Minewide Convergence of Control and Information

Pat Murray
June 2010

LISTEN.
THINK.
SOLVE.®

AB Allen-Bradley · Rockwell Software

Rockwell Automation

Production Management Concerns

- Maintaining a Safe work Environment

- Lack of visibility and remote management

  - Troubleshooting and Autonomous Mining

- Maintaining process stability and efficiency

- Managing labour skill gap

- Reducing operating costs and TCO

- Managing the risk of displacing existing technology

- Complying with regulatory requirements

Innovation: IT Convergence

Methodology:

Reduce Cost of Ownership & IT support burden via:

- Integration of complementary applications
- Elimination of overlapping applications

Trends in IT Convergence:

- Standards-based app integration (i.e. ISA 88/95, OPC, etc)
- Consolidation of disparate data models and sources
- Business process workflow management

Current Technology

- Many custom applications developed over time
- Proprietary interfaces
- No overall view of Mfg landscape
- Labor-intensive report generation

Technology Evolution

Future: Enterprise & Manufacturing Integration

- Common data model
- Role-based information portals
- Dynamic reports – not static
- Centralized workflow mgmt

Cultural and Organizational Convergence

Security Policies	IT Network	Controls Network
Focus	Protecting Intellectual Property and Company Assets	24/7 Operations, High OEE
Priorities	Confidentiality Integrity Availability	Availability Integrity Confidentiality
Types of Data Traffic	Converged Network of Data, Voice and Video	Converged Network of Data, Control, Information, Safety and Motion
Access Control	Strict Network Authentication and Access Policies	Strict Physical Access Simple Network Device Access
Implications of a Device Failure	Continues to Operate	Could Stop Operation
Threat Protection	Shut Down Access to Detected Threat	Potentially Keep Operating with a Detected Threat
Upgrades	ASAP During Uptime	Scheduled During Downtime

Enterprise Systems

Enterprise Networks
- IT Domain
- Gigabit Backbones
- Self-Defending Networks

– *Ethernet to the Factory* –
- Network Management
- Switching
- Security
- Wireless
- Voice over IP
- Video
- Etc …

Network Convergence

Automation Networks
- Control Functionality / Real-Time Performance
- Safety
- Environmental / Form Factor
- Ease of Use
- Legacy Migration
- "IT Compatible"

– *EtherNet/IP* –

- Standard, Unmodified Ethernet

- Integrated Control AND Information

The Factory

Converged Minewide Ethernet Architectures

- Manufacturing reference architectures
- Common reference and common language for IT and manufacturing
- A set of tested and validated design and implementation best practices (Cisco Validated Design - CVD)
- Education Series
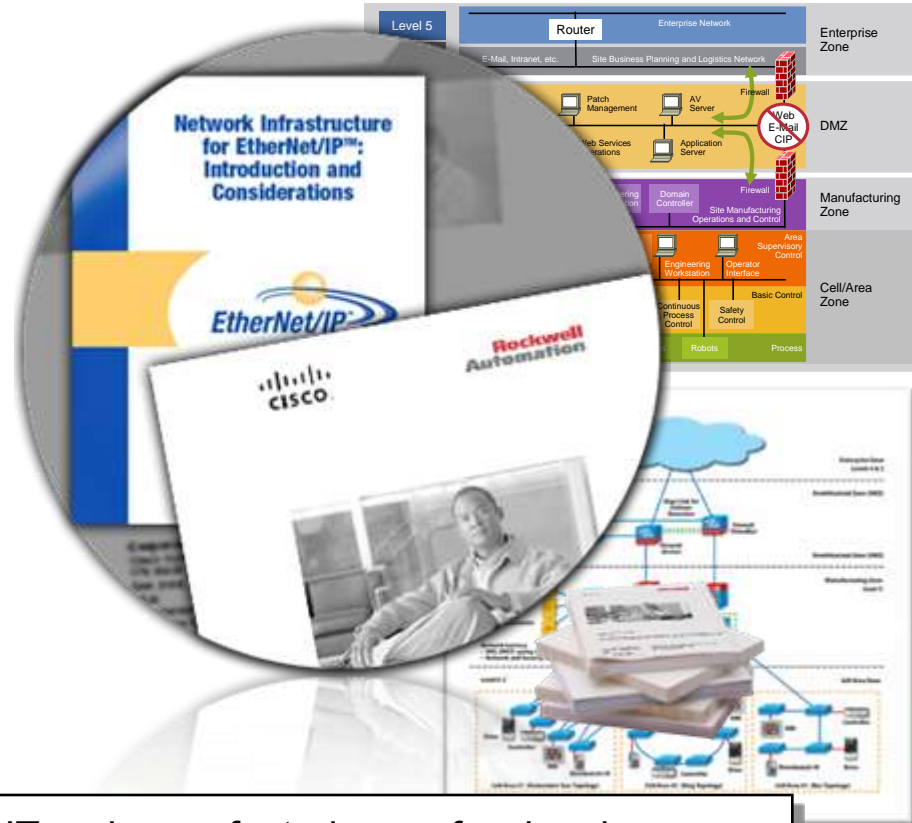
"With this implementation guide, for the first time IT and manufacturing professionals can share a common document for planning a converged IP network including the factory floor and automation equipment."

– Harry Forbes, ARC Advisory Group

Converged Minewide Ethernet Architectures

- Technology
  - IEEE 802.3 - standard Ethernet, Precision Time Protocol (PTP - 1588)
    - 802.11n – wireless (future)
  - IETF - standard Internet Protocol (IP)
  - ODVA - Common Industrial Protocol (CIP)
  - IEC – International Electrotechnical Commission
  - ISA-100 - wireless (future)
- Manufacturing
  - Purdue Reference Model for Control Hierarchy
  - ISA-95 - Enterprise-Control System Integration
  - ISA-99 - Manufacturing and Control Systems Security
  - NIST – National Institute of Standards and Technology

