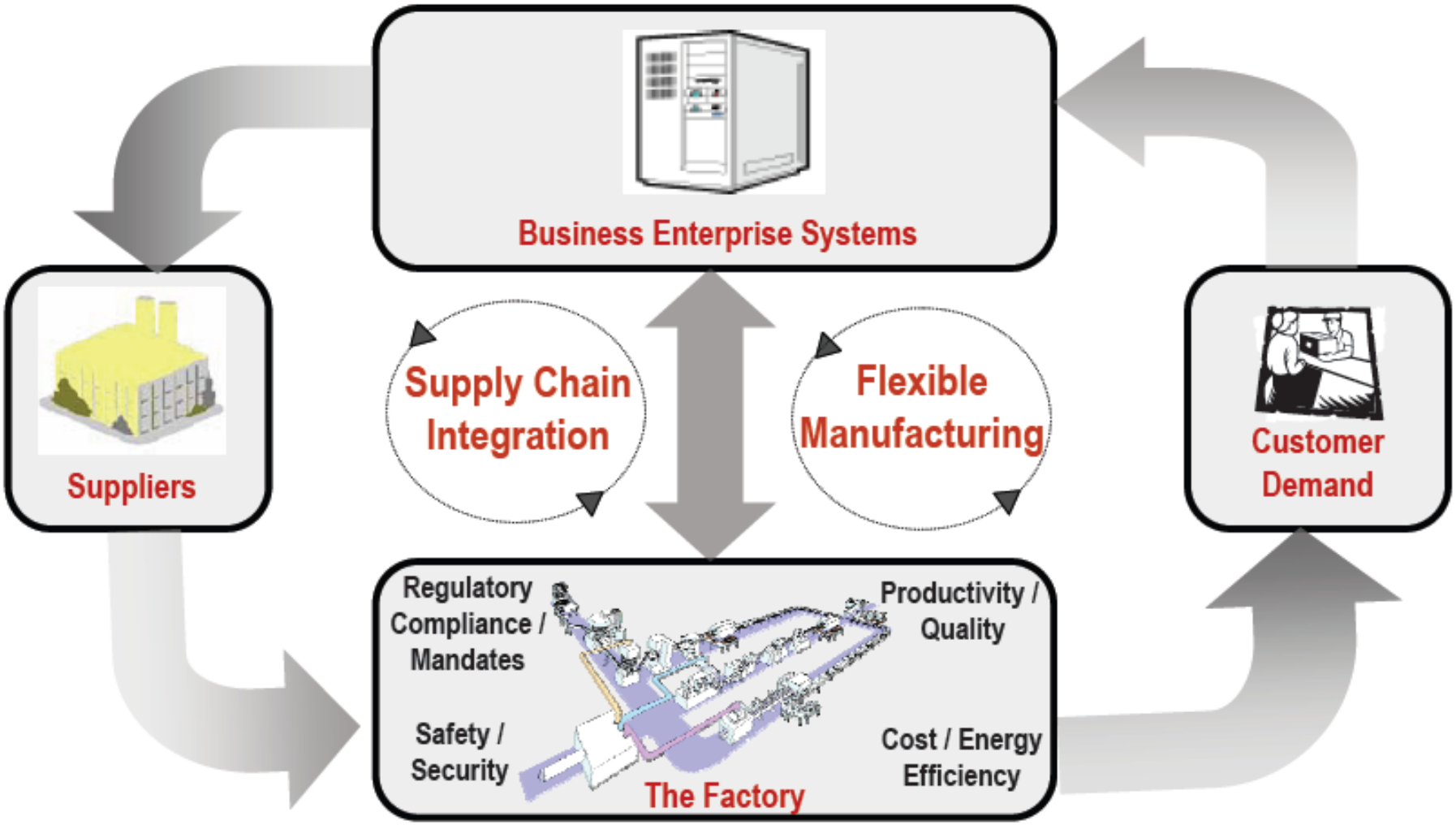
LISTEN.
THINK.
SOLVE.SM

Trends in Automation

Jordi Cruz
European Business Manager,
Integrated Architecture

Manufacturing Trends



Supply Chain Integration and Flexible Manufacturing Are Driving The Integration of Factories With Business Enterprise Systems

