Innovation in the Knowledge Economy
Some Key Grand Challenges

Irving Wladawsky-Berger

Society

Business

Technology

Focus on Innovation

"We will fight our battles not on the low road to commoditization, but on the high road of innovation."
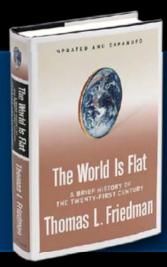*- Howard Stringer, Chairman and CEO, Sony Corporation*

"Constant reinvention is the central necessity at GE... We're all just a moment away from commodity hell."
- Jeffrey Immelt, Chairman and CEO, GE

"We've committed ourselves to a business model that relies on continual innovation" - Sam Palmisano, IBM CEO

"Economic competition in the flat world will be more equal and more intense... the most important attribute you can have is creative imagination."
- Thomas Friedman

What Is Innovation?

- **Significant value created for society or business:**
  - Creates new industries and markets
  - Spurs productivity and economic growth
  - Fuels wealth creation and profits
  - Generates high-value, higher-paying jobs
  - Raises standard of living

- **Innovation has to be useful as well as unique**

- **Requires looking beyond today's problems**

But why is this so important now?

Why is Innovation such a business imperative?

Our environment is constantly changing
- Technologies: Internet, IT, bio-informatics, . . .
- Market conditions: competition, commoditization . . .
- Socio-economic: globalization, trade barriers . . .

Innovation

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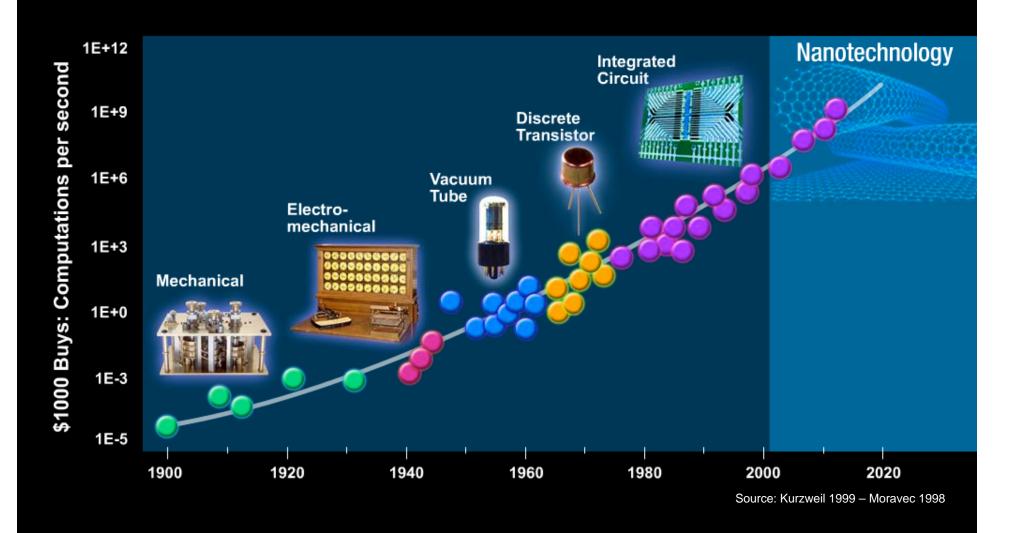
Innovation

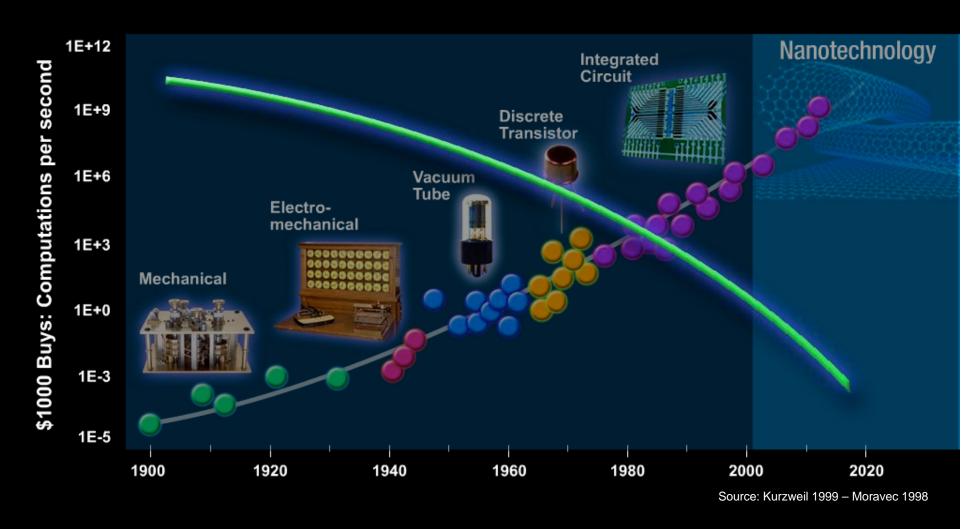Society

Business

Technology

Innovation is indispensable to
- adapt to changes
- go after new opportunities
- ward off competitors
- preserve leadership position