Built on Industry Standards

EtherNet/IP
A Single IT-friendly Network for Commercial and Industrial Applications
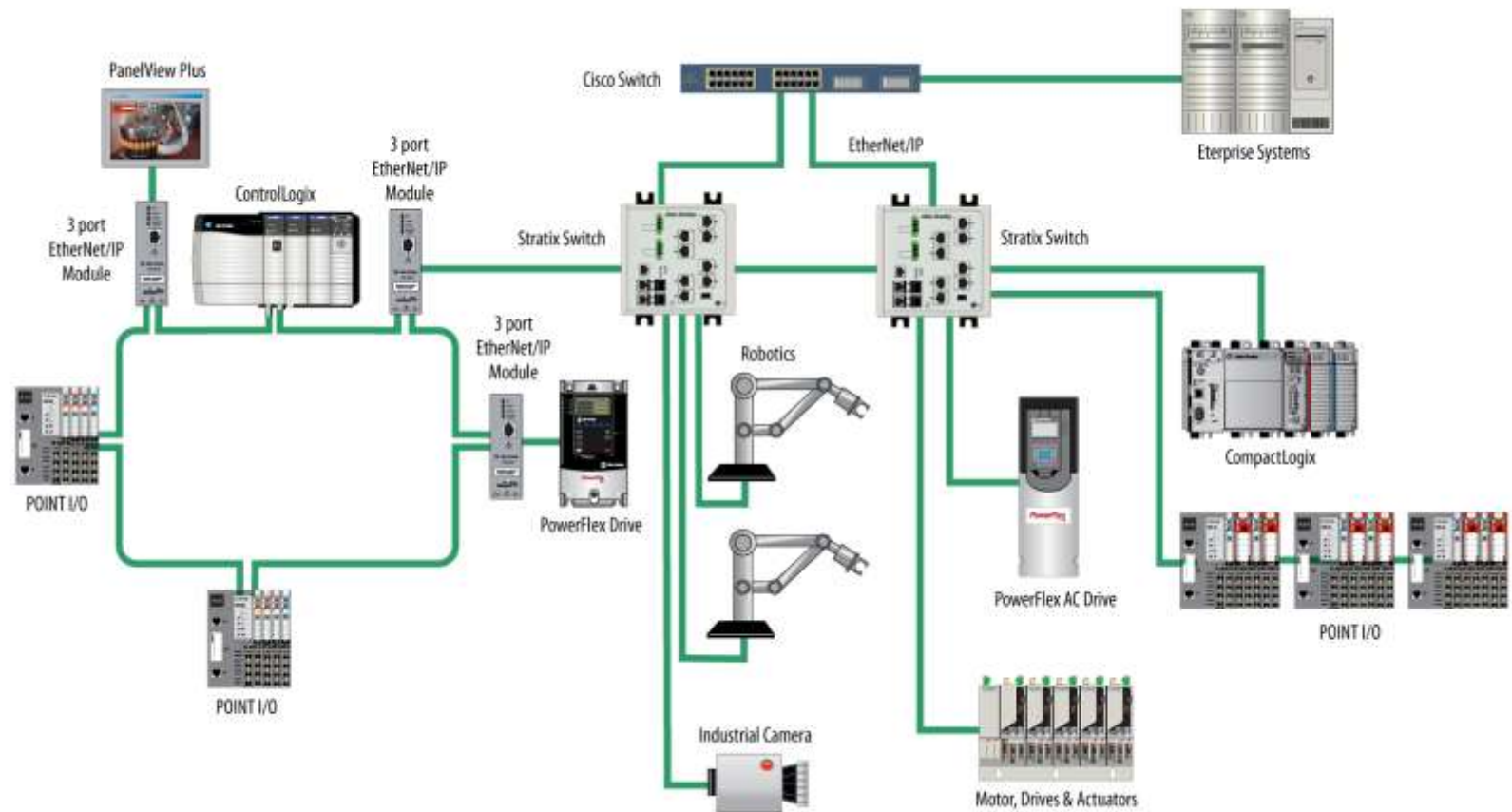
- Single version of Ethernet – the standard for IT and industrial applications
- Real-time access to power and control systems without hardware or software gateways
- The global standard adopted by leading automation vendors