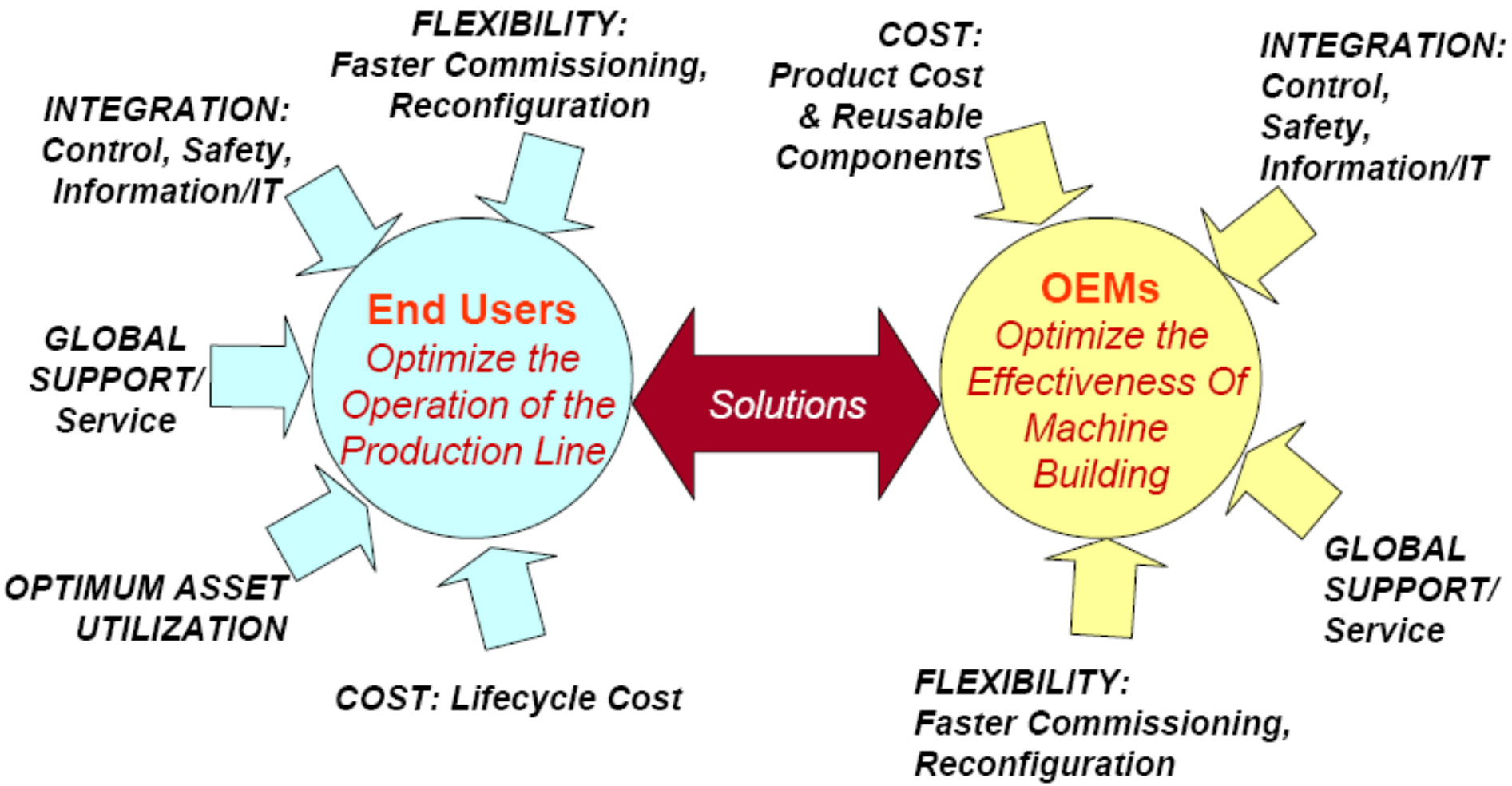
Manufacturing Trends and Drivers

FROM	TO
Mass Production	Mass Customization
Discrete Supply Chain	Supply Chain Synchronization
Loosely Coupled Design & System	Integrated System
Local	Global
Physical assets	Functional Assets
Lowest Procurement Cost	Total Cost Optimization

What Do Manufacturing Companies Want?

- Major Food Company
  - Rolling out ERP (focus on supply chain integration)
  - Into "second wave" of driving productivity of manufacturing plants
    - Looking to save $800M / year (derived about $1B / year savings from the first "low-hanging fruit wave")
  - Plants are efficient today; however, annual waste is $200M
  - Moving to new, "healthier" products will require new processes
    - Do not have internal expertise for designing new automation processes
    - Would prefer to outsource "chunks of process implementation"
  - Regulatory Mandates: Walmart and FDA
  - Walmart's competitors demanding "customized" products
    - E.g., nonflex wrapped snacks, target ethnic groups with products such as rice snacks, salsa products, etc.
  - Long-term vision: flexible and integrated manufacturing - "customized trail mix" for every consumer

Manufacturing Drivers Today



Common Drivers for OEMs and End Users

Six Manufacturing Imperatives For The Future

- **Maximize Customer Value Through Solutions**
  - low cost, high quality, fast delivery, rapid commissioning, increased flexibility, integrated safety
- **Deliver Highest Operating Efficiency**
  - asset productivity, energy efficiency, …
- **Integrate the Supply Chain**
  - get the right products and information, to the right place at the right time
- **Lean Enterprise**
  - flow manufacturing, build to order, …
- **Compliance with Regulatory Concerns**
  - safety, audit trails, emission controls, …
- **Diversified Global Environmental Compliance**
  - global decisions on environmental issues

Technology Evolution

Nano & Virtual

2010 to .....

