-day development cycles,
rapid deployment and
low cost support of legacy systems,
complex platforms,
and hundreds of thousands of
networked technology capabilities,
including wearable, robotic, and small but customized stuff,
much of which will be consumable or software.

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Barriers

As velocity is substituted for mass,

in the technology realization

value stream

as in military operations,

precision, resilience,

security, and agility

become critical.

Netcentric Warfighter

- Needs immediate access to design/technology resources and cannot afford the delays occasioned by slow communication, assessment, feedback, and stovepipe constraints.

- Short decision/technology deployment loop critical to network-centric warfare

- Combined commercial/military technology situational awareness critical.

- Existing commercial solutions exist and can be stretched easily.

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Velocity, Agility, Affordability

- Significant decreases in total cost of ownership for the Government

- Increased focus of Government investment and expenditures on military unique and specialized technologies

- Significant portions of value stream costs – including substantial capital investment – shifted from the taxpayer to the private sector

- Significant reductions in operating and maintenance costs.

- Significant leverage of commercial technology and commercial manufacturing infrastructures for defense and homeland security, enabling retention of critical United States manufacturing infrastructure and employment without either subsidies or expenditure levels traditionally associated with defense manufacturing.
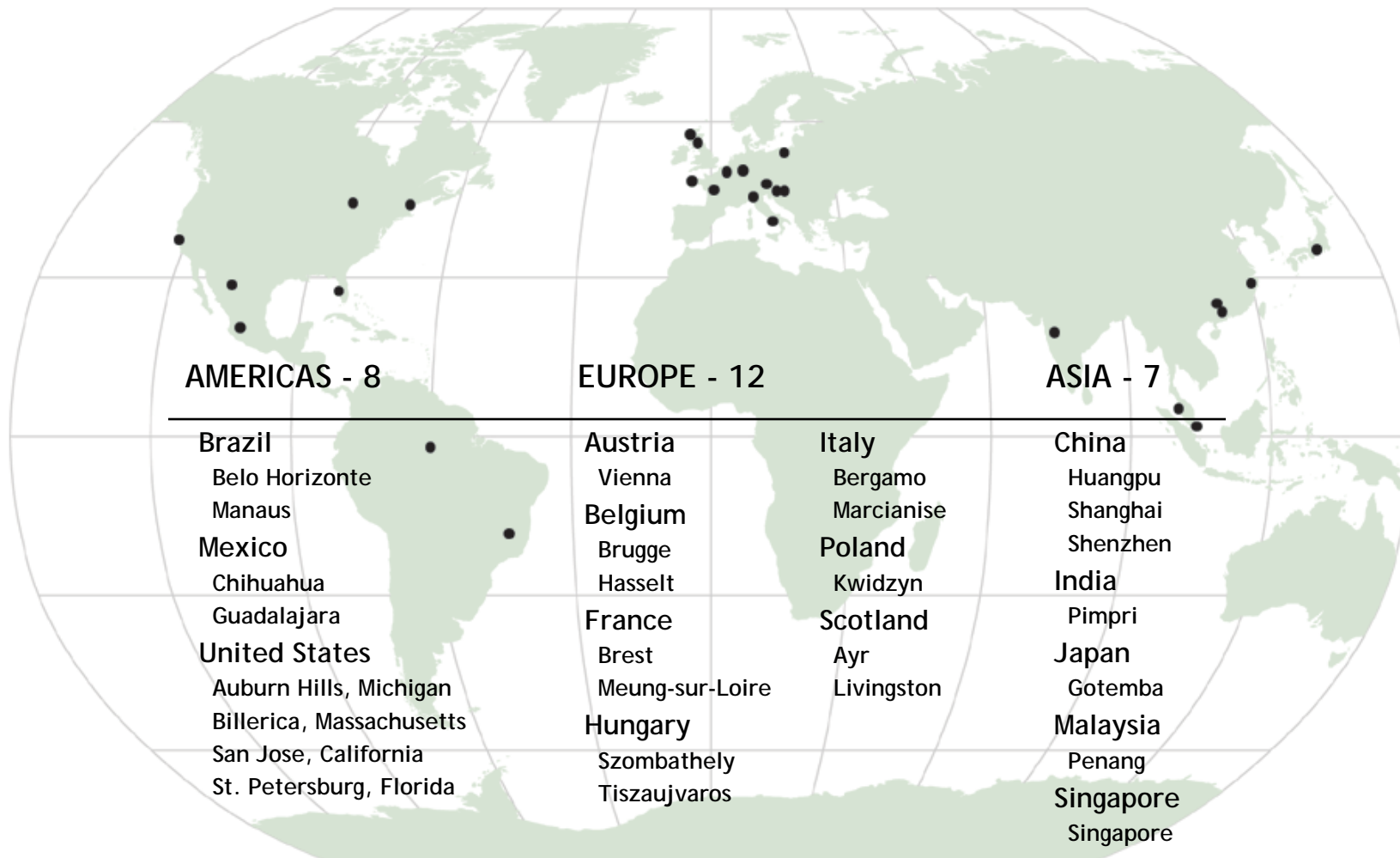
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Result

- Real time operational/logistics/technology awareness, a common operational picture, and the ability to prioritize actions and the distribution of assets for combatant commanders.

- High velocity, networked solutions with factory-to-foxhole links

- Technological superiority and capability on demand from a closely-coupled, affordable industrial base

- Minimized inventories and support footprint

Who is Jabil Circuit anyway?

- S&P 500 company; NYSE-listed (JBL)
  - Founded in Michigan, 1966; headquartered in St. Petersburg, Florida

- Global presence: on-demand manufacturing on 4 continents
  - 35,000+ employees – bottom-up, customer-coupled organization
  - $5.8+ Billion in electronics manufacturing revenue
  - $4.8+ Billion electronics components spend
  - 5+ Sigma, AS-9100 aerospace quality at commercial cost and velocity

- Global, open standards, XML-based information interchange
  - Globally synchronized design, configuration, process, product lifecycle information
  - Integrated product/process development – three-day prototyping turns
  - More than 20 million product variants: hardware/software configuration controlled
  - More than billion supply net, manufacturing, test, logistics transactions every month

- On-demand, true lean manufacturing:
  - Lot size = one capability *(60% of Jabil manufacturing volume has lot size <50)*
  - Line changeover time = virtual zero