Accelerating Advances in Technology

Source: Kurzweil 1999 – Moravec 1998

Accelerating Advances in Technology
Driving Costs Steadily Downward

Source: Kurzweil 1999 – Moravec 1998

The Internet: Industrial ➡ Knowledge Economy

Evolution of Systems

- Global, integrated

- Market facing, services oriented

- Complex, unpredictable
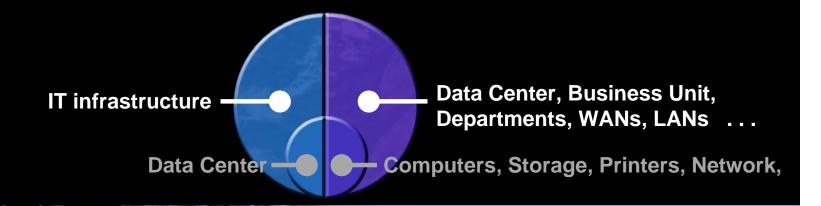
Evolution of IT Systems
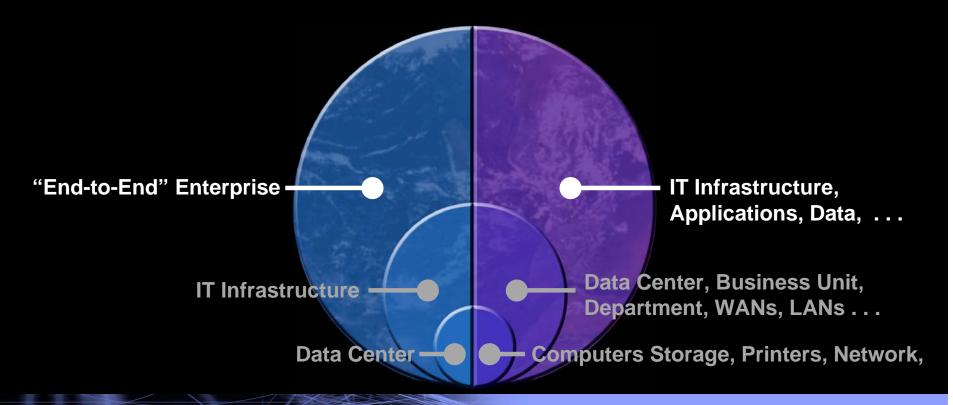
Evolution of IT Systems
1960s, '70s and Early '80s

Data Center ———⬤ ⬤——— **Computers, Storage, Printers, Network, . . .**

Evolution of IT Systems
1980s and Early '90s

IT infrastructure ⎯⎯● ●⎯⎯ **Data Center, Business Unit, Departments, WANs, LANs . . .**

Data Center ⎯⎯● ●⎯⎯ **Computers, Storage, Printers, Network,**
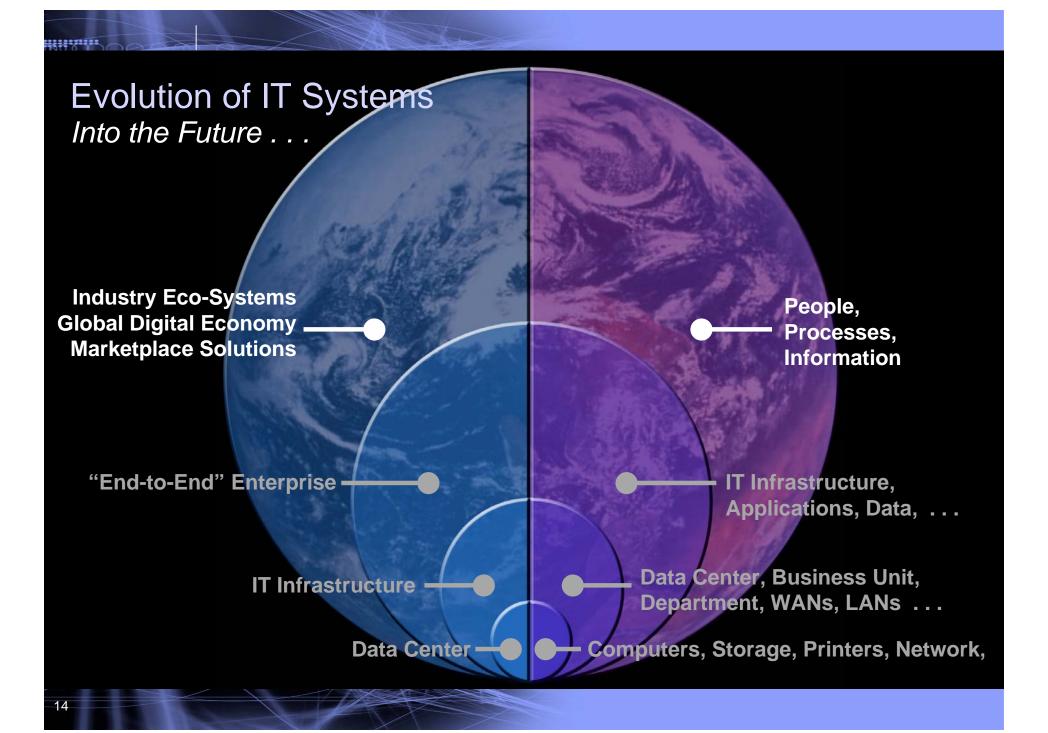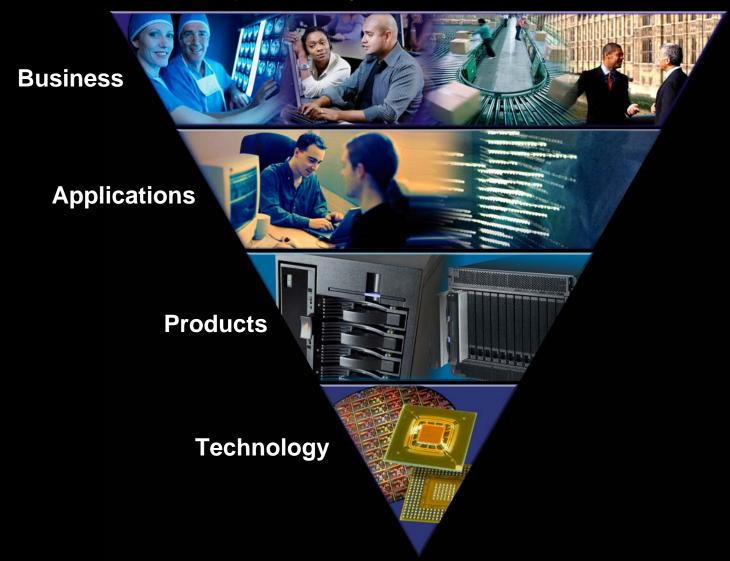
Evolution of IT Systems
Mid '90s to Present

"End-to-End" Enterprise

IT Infrastructure, Applications, Data, . . .