Information Technology

1960 to 2010

Industrial

1800 to 1960

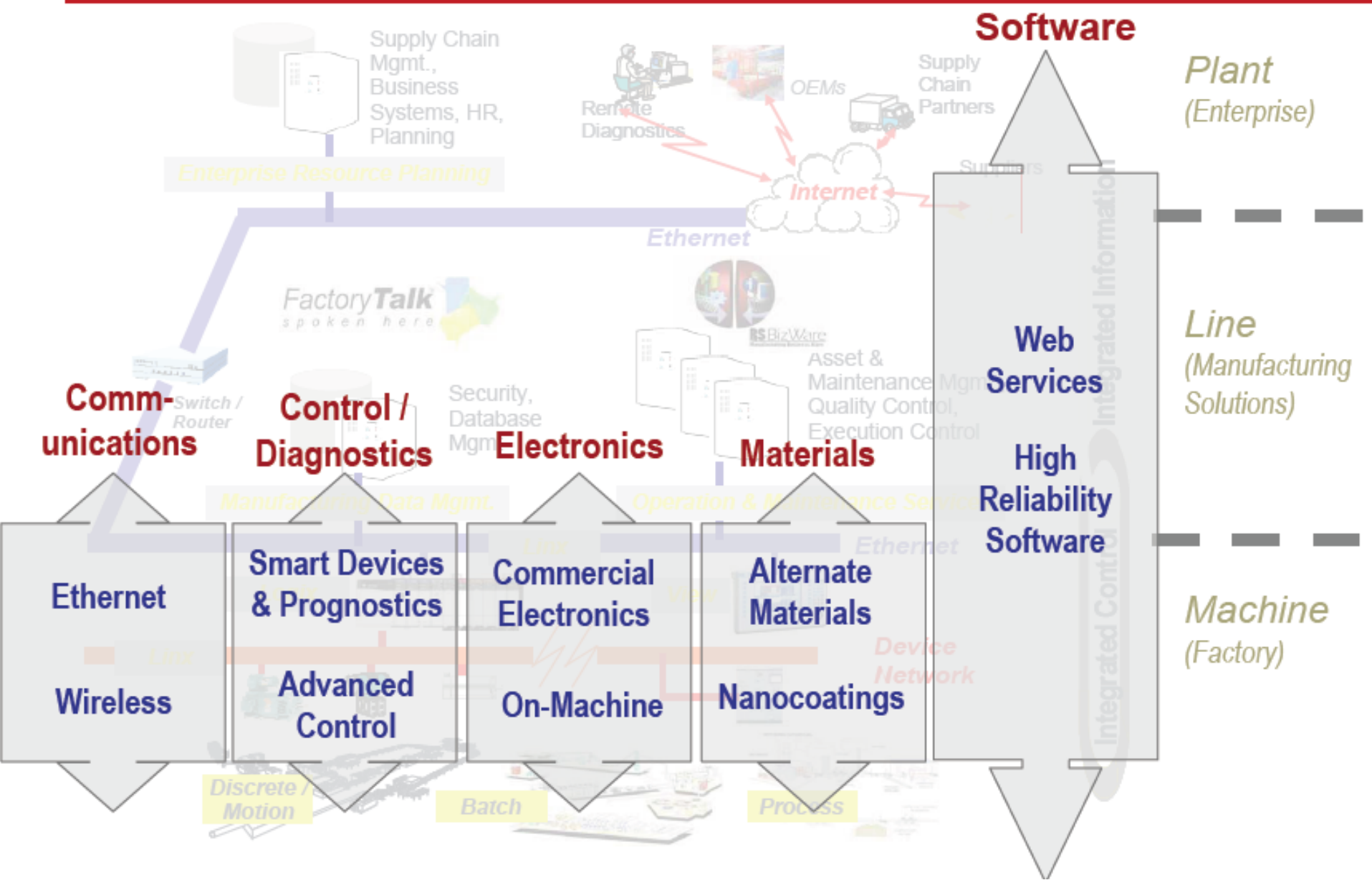
Agriculture

10K BC to 1800 AD

Hunting/ Survival

Million BC to 10 BC

The Five "Core Technologies" For Industrial Automation

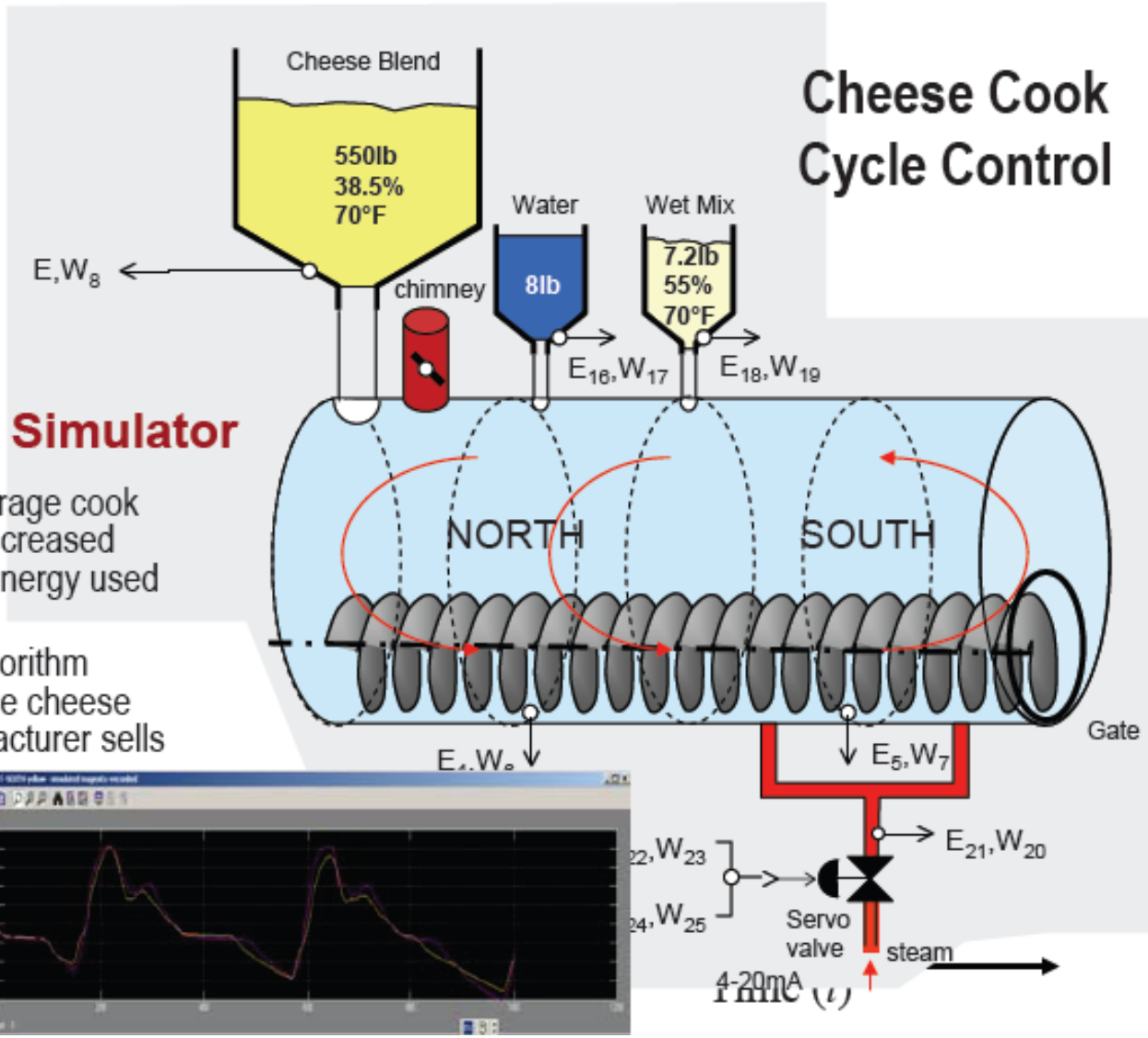


Long-Term Architecture Trends for Industrial Automation

- **Integrated Information, Safety, Security, and Control**
  - Safety and Control on Common Network and Platform
  - Security Solutions for Open, Ethernet Communications
- **Open Communications Over Ethernet**
  - Controllers evolve to Industrial Ethernet “Appliances”
- **Peer to Peer Computing For Flexible, Fault-Tolerant Manufacturing**
  - Software Control Can Reside Anywhere
  - Autonomous Agents for Reconfigurable Control
- **Multivendor Compatibility Through Software Standards**
  - Common Profiles and Data Exchange Standards
- **Continued Compliance with International Regulatory Standards, Industrial Standards, and Compliance Marks**