- Global, sense-and-response – design through end-of-life
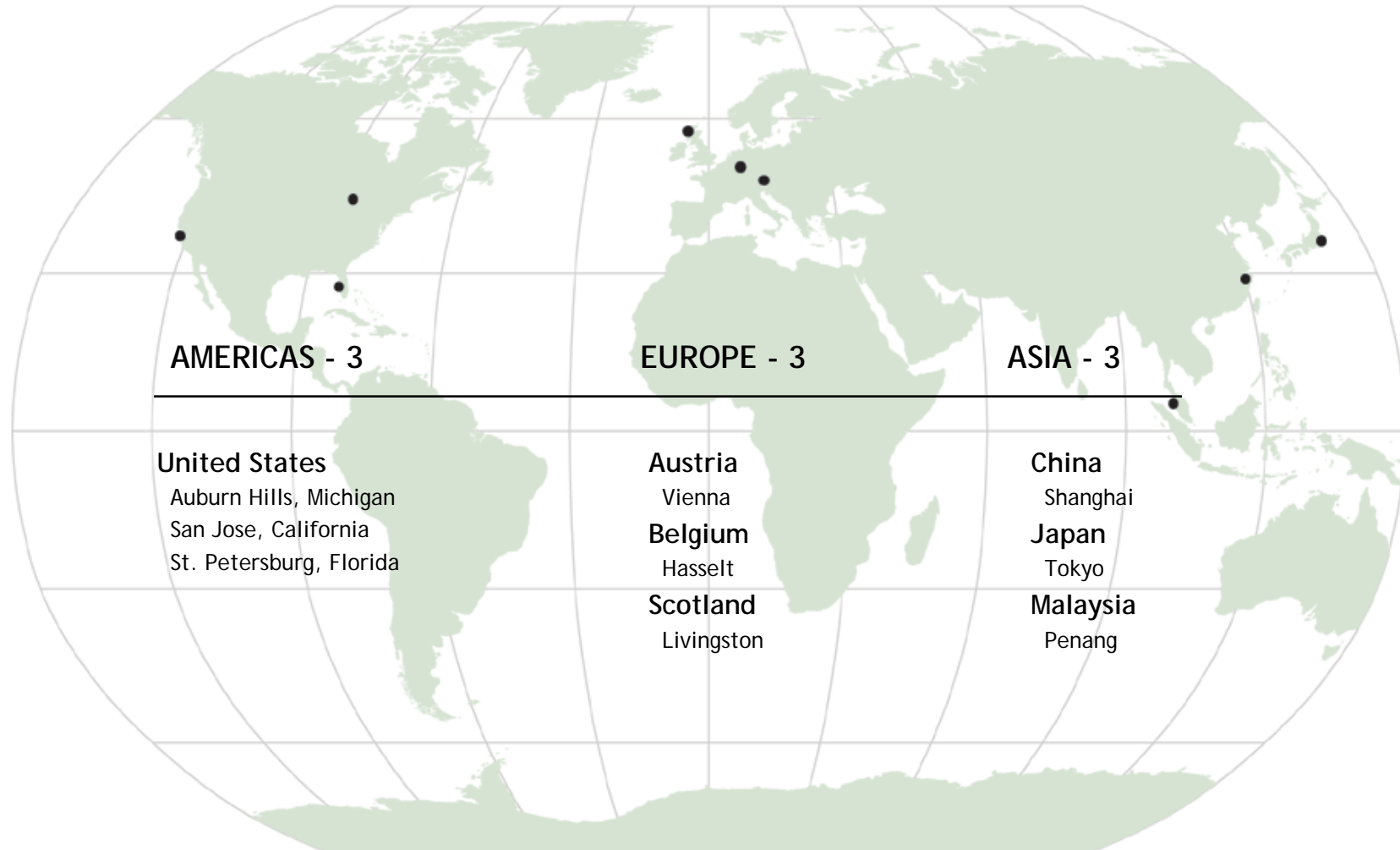 - Direct fulfillment to end customers in more than 110 countries

Worldwide Manufacturing Locations
27 locations on 4 continents

AMERICAS - 8

Brazil
Belo Horizonte
Manaus
Mexico
Chihuahua
Guadalajara
United States
Auburn Hills, Michigan
Billerica, Massachusetts
San Jose, California
St. Petersburg, Florida

EUROPE - 12

Austria
Vienna
Belgium
Brugge
Hasselt
France
Brest
Meung-sur-Loire
Hungary
Szombathely
Tiszaujvaros

Italy
Bergamo
Marcianise
Poland
Kwidzyn
Scotland
Ayr
Livingston

ASIA - 7

China
Huangpu
Shanghai
Shenzhen
India
Pimpri
Japan
Gotemba
Malaysia
Penang
Singapore
Singapore

Worldwide Design Centers

9 collaborative design centers – with design around the clock capability

AMERICAS - 3	EUROPE - 3	ASIA - 3
United States Auburn Hills, Michigan San Jose, California St. Petersburg, Florida	**Austria** Vienna **Belgium** Hasselt **Scotland** Livingston	**China** Shanghai **Japan** Tokyo **Malaysia** Penang