IT Infrastructure

Data Center, Business Unit, Department, WANs, LANs . . .

Data Center

Computers Storage, Printers, Network,

Evolution of Marketplace Systems

Business

Applications

Products

Technology

Market Facing Systems
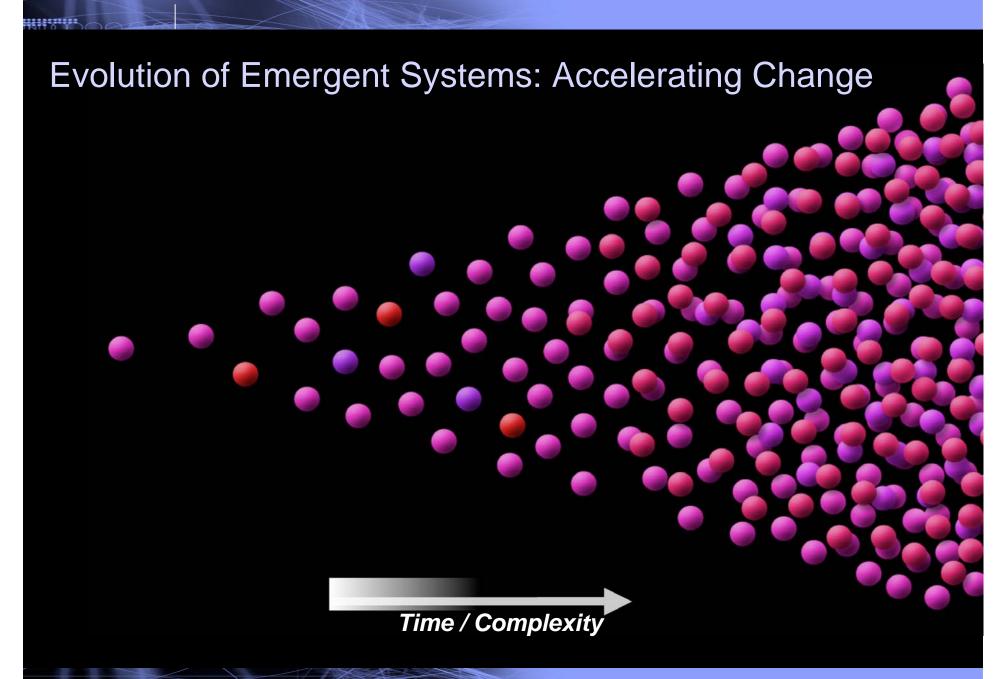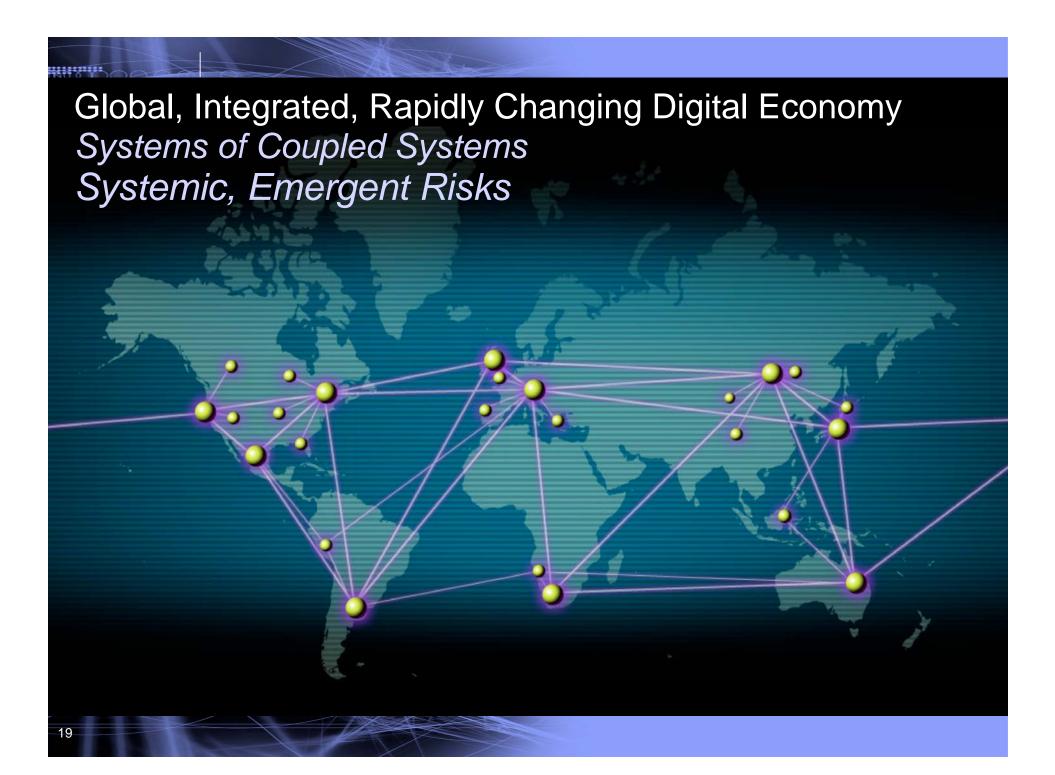
Back Office Systems

People and Services

Machines and Products

Evolution of Emergent Systems: Accelerating Change

Time / Complexity

Global, Integrated, Rapidly Changing Digital Economy
Systems of Coupled Systems
Systemic, Emergent Risks

Some Key System Grand Challenges

- Cloud Computing

- Global Integrated Enterprises

- Virtual Worlds

Cloud Metaphor → Massive Scalability, Quality of Experience
10X - 100X over the next decade
25% - 55% CGR for selected workloads