Core Technologies : Control

Trend toward application-specific advanced control methods that optimize performance and energy efficiency.



- Increased production - shortened average cook cycle duration by 10%, which led to increased production with the same amount of energy used for heating
- Increased efficiency - New control algorithm enabled stabilizing water content in the cheese on the maximum allowed. The manufacturer sells less cheese for the same cost.

Prognostics Application

Pump diagnostics & prognostics

- Bearings, pump cavitation, vibration monitoring
- Spectral signature analysis, Neural Networks
- Motor condition monitoring

Customer's Problem:
Pump Life unloading rail cars

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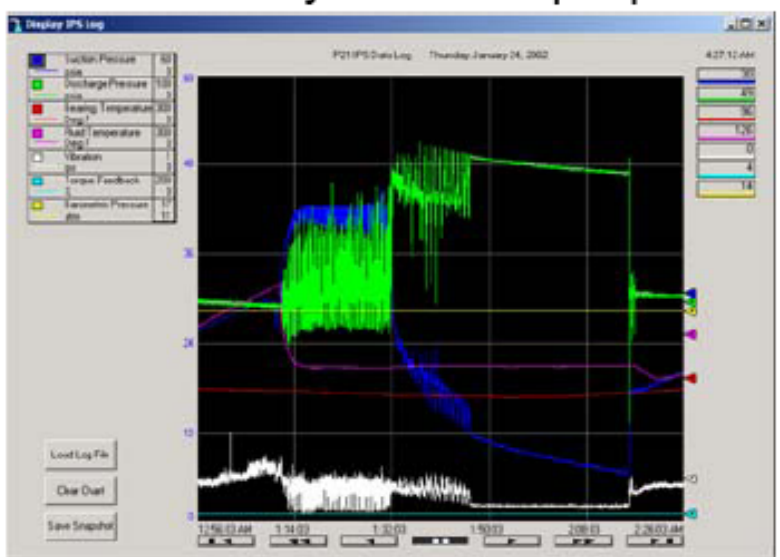
Monitoring

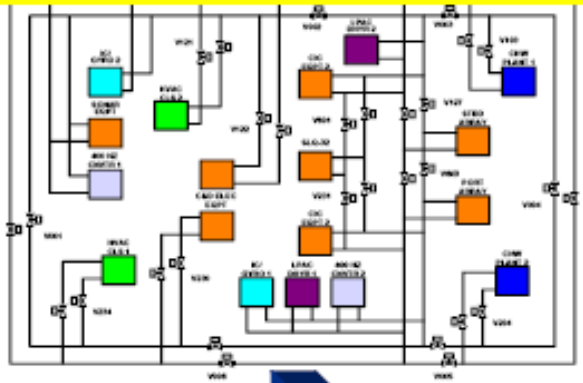
- Discharge Pressure
- Suction Pressure
- Bearing Temperature
- Fluid Temperature
- Vibration
- Barometric Pressure
- Current (future)