Conceptual System design
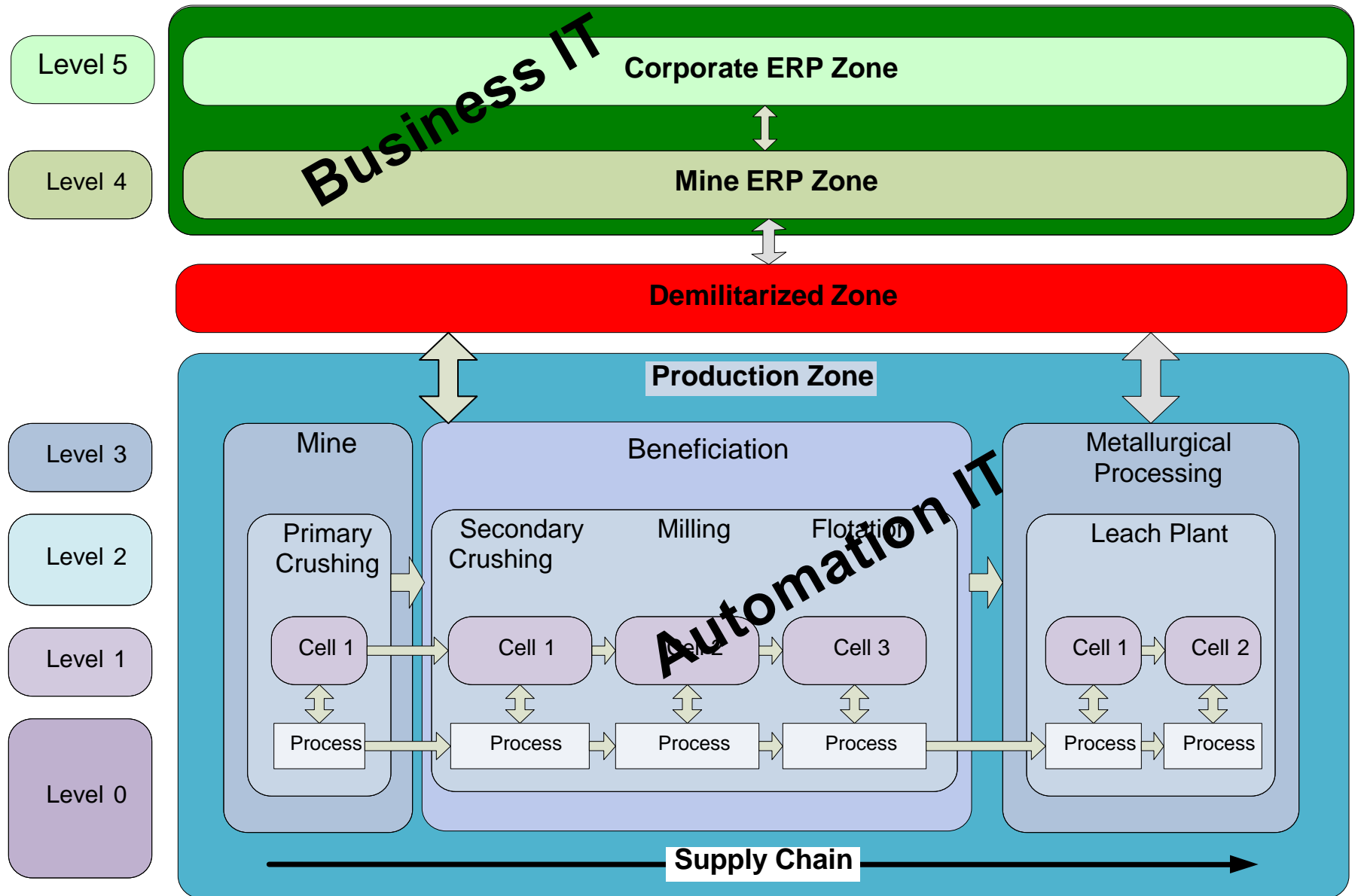
Standard Distributed System Architecture
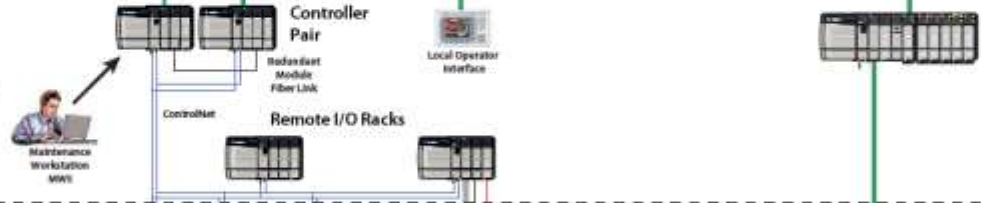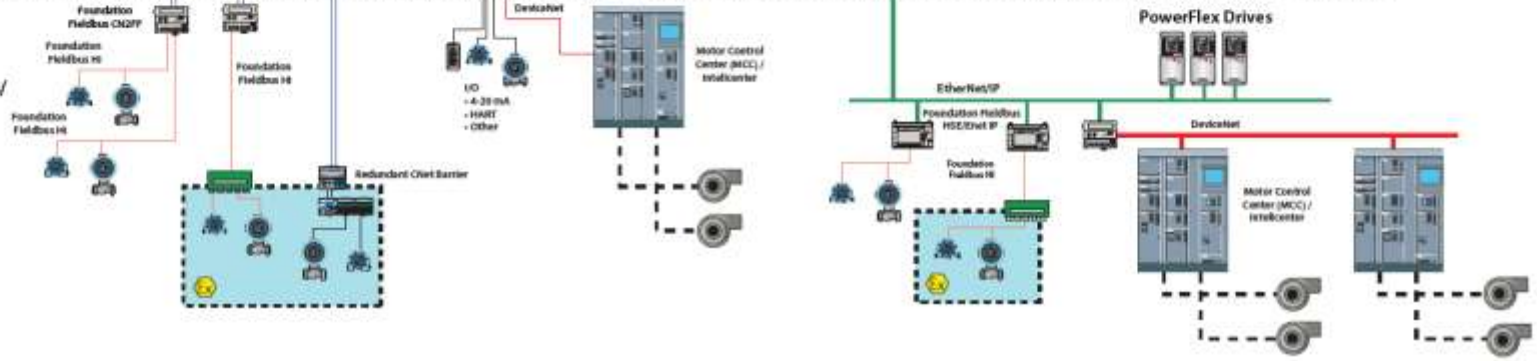
Networking Power Control to Leverage Information
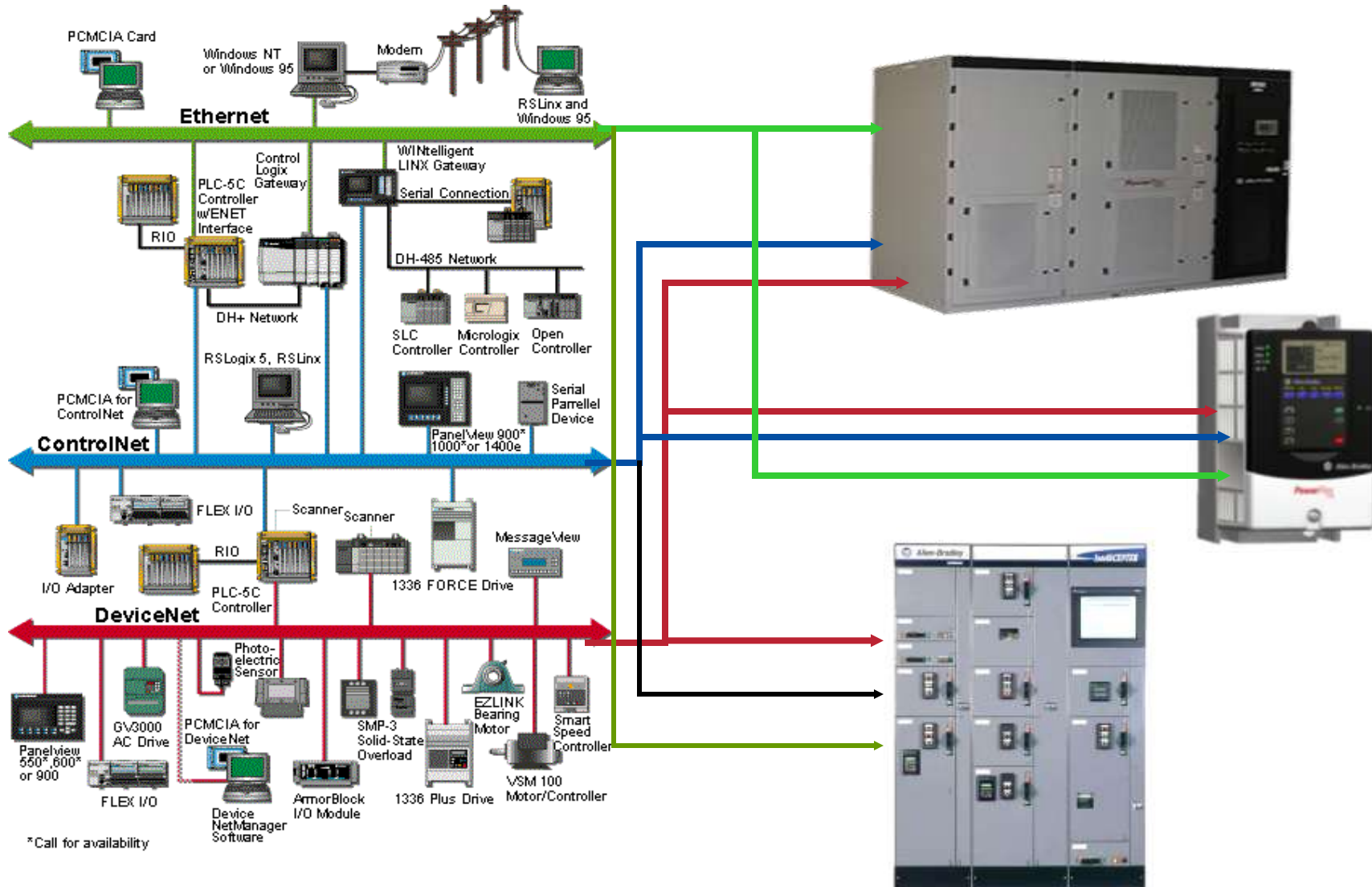
Converged Plantwide Ethernet Architectures