Business and Consumer Services

Real-time Information

Web N.0

People, Devices, Sensors

Business and Consumer Services

Real-time Information

Devices, Sensors, etc
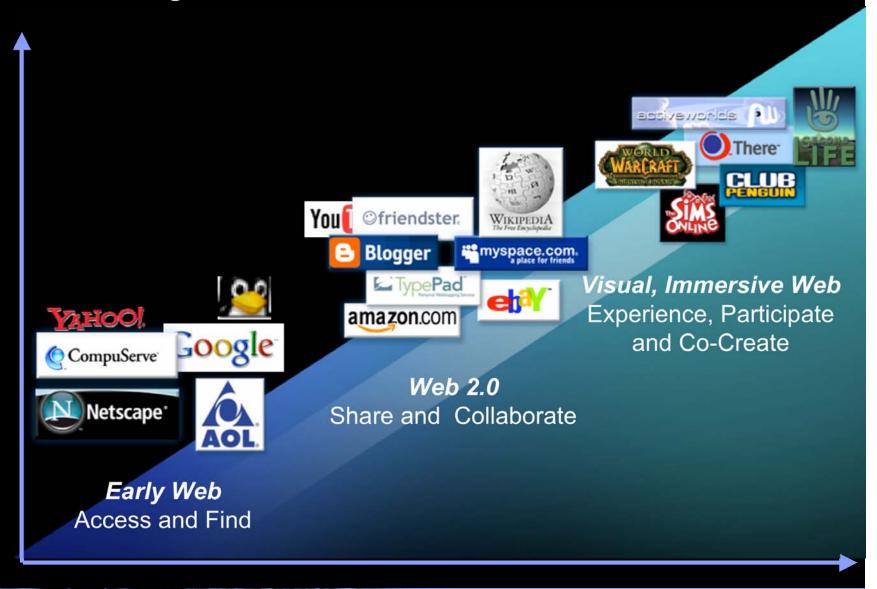
Continuing Web evolution