Worldwide Product Support and Logistics Locations

10 service centers in 8 countries

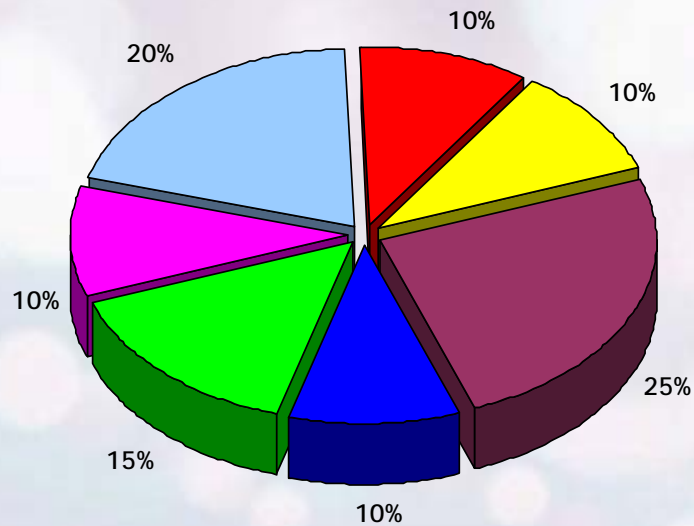| AMERICAS - 4	EUROPE - 4	ASIA - 2
Mexico	**Belgium**	**China**
Reynosa	Brussels	Shanghai
United States	**England**	**Malaysia**
Louisville, Kentucky	Coventry	Penang
McAllen, Texas	**Ireland**	
Memphis, Tennessee	Dublin	
	Italy	
	Marcianise	
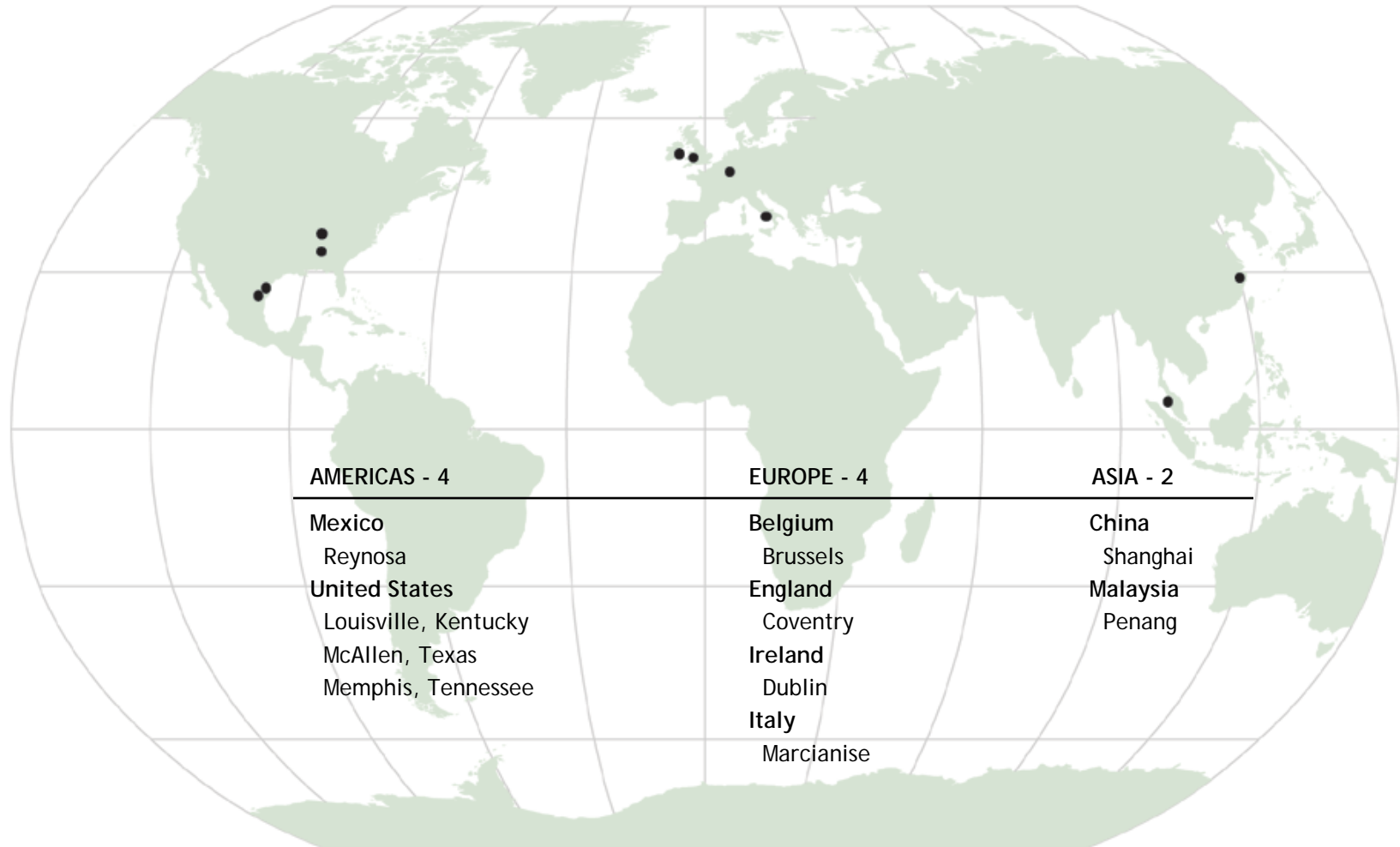
What does Jabil do?

Jabil replaces make/sell with sense and respond

- Jabil selectively partners with approximately 40 technology firms to create an adaptive, global electronics ecosystem responsible for the design, manufacture, and support of more than $150 billion in products annually

- In last twelve months, Jabil:

    - built and shipped >2 million customized network systems to end users in 104 countries

    - built, configured, and tested millions of complex systems to order with six-to-eight hour turns

    - manufactured electronics for more than 24 million automobiles

    - built and tested >180 million circuit card assemblies and systems

    - purchased and consumed >150 billion electronic components

    - slashed new product introduction cycles with 72-hour prototyping, DFx engineering, and test

    - created and managed more than 400 million XML document instances

    - executed >1 trillion design, supply, quality, and manufacturing transactions

    - optimized technology, productivity, quality, and affordability across the full-range of electronic systems: telecom, networking, defense, computing, storage, automotive, instrumentation, medical, sensor, control, and consumer products

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What does Jabil build?

Pie chart values: 10% (Automotive), 10% (Defense, Instrumentation, Medical Other), 25% (Networking), 10% (Telecom), 15% (Computing & Storage), 10% (Peripherals), 20% (Consumer)