- Logical framework
- Industrial and IT network convergence
- Hierarchical segmentation
  - Scalability
  - Resiliency
  - Traffic management
  - Policy enforcement
- Security policies
  - Defense in depth
- Secure remote access

Industrial Control System
Secure Remote Access

Industrial Control System
Secure Remote Access

DMZ

SSL VPN

Manufacturing Zone

Cell/Area Zones

Industrial Control System
Secure Remote Access

DMZ

SSL VPN

Cisco Adaptive Security
Appliance (ASA) 5520 Firewall

Manufacturing Zone

FactoryTalk Application Servers
- View
- Historian
- Asset Centre
- Transaction Manager

FactoryTalk Services
- Directory
- Security/Audit

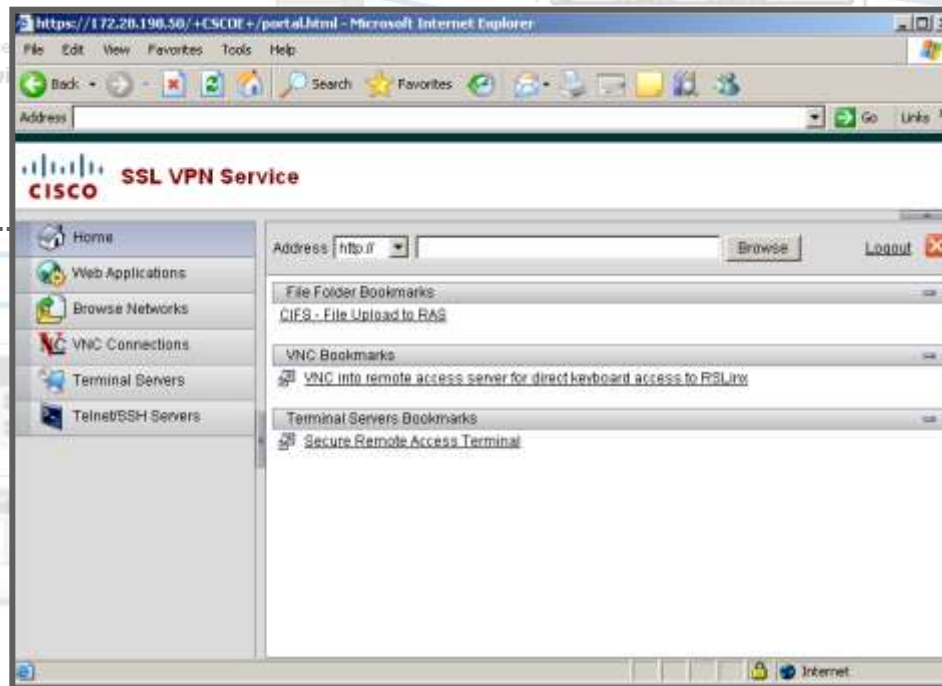Data Servers

Cisco 3750G
Stackwise Layer 3
Distribution Switch

Remote Access Server
- Terminal Server
- RSLogix 5000
- FactoryTalk View Studio
- RSLinx Classic / Enterprise

Cell/Area Zones

Stratix 8000
Rockwell Automation
IE Managed
Layer 2 Access Switch

ControlLogix
Rockwell Automation
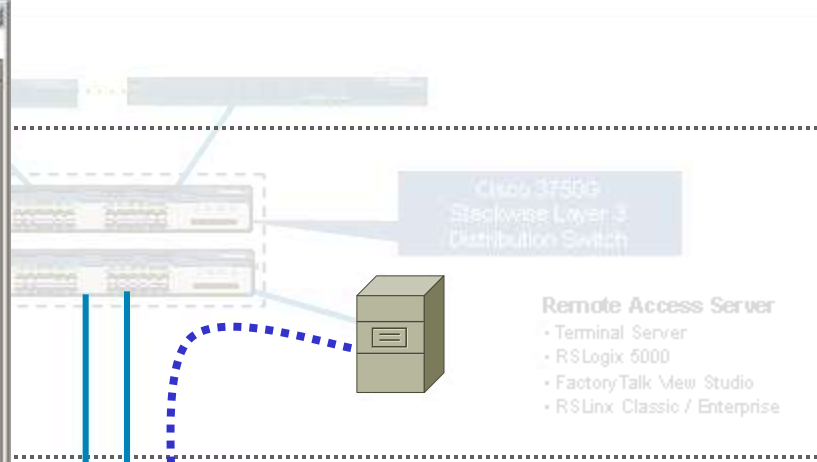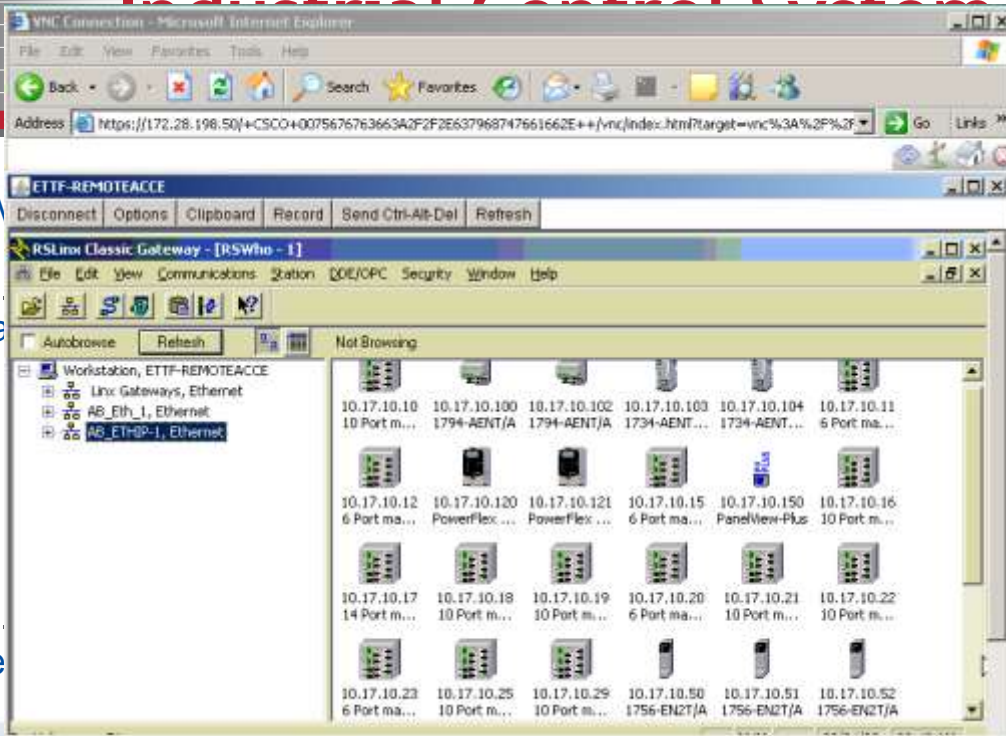Programmable
Automation Controller