Remote Analysis of Pump Operation

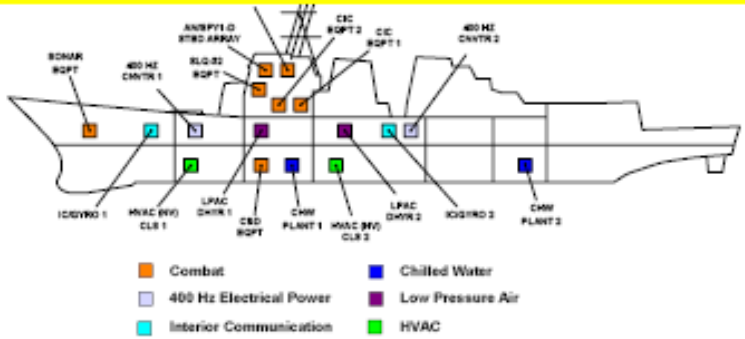


Autonomous Control Systems Application: Shipboard Automation

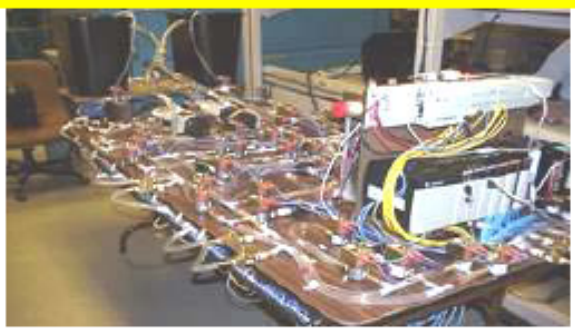
Agent Based Solution Developed



Navy Requires Highly Survivable System



Agent based prototype developed



- Test and debug automatically generated agents
- Test Agent Behavior for different configurations
- Test Distributed Diagnostics System

Demonstrate on the Navy's Land based Simulator

Test Reconfigurable Shipboard Automation Architecture

Key Learnings From Autonomous Systems R&D

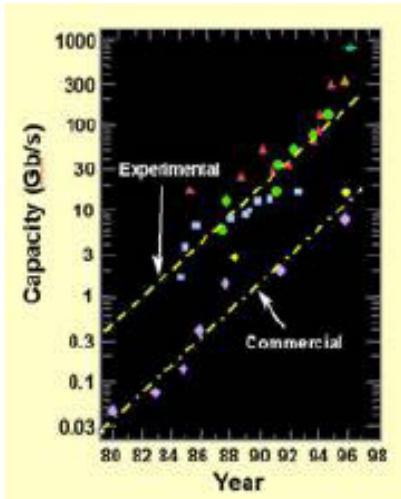
- Simulation in-the-loop is needed
- Although the system is highly distributed, some degree of centralization is required to ensure system stability, and reduce agents size and complexity
- Successful case studies involving redundant systems
- Agent technology applied with COTS controllers
- Interoperability Standards evolving

Customer Value Propositions
Example: Package Sorting

- Faster commissioning
- Fault-Tolerant
- Self-configuring
- Minimal operator intervention

Core Technologies: Communications Trends

- Ubiquitous Access to Information From Anywhere at Anytime
  - Internet explosion, wireless access
- Continued migration to Ethernet and open protocols
  - Everything web-enabled
  - Pervasive Ethernet
  - Powered Ethernet for smaller devices
  - Powerline Ethernet with fusion of Power, Control,
  - Communications and Safety over single cable & WLAN
  - Time Synchronization services over Ethernet



- Wireless
  - Migration to 2 tier wireless architecture: Information Radio (802.11b) and Device Radio (ZigBee)