Visual, Immersive Web
Experience, Participate and Co-Create

Web 2.0
Share and Collaborate

Early Web
Access and Find

The Industrial Revolution
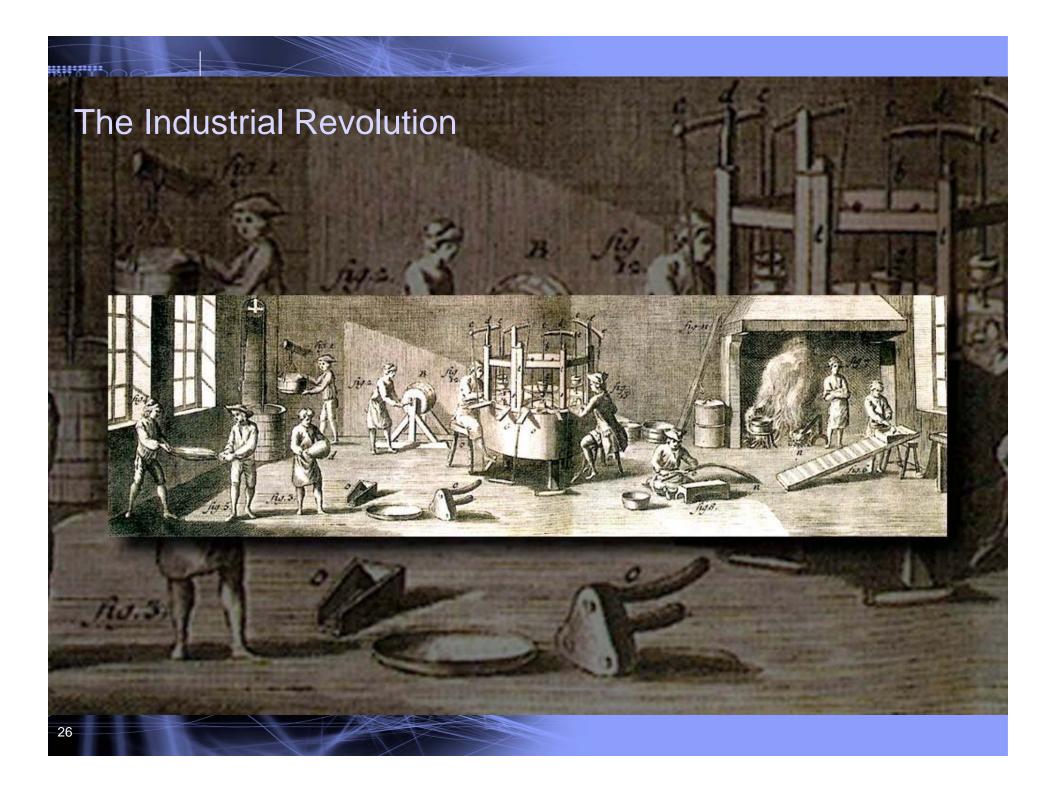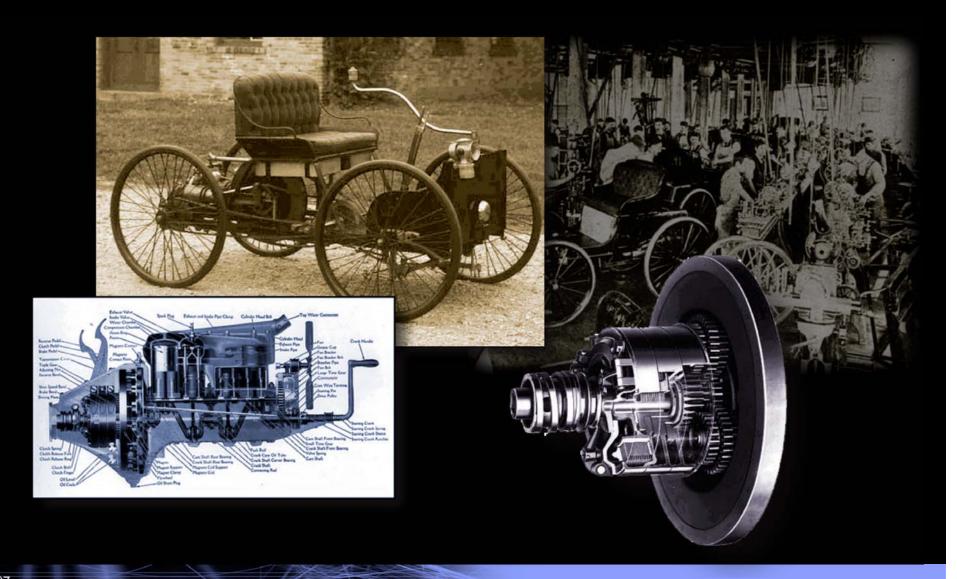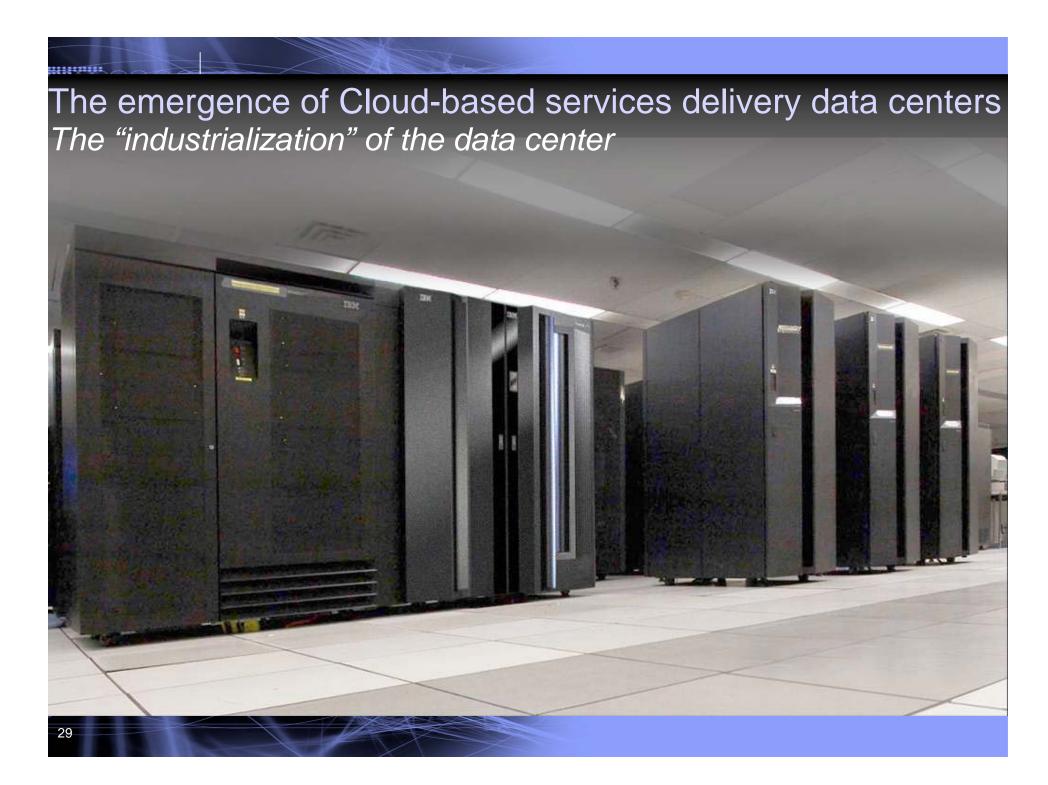
Evolution of Manufacturing

Leadership in Manufacturing
Toyota Production System
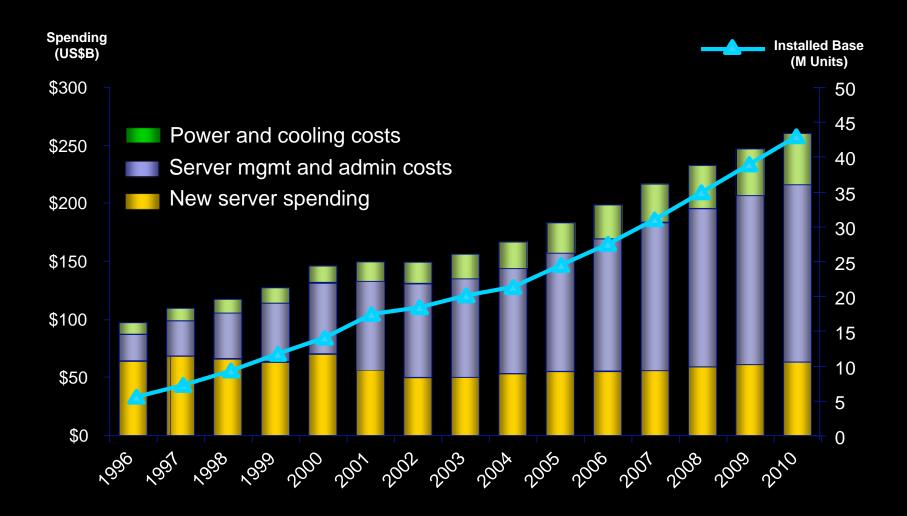
- Supply chain
- Just-in-time production
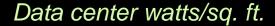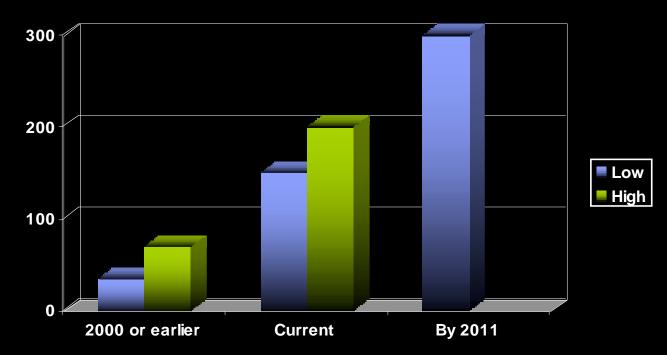- Continuous improvement