Legend:
- Networking
- Telecom
- Computing & Storage
- Peripherals
- Consumer
- Automotive
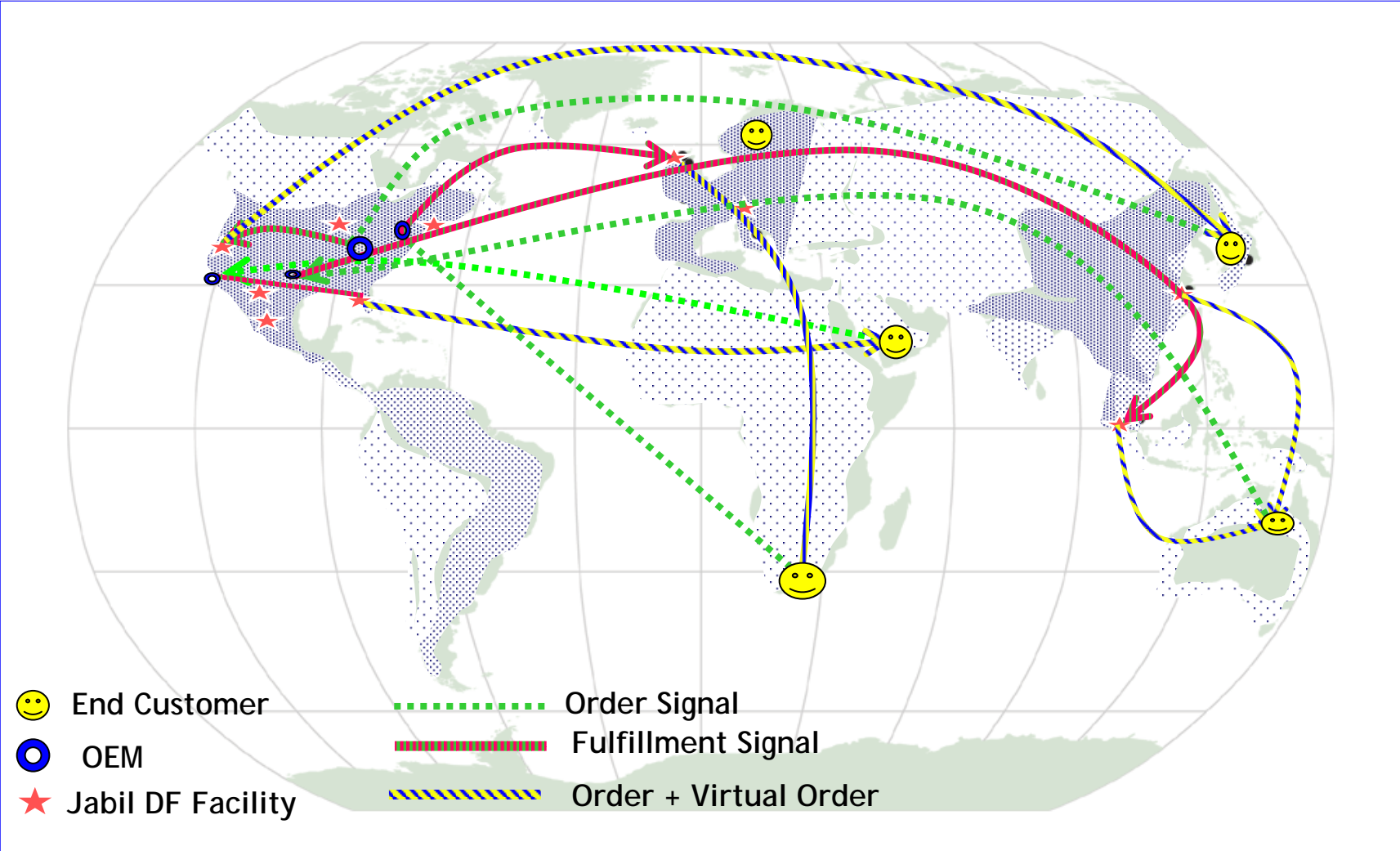- Defense, Instrumentation, Medical Other

Today, Jabil-manufactured electronics are in C4ISR systems, air and ground systems, command centers, national infrastructures, vehicle mounted tactical networks – and just about everywhere else where networked sensors, commanders, and systems are shrinking observe, orient, decide, act loops.
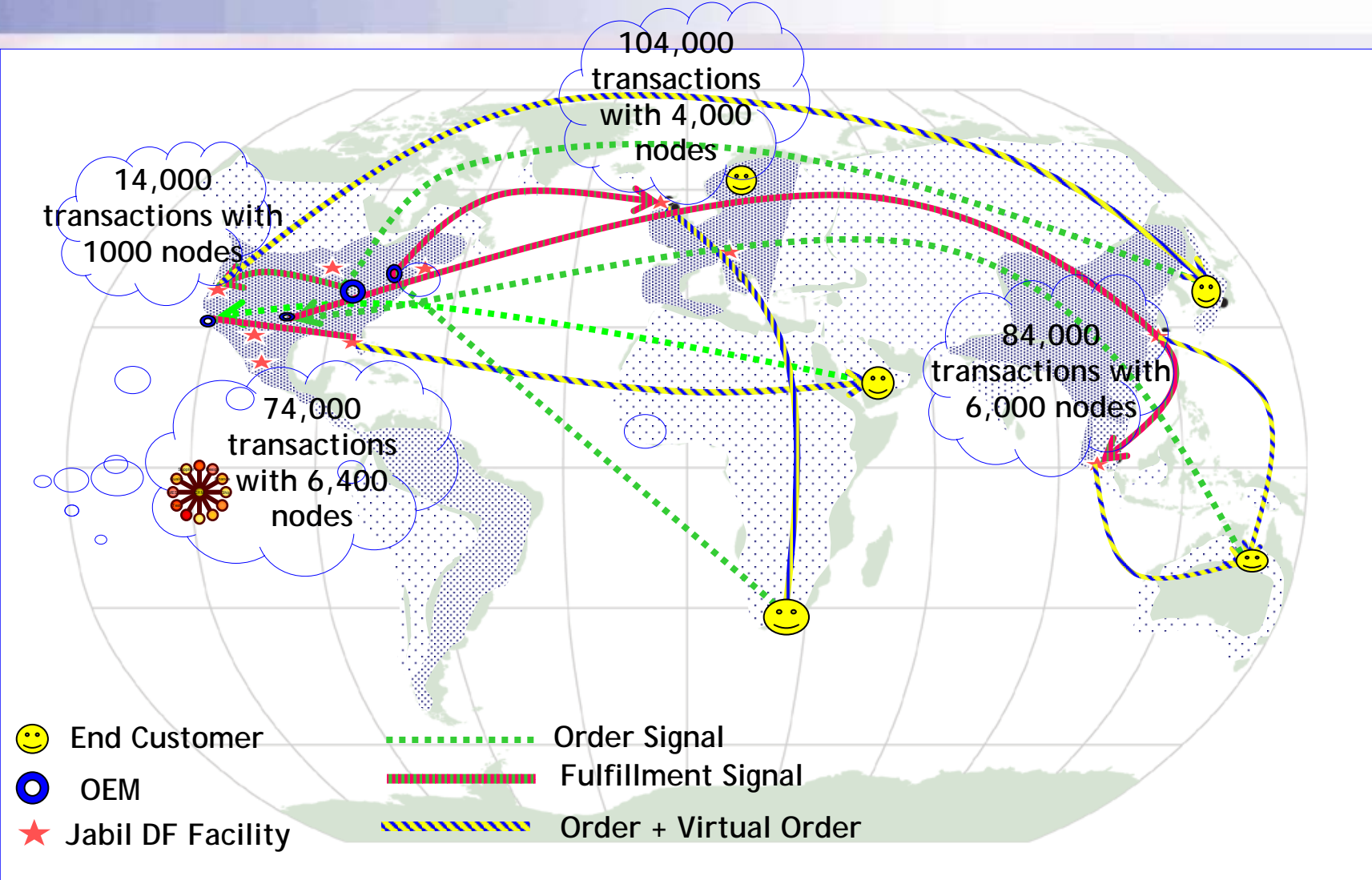
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Here's an example