EtherNet/IP

ICS Asset Protection
- Network Authorization
- Application Authorization
- Change management control
- Audit

https://172.20.198.50/+CSCOE+/portal.html - Microsoft Internet Explorer

File   Edit   View   Favorites   Tools   Help

Back • • •   Search   Favorites   •   •

Address   Go   Links »

CISCO   SSL VPN Service

- Home
- Web Applications
- Browse Networks
- VNC Connections
- Terminal Servers
- Telnet/SSH Servers

Address http://   Browse   Logout

File Folder Bookmarks
CIFS - File Upload to RAS

VNC Bookmarks
VNC into remote access server for direct keyboard access to RSLinx

Terminal Servers Bookmarks
Secure Remote Access Terminal

Internet

Industrial Control System

DM

Ma

Ce

Industrial Control System

DMZ

Manufacturing Zone

Cell/Area Zones

Remote Access Server
· Terminal Server
· RSLogix 5000
· FactoryTalk View Studio
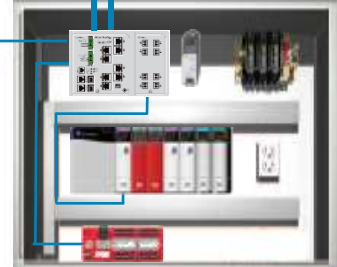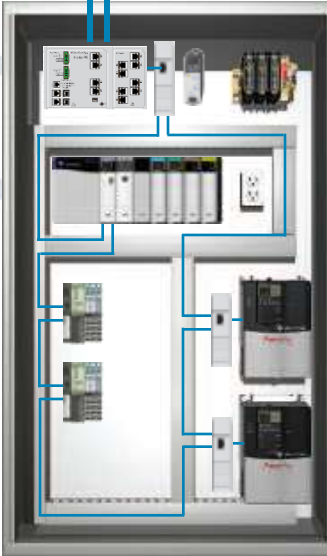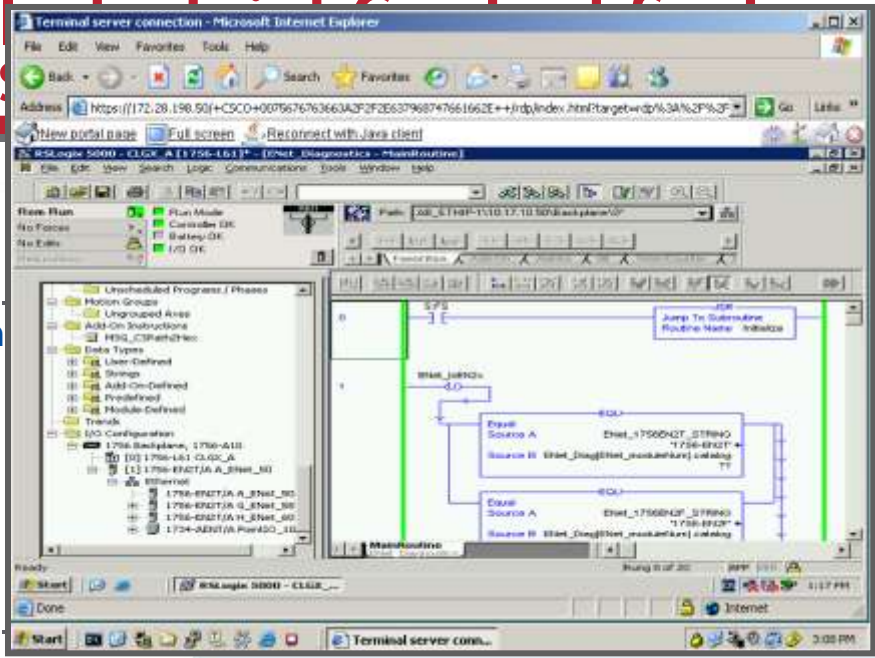· RSLinx Classic / Enterprise

Ring Topology

EtherNet/IP

Stratix 8000
Rockwell Automation
IE Managed
Layer 2 Access Switch

ControlLogix
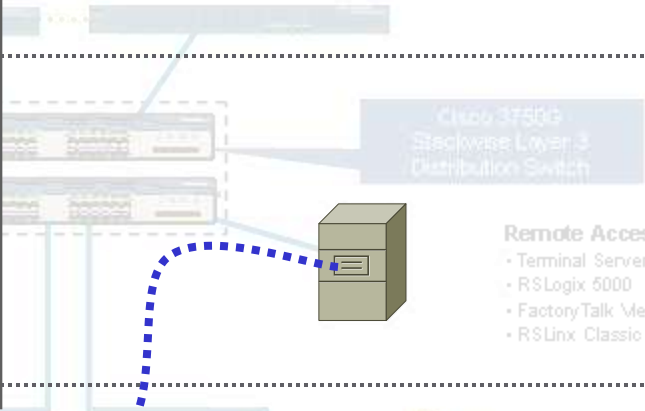Rockwell Automation
Programmable
Automation Controller

Cisco 3750G
Stackwise Layer 3
Distribution Switch

ICS Asset Protection
· Network Authorization
· Application Authorization
· Change management control
· Audit

Industrial Control System
Secure Remote Access

DMZ

Cisco Adaptive Security
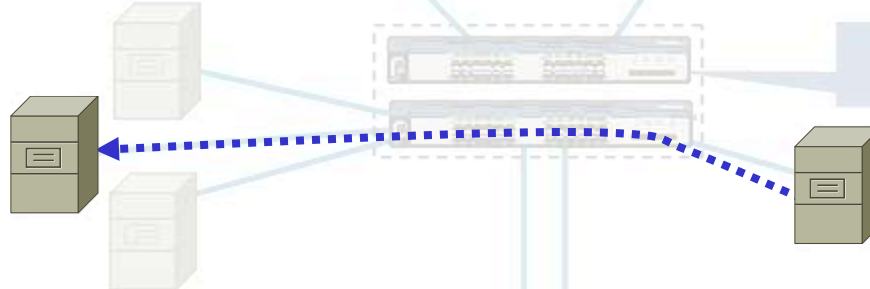Appliance (ASA) 5520 Firewall

Manufacturing
Zone

FactoryTalk Application Servers
- View
- Historian
- Asset Centre
- Transaction Manager