The emergence of Cloud-based services delivery data centers
The "industrialization" of the data center

IT infrastructure growth

Source: IDC, Virtualization 2.0: The Next Phase in Customer Adoption, Doc #204904, Dec 2006

IT energy crisis

- During the next 5 years, most datacenters will spend as much on energy as they do on hardware

Data center watts/sq. ft.
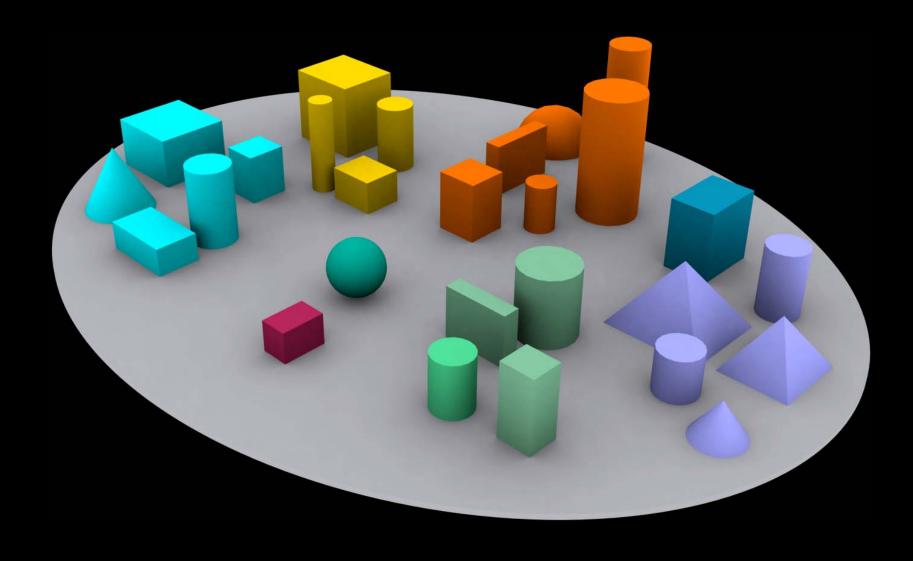
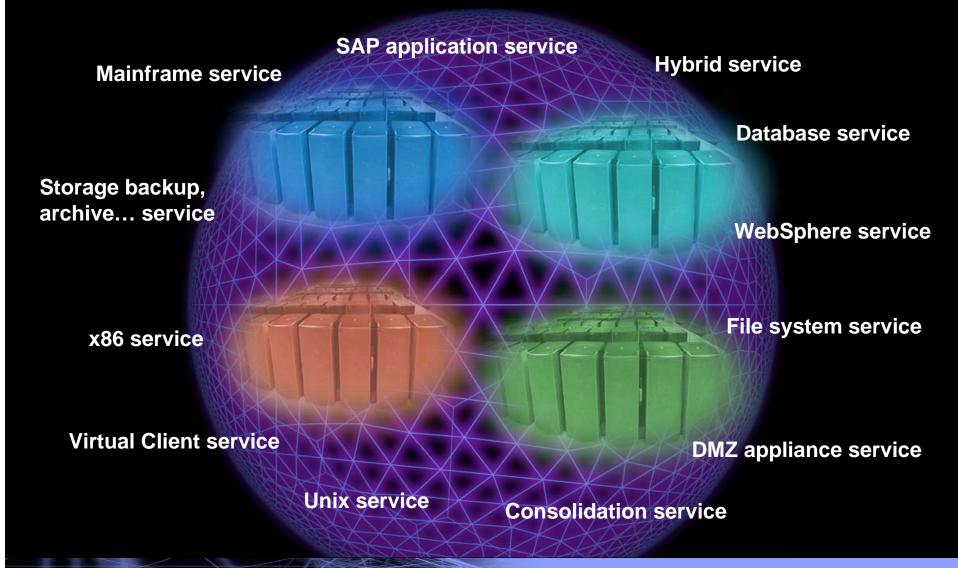*Doesn't include energy needed to remove heat…*
can increase overall power requirements by 80% to 120%

The IT Complexity Crisis
Classic Complex Data Center

Data Center "Ensemble" Approach To IT Simplification

Virtualized, Federated Ensembles – SOA/Grid Protocols

SAP application service

Mainframe service

Hybrid service

Database service

Storage backup, archive… service

WebSphere service

x86 service

File system service

Virtual Client service

DMZ appliance service

Unix service

Consolidation service

What does it take to be world-class in services delivery?
Flexible, Adaptable Architectural Frameworks