Complex Network Server Product

Major Product Families	25	End Customer Countries	>100	Manual Data Transforms	0
				Non-Electronic Supplier Transactions	0
Discrete Products	>1050	New Products/Month	2	Non-Closed Loop Transactions	0
Product/Configuration Variants	>500,000	New Product Options/Month	15	Maximum Customer Lead-Time	16 hours
Hardware Variants/Product	362	Mean New Product Introduction Cycle	120 days	Mean Component Population/Circuit Card	1,400
Software Variants/Product	>500	Circuit Card Assembly Types	192	Maximum Component Population/Circuit Card	>4,000
Hardware /Software Configuration Management	Integrated	Design Information Interchange	Automated	Modeling/Simulation	Web-enabled

Supplier and Quality Information					
Suppliers		Daily Material Transactions		DPMO	<200
At Start	1005	End-to-End Inventory Turns	30	Final Integration Inventory Turns	>300
Current	<500	Daily Inbound Material Receipts	180		

Production Volume and Variance					
		Day	Week	Month	Year
Complete Systems					
	Mean	547	2,736	11,766	141,192
	Maximum	1,370	13,540	50,456	590,600
Spares					
	Mean	4,950	24,752	106,437	1,277,244
	Maximum	8,123	64,510	320,100	3,448,087

Network-Centric View of Jabil

End Customer — Order Signal
OEM — Fulfillment Signal
Jabil DF Facility — Order + Virtual Order

Network-Centric View of Jabil

104,000 transactions with 4,000 nodes

14,000 transactions with 1000 nodes

74,000 transactions with 6,400 nodes

84,000 transactions with 6,000 nodes

End Customer

OEM

Jabil DF Facility

Order Signal

Fulfillment Signal

Order + Virtual Order

Network-Centric View of Jabil

Velocity and precision are derived from the content, quality, and timeliness of information moving between nodes on the network.

>6,400 Customer Nodes

>27,000 Internal Nodes

>285,000 Supplier Nodes

>10^6 End Customer Nodes

Some dedicated links

More VPN

Mostly commercial Internet

Good News – Bad News

The "how" is even more important than the what and where of Jabil

High-performance, global information grid

- content-oriented open standards information interchange for design, configuration, manufacturing execution, and demand loops

- direct, single-glass, XML-based access to quality, performance, configuration, materials, and manufacturing information, including integrated PDM, work instructions, drawings, supplier process/quality performance, part data, and near real-time status

Self-synchronizing, bottom-up organizational model

- standards-based global information interchange enables customer-coupled business units to organize and synchronize complex activities from the bottom up

Four dimensional situational awareness

- leadership in global technology, market, and materials environments – with visibility extending beyond defense stovepipes to the larger, high-velocity commercial technology markets – networking, computing, communications, sensing, and transportation

Velocity and precision enable virtual to replace vertical

- right every time, with just the right capacities, responsive to demand without inventory burdens -- OEM ROI% can rise 50-70% or more

Information-enabled Technology Realization

Effects-Based, Collaborative, Scalable, Global, Complex

Business System Independent Strategy
- >5,700 suppliers, >450,000 SKUs, >1,000,000 product variants
- >100 country destinations, 24/7 global sustainment operations
- integrated systems, subassemblies, spares on demand

Normalized Data Management
- Open standards, automated interchange and transforms create common data set independent of platform.

Legacy Variety
SAP ORACLE BAAN, etc.

Customer-Supplier Portal Access
- Responsive, near-real time browser-based visibility across all nodes with collaborative, adaptive engagement and on-demand simulation.

XML

Real Time B2B – Demand and Design
- ABCTO (Assemble, Build, Configure to Order) interconnectivity to disparate customer platforms.
- Real-time design and quality engineering collaboration.

SAP

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Right Stuff isn't first by accident:

Demand Loop has limited value without Design Loop

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RMA

Even if some of the coaches and players don't know it yet,
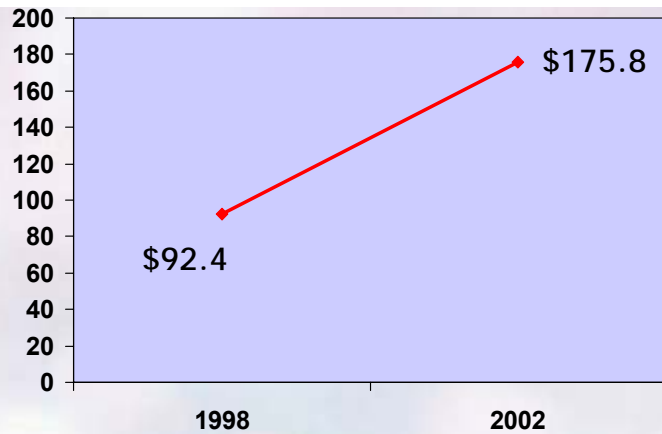The Game Has Changed

"Arising from fundamental changes in American society and business,
military operations increasingly will capitalize on
the advances and advantages of information technology."

"Here at the end of a millennium we are driven to a new era in warfare.
Society has changed.
The underlying economics and technologies have changed.
American business has changed.
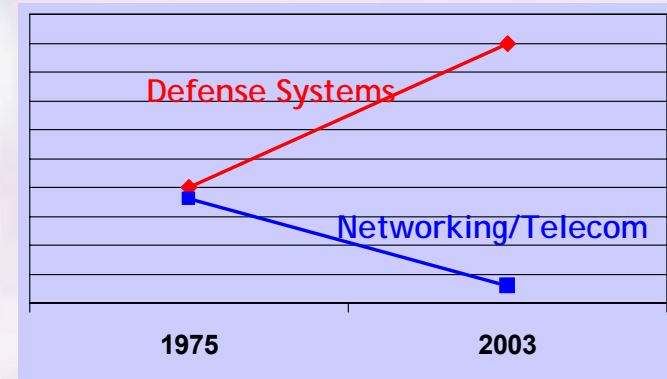We should be surprised and shocked if America's military did not."

Cebrowski and Garstka, "Network Centric Warfare: Its Origin and Future,"
Proceedings of the Naval Institute 124:1 (January 1998): 28-35.
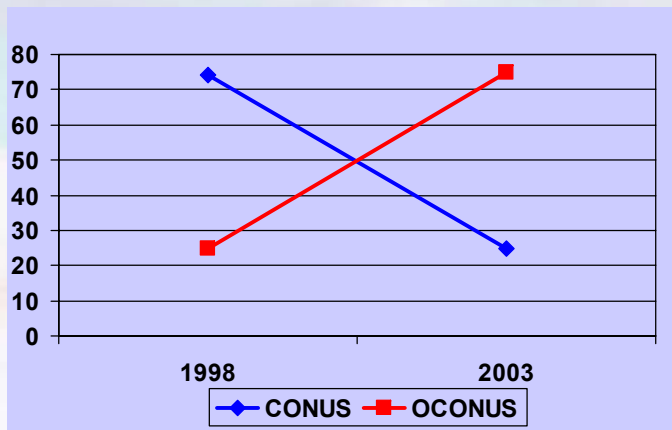
# In electronics, the game has changed

Global EMS revenues: $92.4 in 1998 rising to $175.8 in 2002.