Wireless Industrial Applications

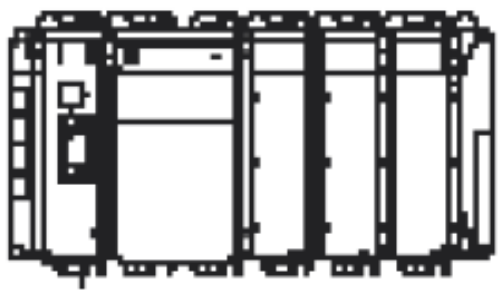
Wireless Ethernet/SCADA

RFID

Source: Milwaukee Journal Sentinel 2/8/03

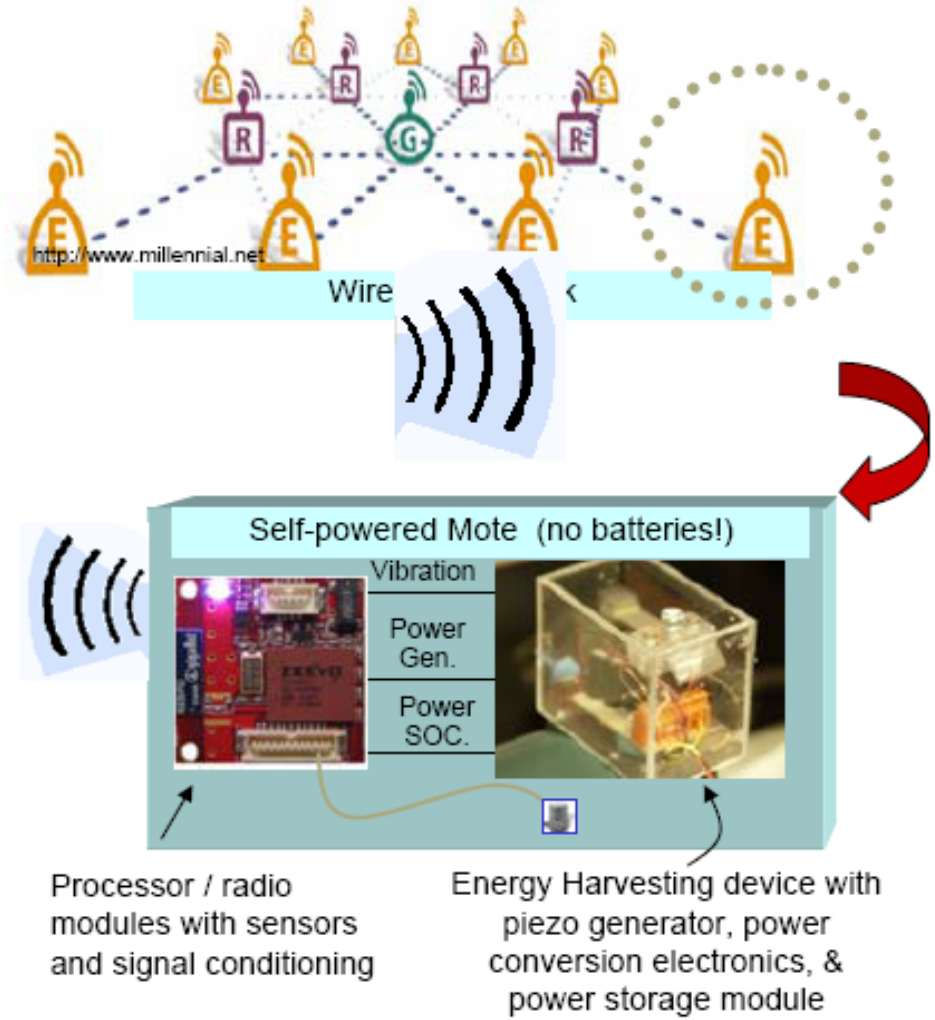
Wireless Sensors

Wireless I/O



Future Of Wireless: Self-powered Wireless Sensors

- Low-power radio
- Energy harvesting technology
  - Sample & record machine vibration, energy generated, etc.
  - Log data to a central "mote" connected to a Palm.



Self-powered, wireless sensors and sensor networks for production metrics, machine health monitoring and remote asset monitoring

Key Considerations for Deploying Wireless in Industrial Automation

- Potential interference
  - Existing wireless, legacy radios, microwave ovens, cordless phones, emerging radios, process, fusion lighting
- Achieving proper coverage
  - Antennas / placement, reliable bandwidth, minimize radios, channel usage (3D), redundancy
- Environment compatibility
  - Indoor/outdoor, temperature, contaminants, wash-down
- Guaranteeing security
  - IEEE 802.11i, 802.1x, TKIP, AES, RADIUS
- Minimizing cost
  - Installation, power, communication, enclosures

Customer Value Propositions
Example: Package Sorting

- Lower cost (wiring)
- Ease of expansion
- Mobility

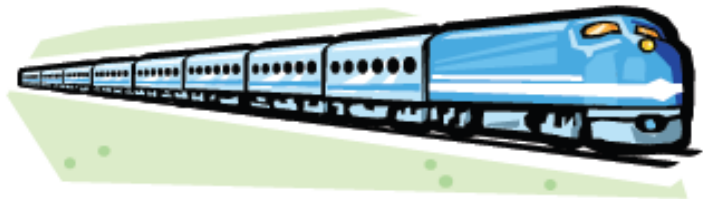
Is RFID Revolutionary?

Bar Code Technology

"Static"

Fixed amount of information

Deeply embedded in existing processes



RFID Technology

- Dynamic -- information can be added or deleted at every step in the supply chain
- Can store significantly more information