Security, Identity Mgmt

Virtualization

Integration

Efficiency

Systems Management

Some Key System Grand Challenges

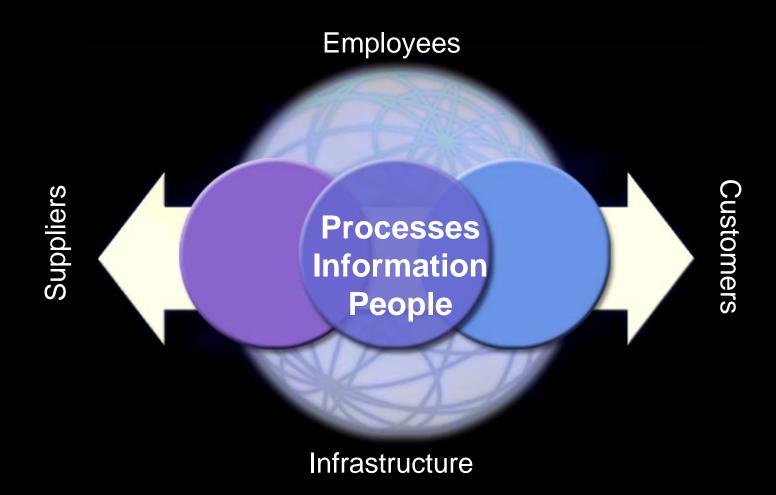- Cloud Computing

- Globally Integrated Enterprises
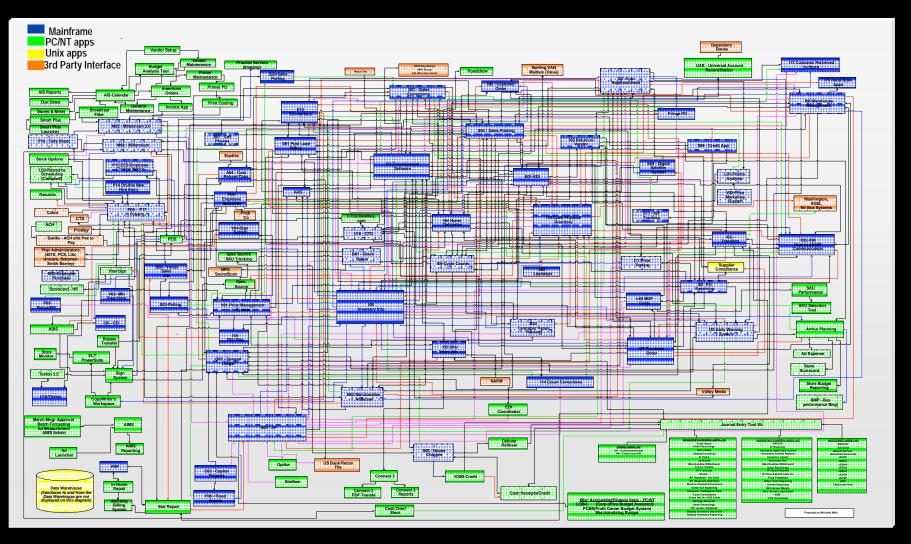
- Virtual Worlds

Globally Integrated Business and Organizational Systems

Employees

Suppliers

Processes Information People

Customers

Infrastructure

Business Realities

Actual Application Architecture for Consumer Electronics Company

Evolution of Engineering Systems
Some Key Lessons

Computer Assisted Engineering Systems
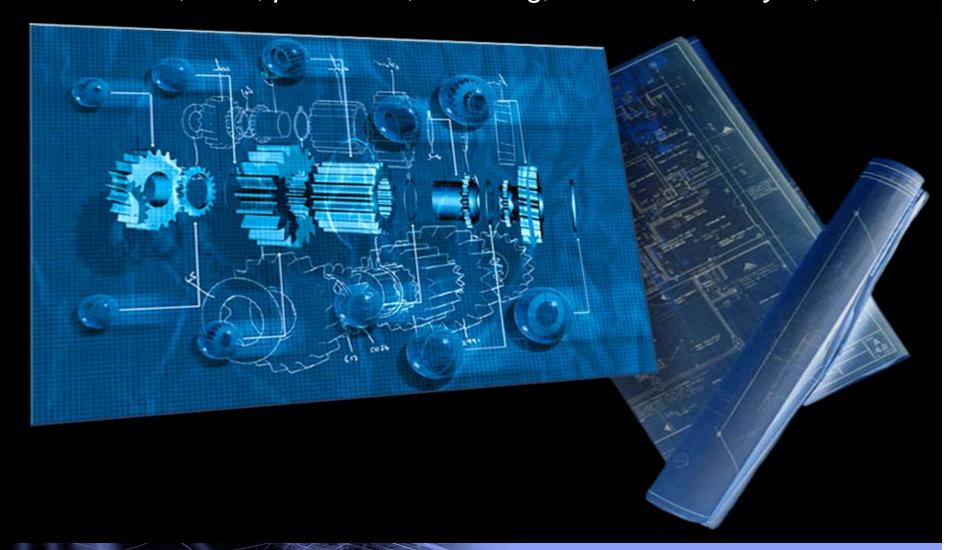
Strategy Collaboration

Design / Simulation

Operation / Maintenance

Manufacturing

Computer Assisted Business and Organizational Systems
Architectures, tools, processes, modeling, simulation, analysis, . . .

Computer Assisted Business and Organizational Systems

**Strategy
Collaboration**

**Business Designs
and Architectures**
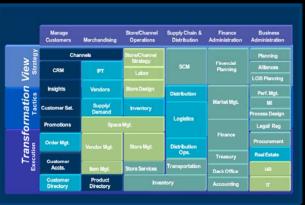
**Operation /
Feedback-loop**

**Implementation
(SOA)**

The Spectrum of Complex Systems

Biological
Systems

Human,
Organizational
Systems

Physically
Engineered
Systems

Some Key System Grand Challenges

- Cloud Computing

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Human – Machine Interactions
Early Days – Machine Oriented Interfaces

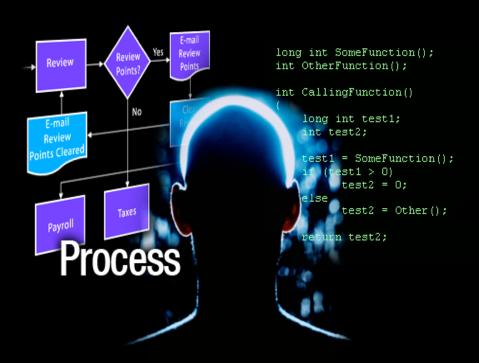*Human*   *Computer*

Human – Machine Interactions
Graphical User Interfaces (GUI) – Xerox PARC (late 1970s)