Time to Deployment of Complex Electronic Systems

Defense Systems; Networking/Telecom; 1975 to 2003.

Geographic Distribution of EMS revenues (%)

CONUS ◆   OCONUS ■
1998 — 2003

Global v. Military Semiconductor Markets (Log Scale)

◆ Global Semiconductor Market
■ Military Semiconductor Market
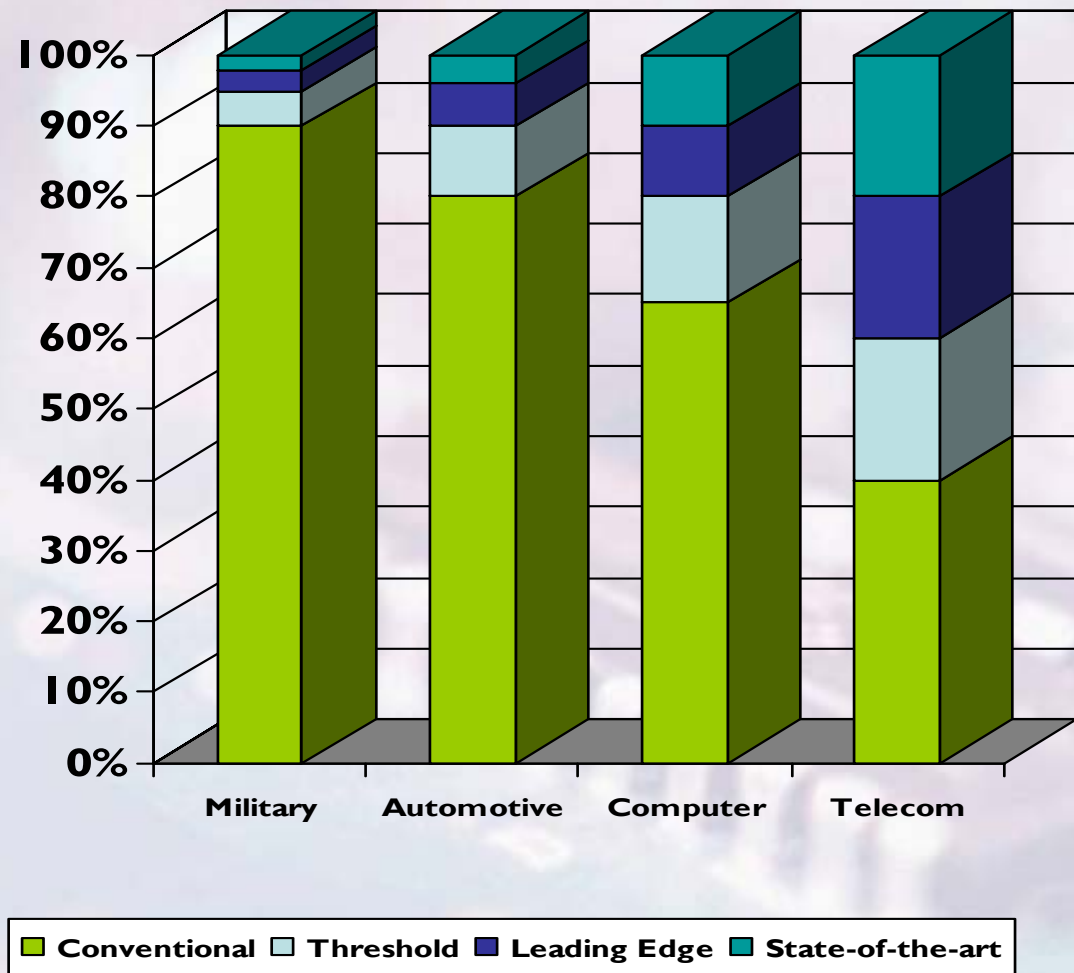1975 — 2003

Jabil CIRCUIT
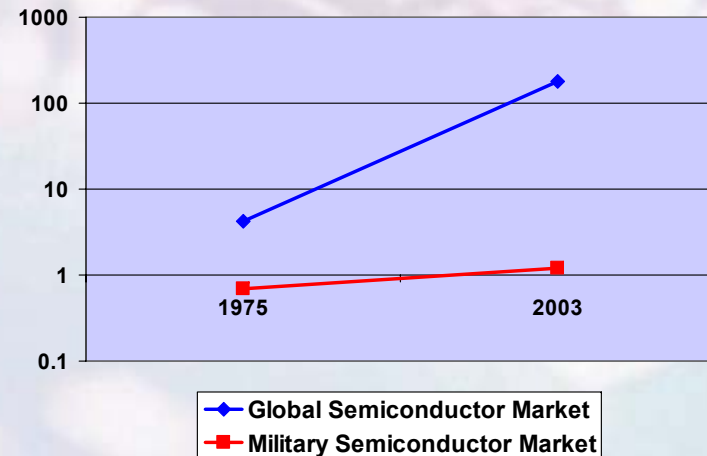
Result: Defense Technology Inversion

"Consider: Since 1975 the Department has doubled the time it takes to produce a weapons system—at a time when the pace for new generations of technology has shortened from years to just 18 months. This virtually guarantees that many of DoD's newest weapons will be one or more technology generations old the day they are fielded."

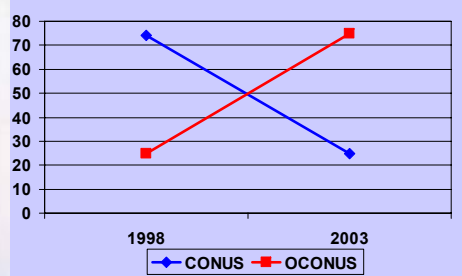"The DOD has been unable to procure advanced weapon systems that can lower the cost and increase the performance of the armed forces. The need to swiftly introduce new weapons systems is paramount."