+

Process Transformation

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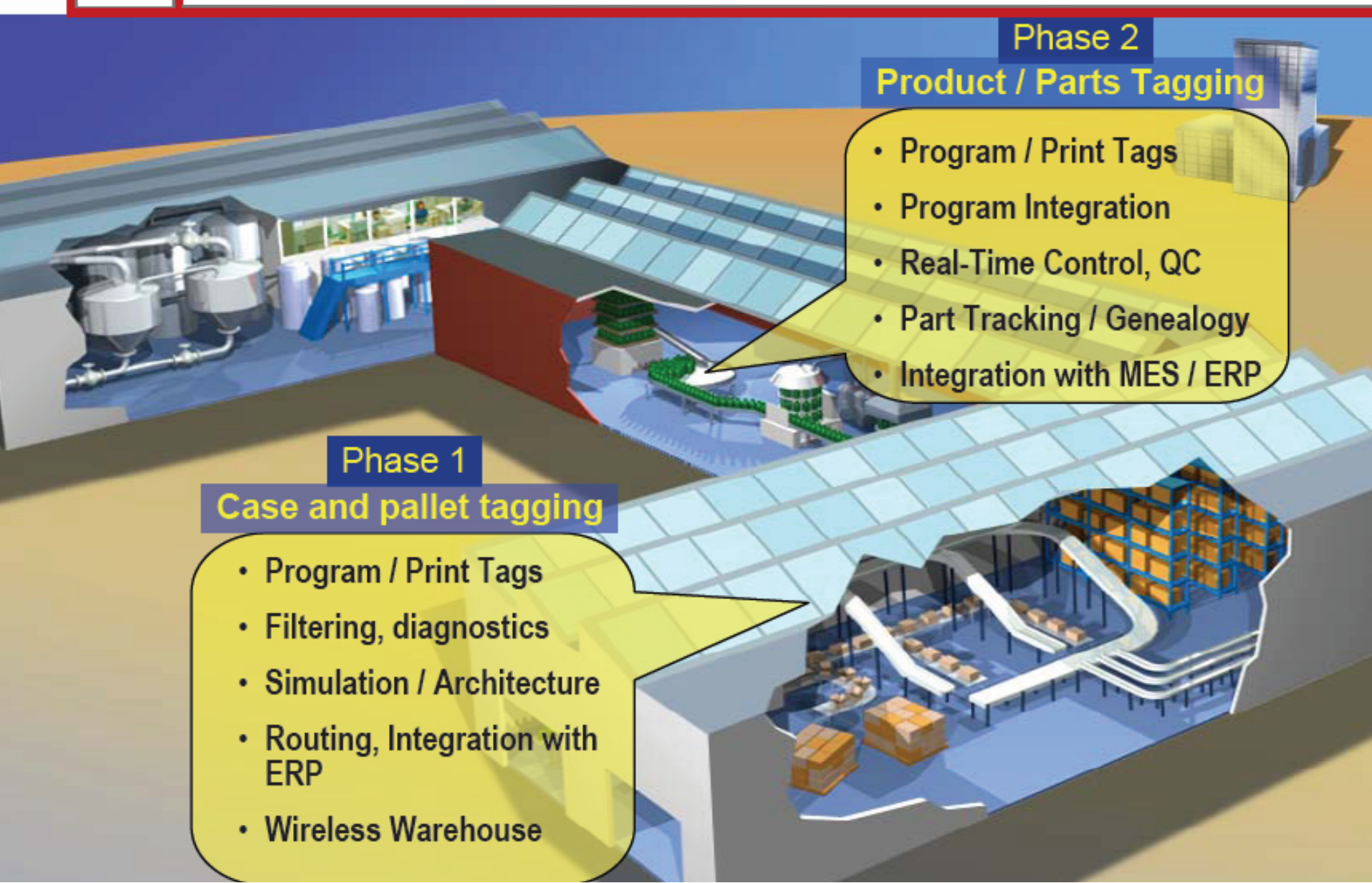
Revolutionary!

RFID For Track/Trace, Genealogy



RFID: Lessons Learned

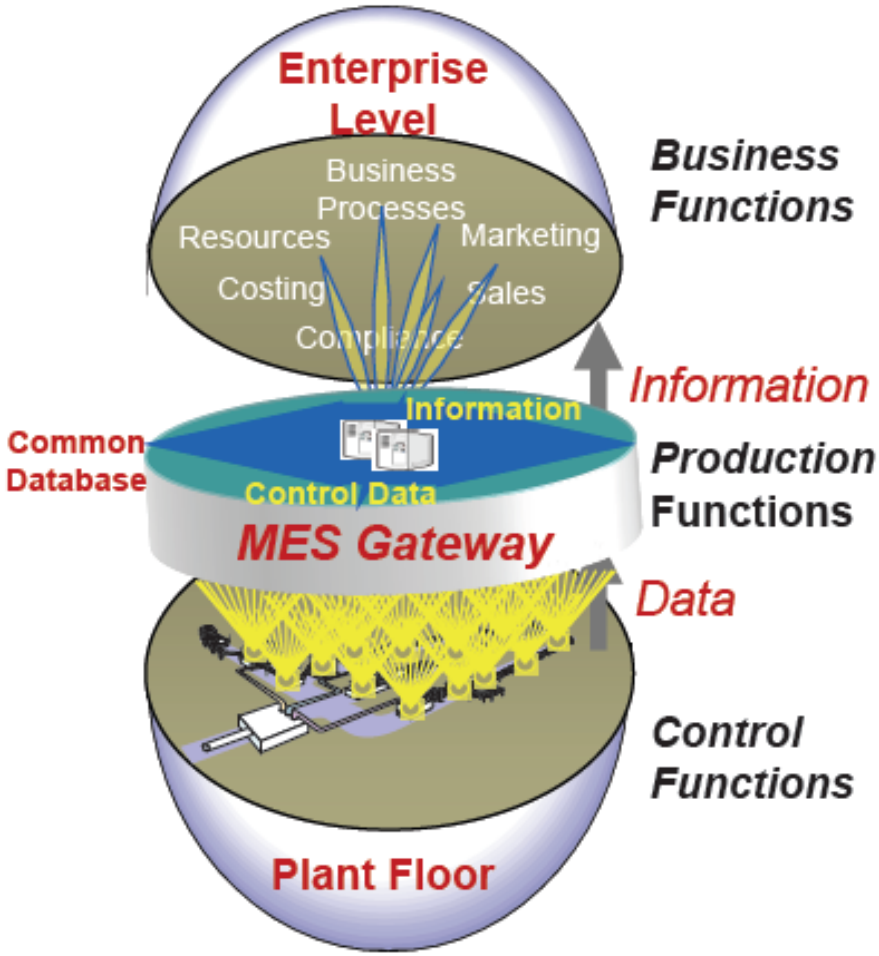
- Bar codes and RFID will co-exist
- Tag Application: product dependent
- Cost of software and services will be greater than the cost of tags / readers
- RFID reliability is product dependent
- ROI for manufacturers will be difficult … must look beyond distribution for significant process improvement / lean opportunities
- Imperative to leverage learnings from Walmart's Top 100
- Start small with a pilot … start early
- Expect continual evolution of standards: software interfaces, application standards