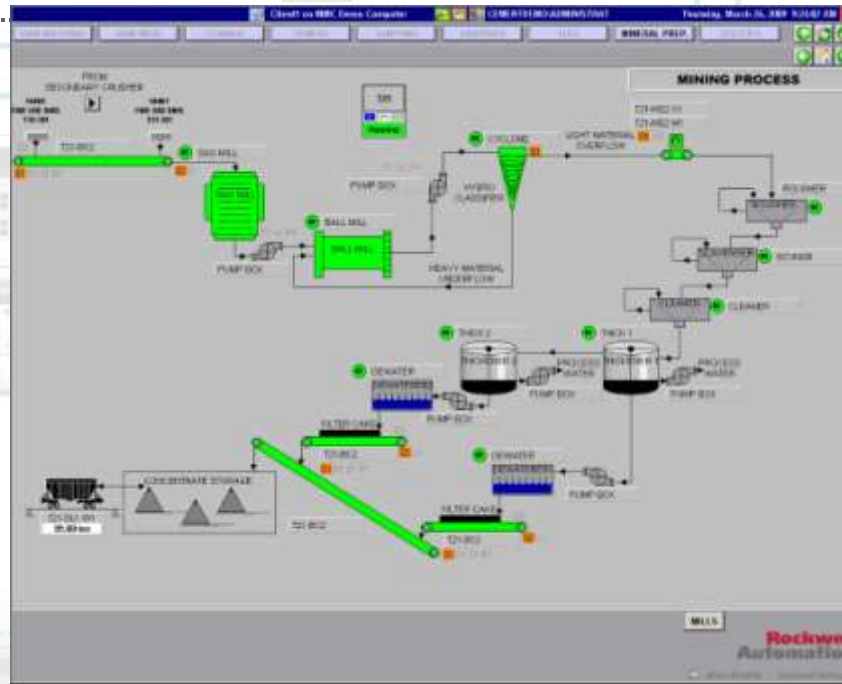**FactoryTalk Services Platform**
- Directory
- Security/Audit

Data Servers

Cisco 3750G
Stackwise Layer 3
Distribution Switch

Remote Access Server
- Terminal Server
- RSLogix 5000
- FactoryTalk View Studio
- RSLinx Classic / Enterprise

Cell/Area Zones

Stratix 8000
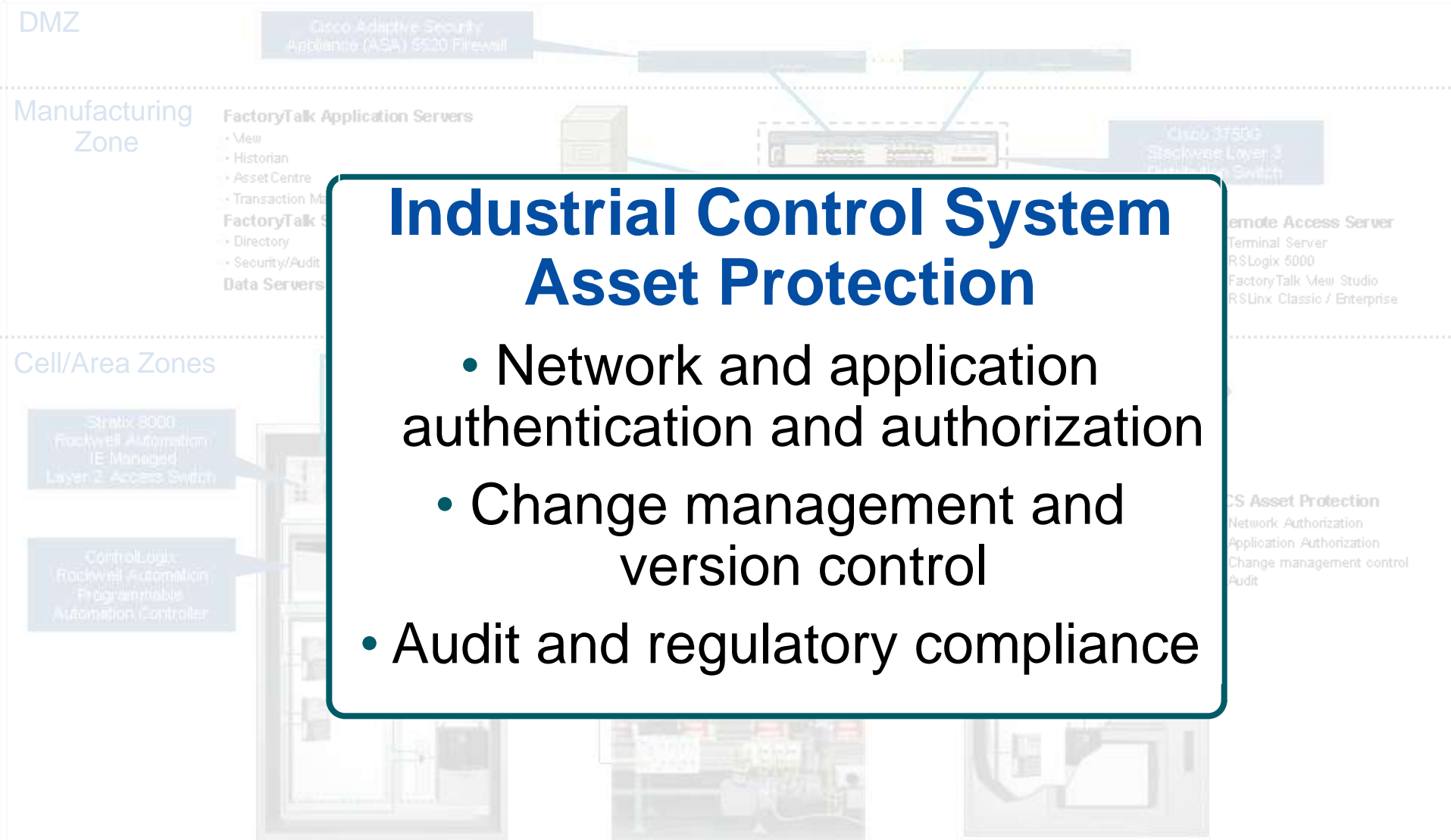Rockwell Automation
IE Managed
Layer 2 Access Switch

ControlLogix
Rockwell Automation
Programmable
Automation Controller

EtherNet/IP
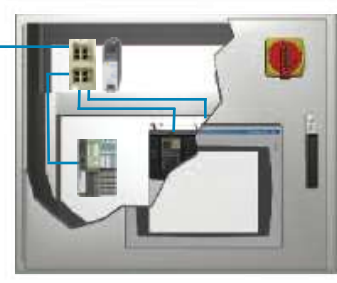
ICS Asset Protection
- Network Authorization
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Manufacturing Zone