Secretary Rumsfeld

Legend: ■ Conventional □ Threshold ■ Leading Edge ■ State-of-the-art

Chart categories: Military, Automotive, Computer, Telecom (y-axis 0% to 100%)

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Result: Commoditized Threat

Geographic Distribution of EMS revenues (%)

(Chart showing CONUS declining from ~75 in 1998 to ~25 in 2003, and OCONUS rising from ~25 in 1998 to ~75 in 2003, with legend: CONUS, OCONUS; y-axis 0 to 80)
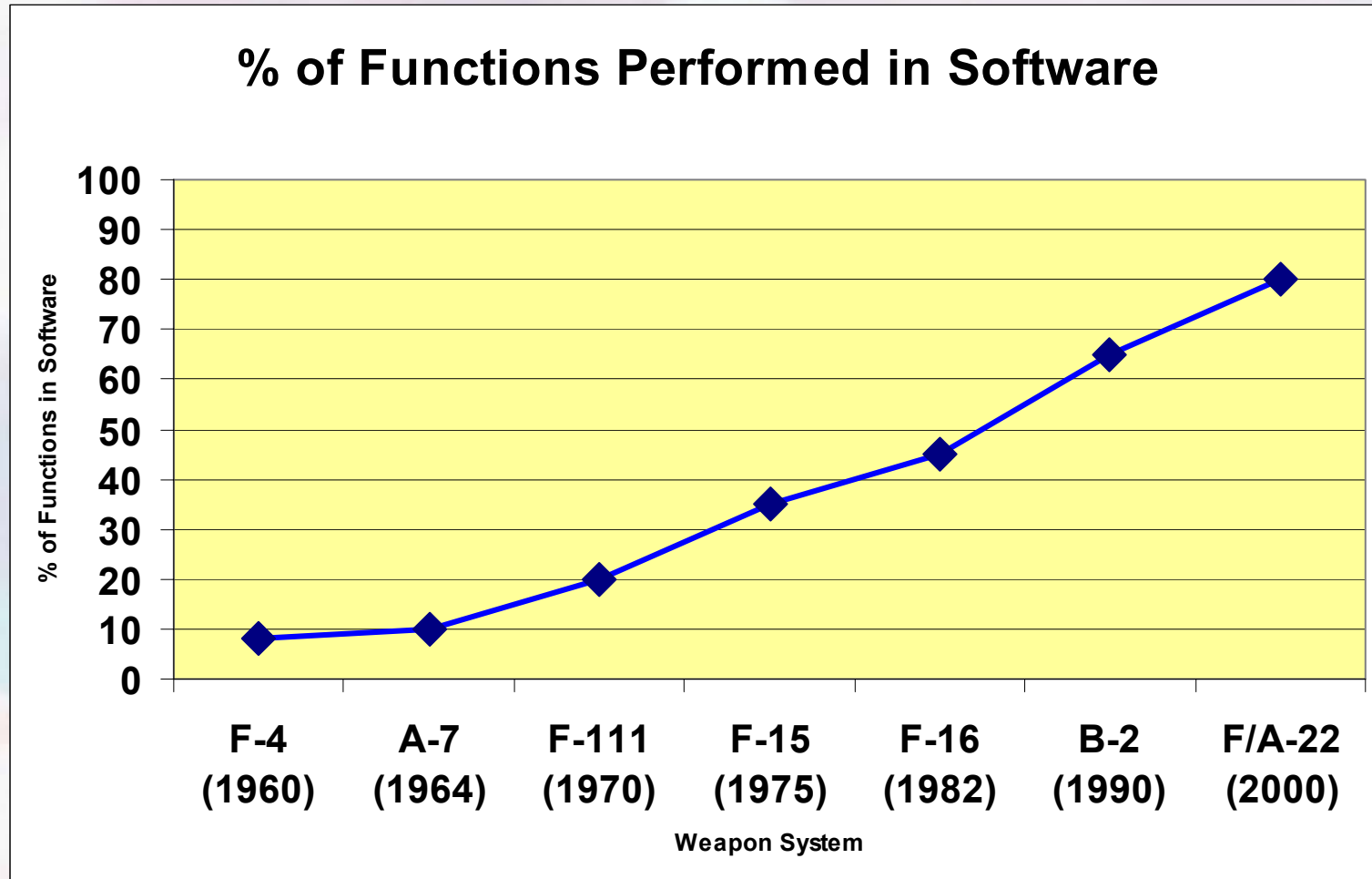
"Maintaining the U.S. technological edge has become even more difficult as advanced technology has become readily available on the world market. Technologies for sensors, information processing, communications, precision guidance, and many other areas are rapidly advancing and are available to potential adversaries."

Secretary Rumsfeld, Annual Report, August 2002

"Who can make war is changing as a result of weapons proliferation and the fact that the tools of war increasingly are marketplace commodities."

Cebrowski and Garstka, *Network Centric Warfare: Its Origin and Future*

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Result: Software Dominance

% of Functions Performed in Software

Chart plotting % of Functions in Software (y-axis, 0–100) vs Weapon System (x-axis):
- F-4 (1960): ~8
- A-7 (1964): ~10
- F-111 (1970): ~20
- F-15 (1975): ~35
- F-16 (1982): ~45
- B-2 (1990): ~65
- F/A-22 (2000): ~80

Why should we care?

"The global future of defense production will be defined by the time and cost to deployment of interoperable, netcentric electronics and software. We cannot maintain defense supremacy with the requirements definition to deployment cycle of the present."

-- VADM Cebrowski, April 27, 2003

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The defense future

- Higher operational tempos
- More critical infrastructures to protect
- Many more softer targets
- Fewer, more capable/flexible large platforms
- Orders of magnitude increase in small systems/devices
- More open architecture systems
- Less military-unique systems
- Higher software fraction
- Shorter product lifecycles
- Compressed time between concept and deployment
- Time and cost to market critical
- Rapid insertion of emerging technologies
- Closer product/process ties

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The future defense industrial base

"Today, military decision makers are unsure of who our future enemies will be, as well as when, where, and under what environments and rules of engagement future conflicts will take place. To respond to these uncertainties, a flexible and responsive industrial base will be critical."

"We need to change our military acquisition capability from one of long cycle times producing technological marvels whose need and costs have to be predicted 15 to 20 years in advance to a capability that flexibly responds to changing threats."

M. McGrath, *et al., Equipping United States Military Forces, 2010 and Beyond:*

The Report of the Committee to Study Integrated Commercial Military Manufacturing

(Washington, D.C.: National Academy of Science Press, 2001).

Commercial Partnering Is Key

"the changed nature of … military equipment, and -- particularly -- the rapid evolution … commercial information technology (with whole new generations of technology, often at lower costs, every 18 months, or less), it is appropriate for us to re-evaluate our current acquisition and procurement practices"

Former Dep. Sec. Jacques Gansler

"The DOD has been unable to procure advanced weapon systems that can lower the cost and increase the performance of the armed forces. The need to swiftly introduce new weapons systems is paramount.

"The present weapons system acquisition process was designed for a different environment than the one that exists today. … … Such processes are not responsive to urgent new challenges that involve considerable uncertainties. They are not capable of harnessing the remarkable genius and productivity of the modern, information-based commercial and industrial sectors that have done so much to revolutionize the U.S. civilian economy. … …

"Simply tinkering with the present acquisition system will not provide the innovation and speed necessary to satisfy future military needs and take advantage of powerful new technologies."