Human

Graphical View
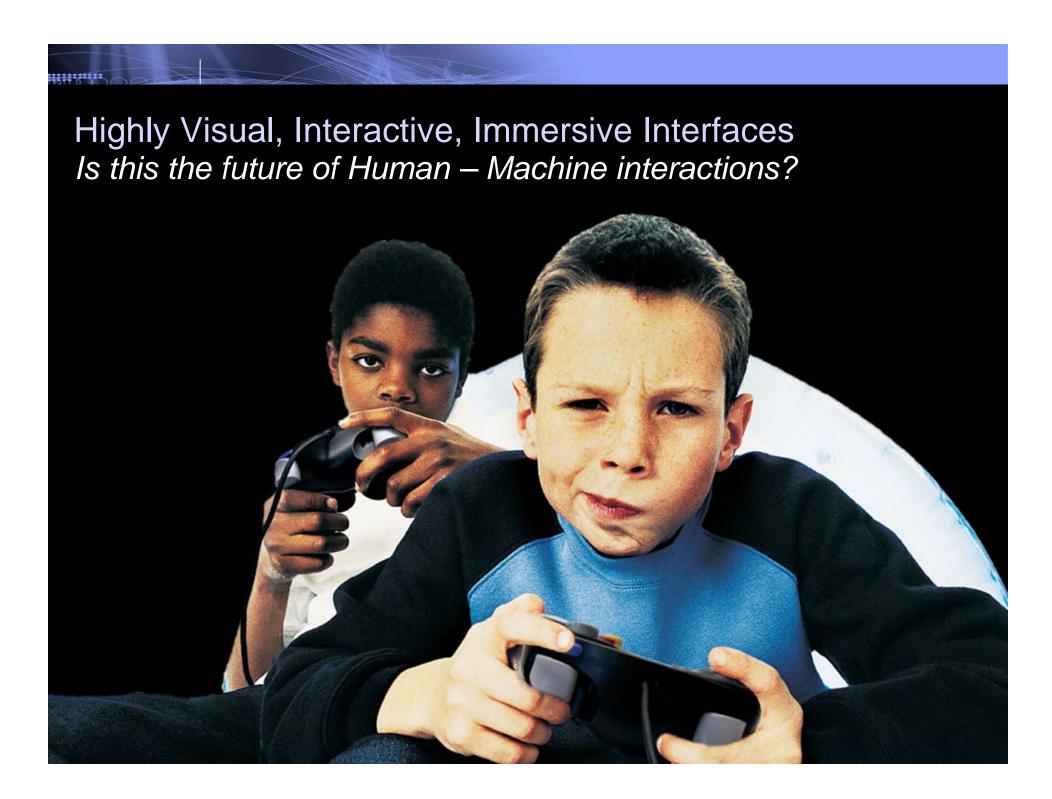
Human – Machine Interactions
Web Browser – GUI based

Human

The Web

Highly Visual, Interactive, Immersive Interfaces
Is this the future of Human – Machine interactions?

Human – Machine Interactions
Highly Visual, Real Time, Immersive

Human

Virtual/Hybrid World

Broadband into the Mind
Struggling to Survive Information Overload

e-mail

IM

Web

voicemail

video

audio

voicemail

Early Adopters

Marketing & Sales

Collaboration and Events

Education and Training

Process Management, Rehearsal, and Operations

Early Adopters – Education & Training

- Connect with experts and teachers from around the world

- Train, rehearse, role play, and certify as individuals and teams in virtual world

- Simulation of real world environments for more effective learning and retention
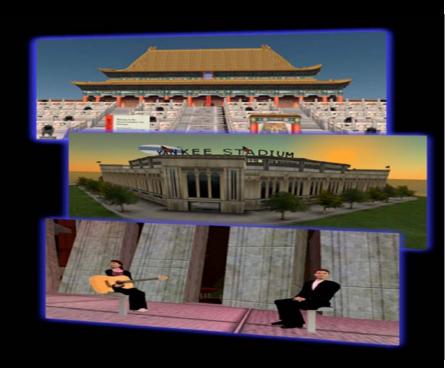
Early Adopters – Collaboration & Events

- Recreate real world destinations and events to stimulate awareness and sales

- Provide a new perspective to immerse spectators in action

- Provide new collaboration capabilities to enhance and increase effectiveness

- Provide forums to support innovation

Process Rehearsal, Management, and Operations

- Use rehearsals to optimize business and technical processes - especially where equipment is costly/complex and risk is great

- Use virtual environment Product Life Cycle management to speed time to market and to reduce cost and errors.

- Manage real-world operations more effectively with 3D cues in virtual environment

Implenia®

Early Adopters – Marketing & Sales

- Test market with low cost prototype – gain feedback

- Support complex product sales – especially where 3D matters

- Provide entertaining sales and brand experiences – link virtual and real sales

Deutsche Bank

circuit City

Knowledge Economy

Industrial Economy

Transition to the Knowledge Economy

**Deepening Integration of IT
into all aspects of
Business and Society**

Business, Societal and Lifestyle Innovation

**Accelerating Advances
in Technology**

Talent: Critical Requirement for Innovation Leadership
The 21st Century Demands Uniquely-Skilled People

- Value of education increases during times of change

- Challenges and opportunities reside at the intersection of business and technology

- Curricula must transform to reflect the realities of today and tomorrow

21st Century Skills
Science & Technology, Business & Management, Social & Communication Skills

"Classic" Skills

Overriding Educational Objective
Develop or Enhance the Leadership Skills for Dealing With:

Complex Systems	*Technical Skills*
Complex Markets	*Business Skills*
Complex Organizations	*People Skills*

A Stream of Disruptive Innovations

Software as a Service

Services Sciences

Web 2.0

Offshoring

Game players

SOA

iPods

Virtual Worlds

Petaflop supercomputers

GIE

Mashups

Cloud Computing

Flat World