FactoryTalk Application Servers
- View
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- Asset Centre
- Transaction Ma

FactoryTalk S
- Directory
- Security/Audit

Data Servers

Cell/Area Zones

Industrial Control System Asset Protection

- Network and application authentication and authorization
- Change management and version control
- Audit and regulatory compliance

Innovation: Asset Utilization

Methodology:

Increase utilization, yields and quality via:

- Capturing critical plant performance data
- Present dashboards showing critical KPIs
- Identify root causes & take corrective action

Trends in Asset Utilization:

- Role-based reports & dashboards via the web
- Integrate data from multiple disparate sources
- Real world references to data – not db tables/fields

Current Technology

- Plant performance KPIs stored to standard data model
- Role-based web reporting environment
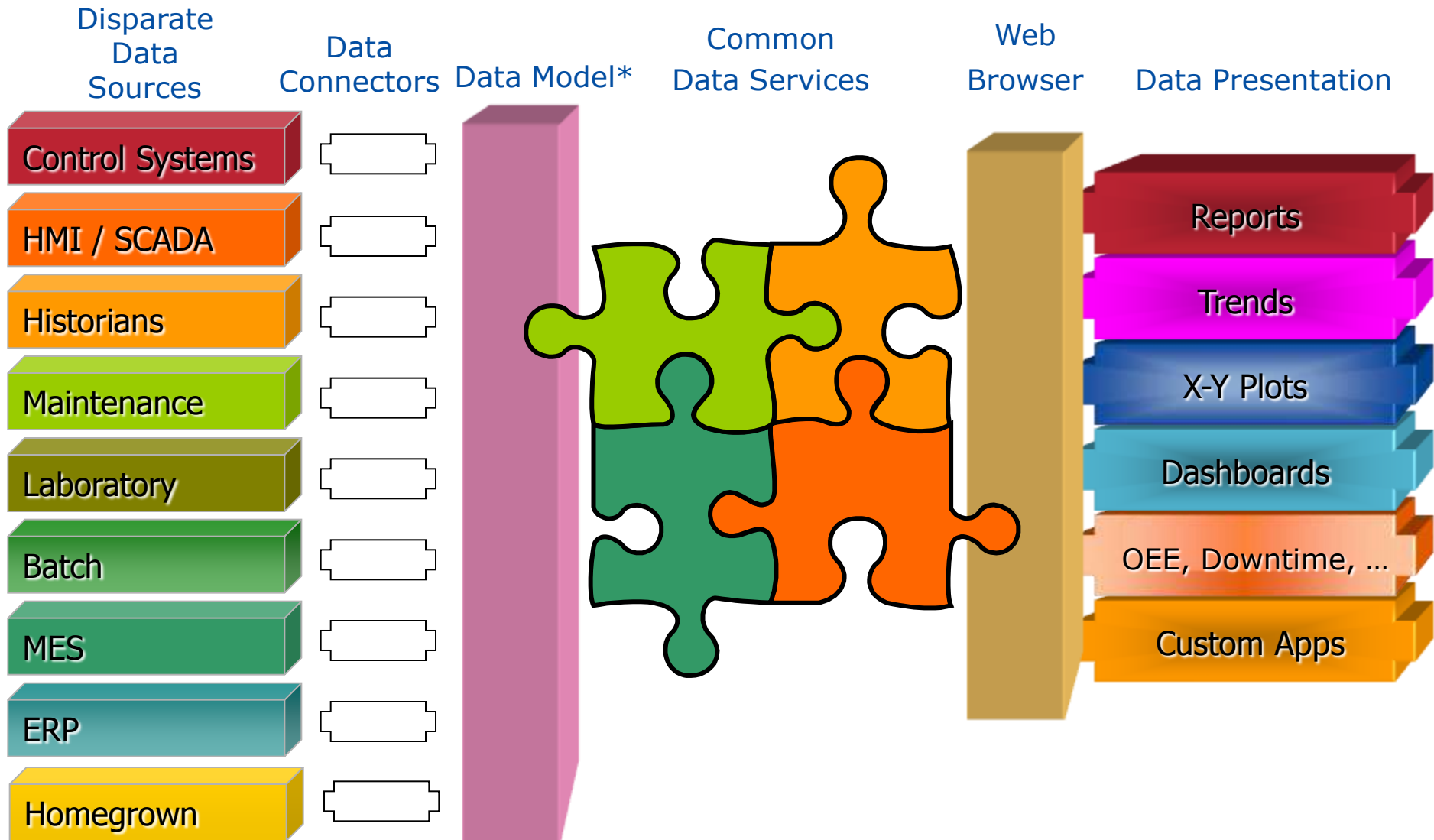- Drill-down reporting capability to identify root causes