Customer Value Propositions

Example: Product, Case & Pallet Tagging

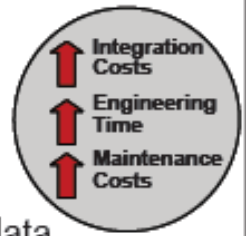
- Track / Trace
- Asset / Inventory Management
- Anti-counterfeiting

Information Architecture - *Customer Problems Today*



Customer Problems Today (Information Architecture):

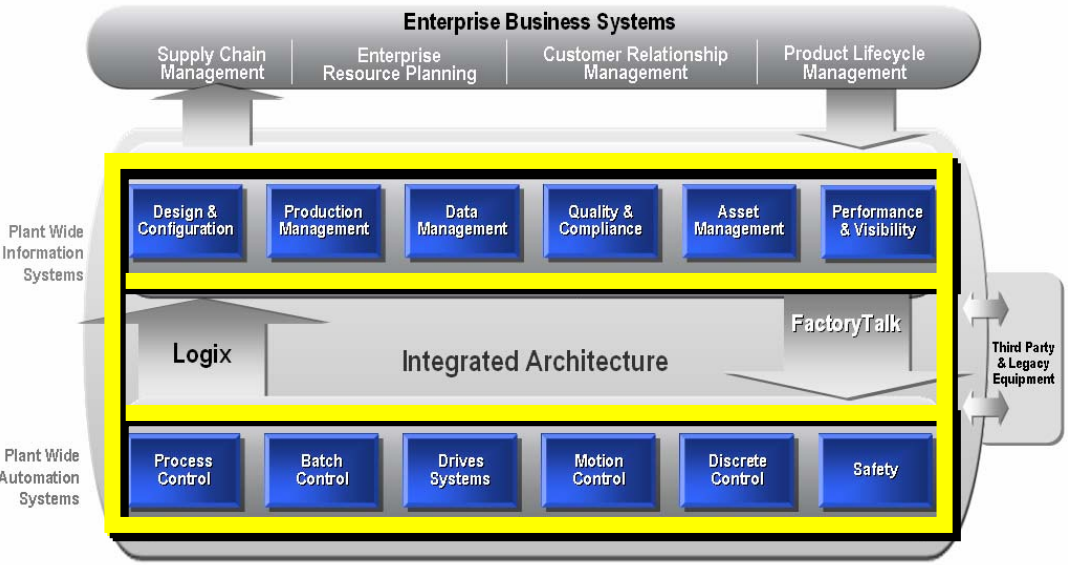
- **High cost**
  - Too many servers
  - Custom code
  - Upgrades difficult
  - Multiple copies of data



- **Difficult to Operate & Maintain** (training, personnel)
  - Too many custom interfaces
  - Lack of standards
- **Lack of Integrated Security**
  - Distributed (decoupled) security
  - No device level security

Integrated Architecture must ensure best in Class Interoperability … *Protect Our Customers' Investment*

Premier Integration



Faster Time to Market
Lower Integration Costs

Lowest Total Cost
Of Ownership

Performance Optimization
Regulatory Compliance

- **Integrated Architecture = Automation & Information**
  - Broadest Scope of Supply
  - Scalable/Modular Platform
  - Real Time Information
- **Plant Wide Information = FactoryTalk**
  - Multiple Production Disciplines
  - Scalable/Modular Platform
  - Automation Empowered
- **Plant Wide Control = Logix**
  - Multiple Control Disciplines
  - Scalable/Modular Platform
  - Information Enabled

Summary: Impact of Technology Trends On Manufacturing

- **Energy Efficient "Smart" Manufacturing**
  - Miniaturization and Sensor Integration (Smart Devices)
  - Self-Diagnostics and Maintenance
  - Distributed Control Systems
  - Health, Safety, and Environmentally Responsible Systems
  - Superconductivity and New Materials Technology
- **Flexible Automation**
  - Reconfigurable Control Systems
  - Simulation and Modeling
  - Machinery & Process Diagnostics & Prognostics
  - Augmented Reality and other human-computer interface innovations
  - Agent-Based, Autonomous Cooperative Systems
- **Integrated Manufacturing Systems**
  - Integration in 2 Dimensions: (1) Supply chain and enterprise (horizontal), and (2) shop floor to top floor (vertical)
  - Maintain Non-Stop Operations
  - Virtual Presence

Modern manufacturing systems have to become modular, adaptable, smart, and efficient