Secretary Rumsfeld

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Equipping Tomorrow's Military Force

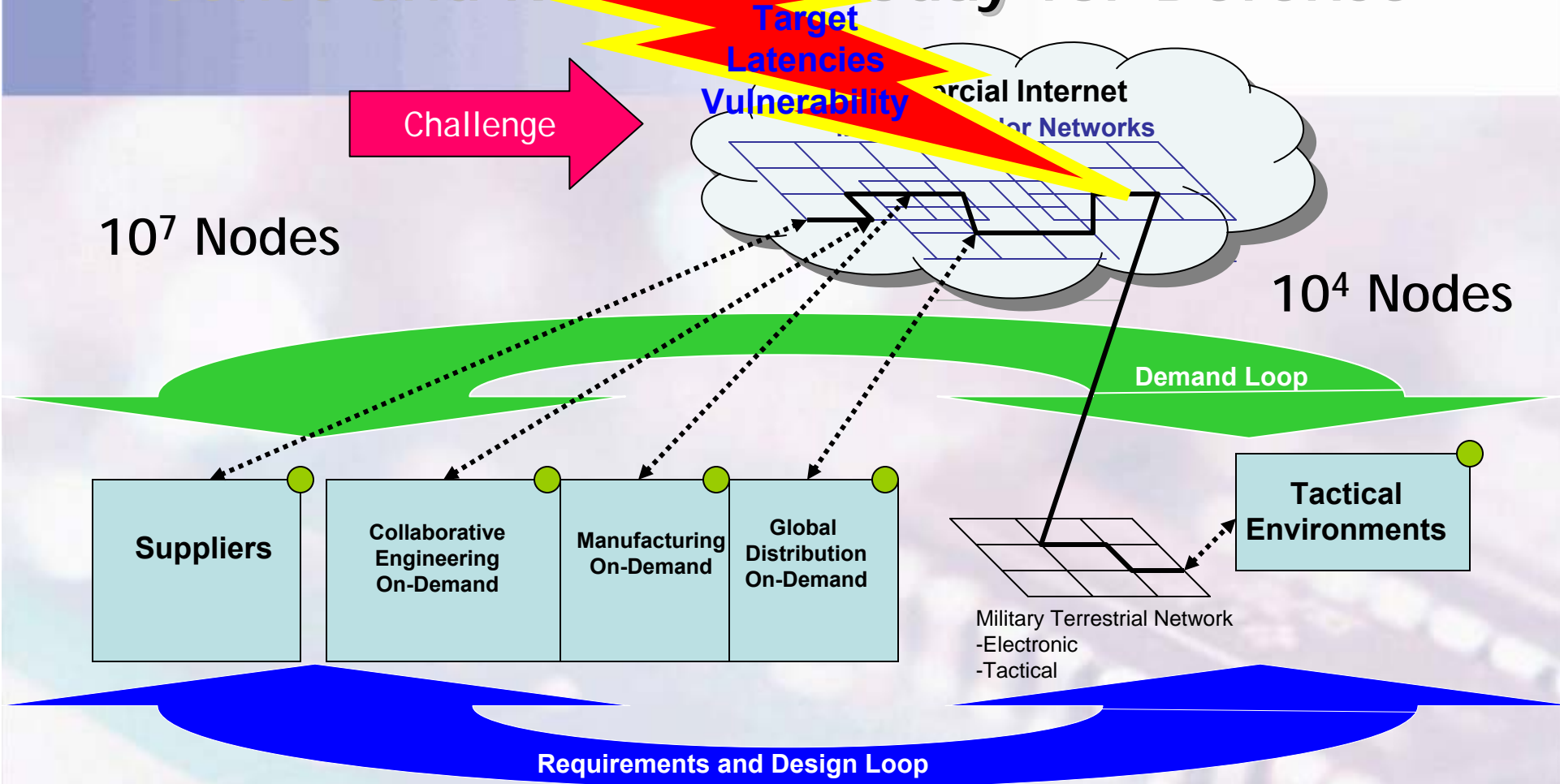## Why ICMM and Why Now?
A compelling military need

- **We face an unpredictable threat (underscored Sep 11)**
  - Cannot equip for all contingencies
  - Commercial base: flexibility, rapid response and replenishment
- **Transformation depends on technological superiority**
  - Commercial sector often has the lead; more so by 2010
  - Need to exploit faster and better than adversaries
  - Spiral upgrades and life cycle support
- **Affordability matters**
  - Low volume defense products from efficient commercial lines
- **Opportunities are growing**
  - Commercial products, processes, facilities increasingly applicable to defense needs -- if barriers are removed

Board on Manufacturing and Engineering Design

7

- "Without ICMM – Integrated Commercial/Military Manufacturing – it is unlikely that the military can keep pace with the electronics technology being introduced by the commercial sector on a new product cycle as short as 9 months but not more than 3 years."

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Sense and R̶... Today for Defense

Target Latencies Vulnerability

Challenge

~~rcial~~ Internet
~~...~~ or Networks

10^7 Nodes

10^4 Nodes

Demand Loop

Suppliers	Collaborative Engineering On-Demand	Manufacturing On-Demand	Global Distribution On-Demand

Tactical Environments

Military Terrestrial Network
-Electronic
-Tactical

Requirements and Design Loop

Good News

• 25% to 60% decrease in cost

• 100% increase in development and deployment velocity

• Secure Interoperablity
• Federation of Data Types
• On-Demand Model with Common Operations
• Using available network connectivity
• Requires minimal middleware
• Existing industry data schemas

Hardware Design and Development
- Simulation-based Acquisition
- Commercial Technology Insertion
- Rapid, Virtual Product Design
Real-time Software Distribution
System-level Design and Implementation

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Integrated Security

Sense and Respond: for the Future

Multiple Spiral Execution – Enhanced Connectivity

Essential requirement for commerce and defense: dynamically provisioned, prioritized, and secured resilient connectivity

Strategically Integrated Internet

10^8 Nodes

10^4 Nodes

Redundant Net

Demand Loop

Industrial Base

Collaborative Engineering On-Demand

Manufacturing On-Demand

Global Distribution On-Demand

Security (Existing and Ad Hoc)

Tactical Environments

Military Terrestrial Network
- Digital Network
- Migration to GIG

Redundant Net

Full Vision GIG
- Open, Highly Scalable Architecture
- Fully Redundant with
- Multiple Security Levels
- High bandwidth, low latency
- QoS
- Ad Hoc
- Legacy to Future Connectivity

Requirements and Design Loop

Better News

Right Stuff
Right Time
Right Way
Right Cost

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