Technology Evolution

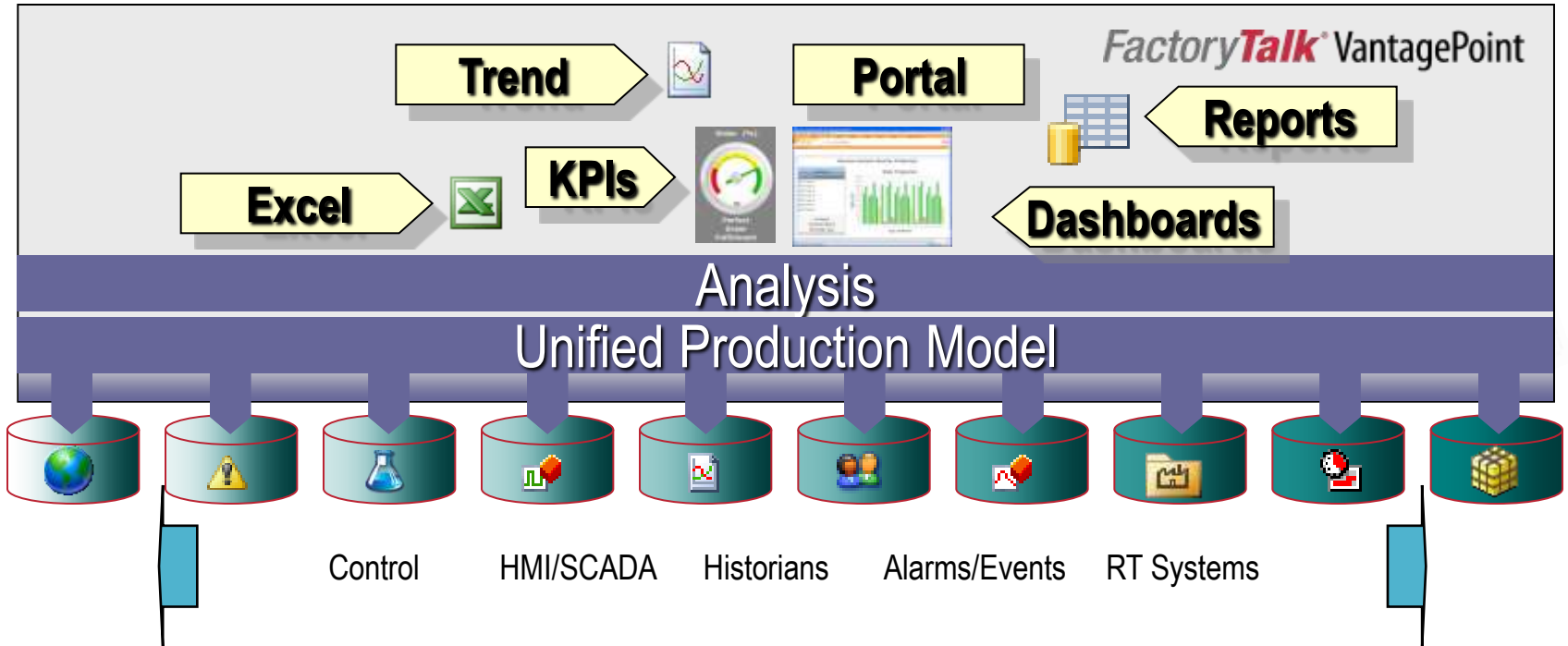## Future: *Manufacturing Intelligence*

- Federated data model to enable site-to-site comparisons/analytics
- Reports publishable across the Enterprise. i.e. MS SharePoint
- Integration of manufacturing data with business system data

FactoryTalk VantagePoint

Disparate Data Sources
- Control Systems
- HMI / SCADA
- Historians
- Maintenance
- Laboratory
- Batch
- MES
- ERP
- Homegrown

Data Connectors

Data Model*

Common Data Services

Web Browser

Data Presentation
- Reports
- Trends
- X-Y Plots
- Dashboards
- OEE, Downtime, …
- Custom Apps

*Data organized in a meaningful way

Unified Production Model (Common Data)

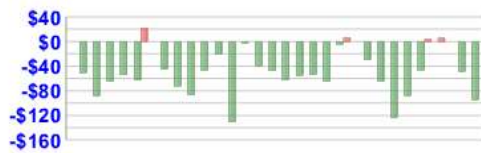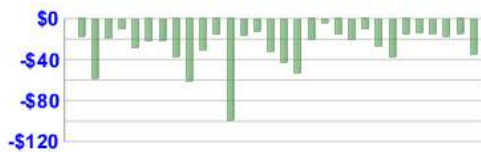# FTVantagePoint Dashboard

FTVantagePoint Dashboard -Energy

FTVantagePoint Dashboard - Energy Trending

Home   Reports   Tools   Help   Server Version 3.1.7105.0

FactoryTalk® VantagePoint EMI   Portal > Reports > **MyEnterprise**

Report Name: | KPI Dashboard | Refresh   ☐ Full Screen
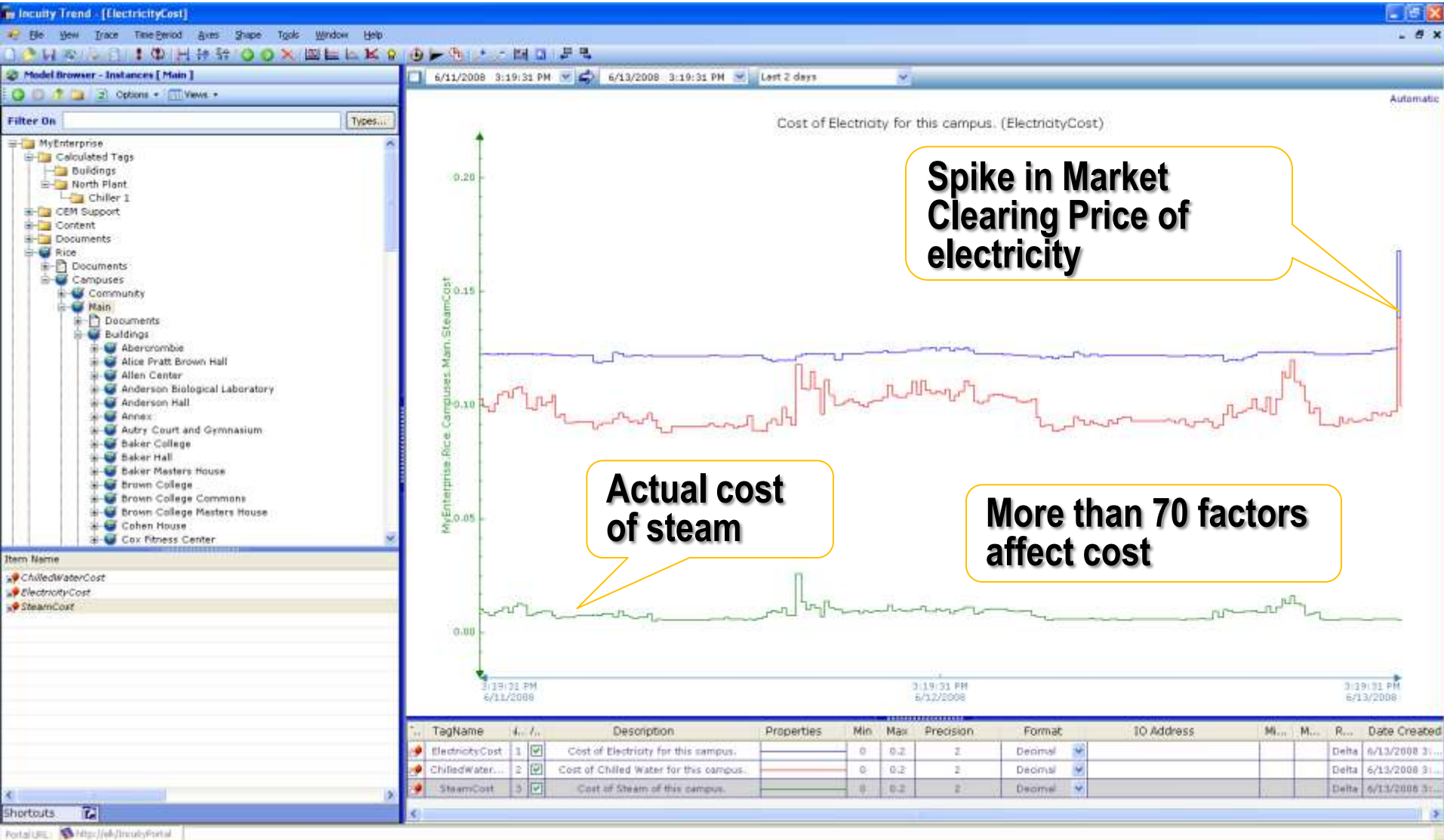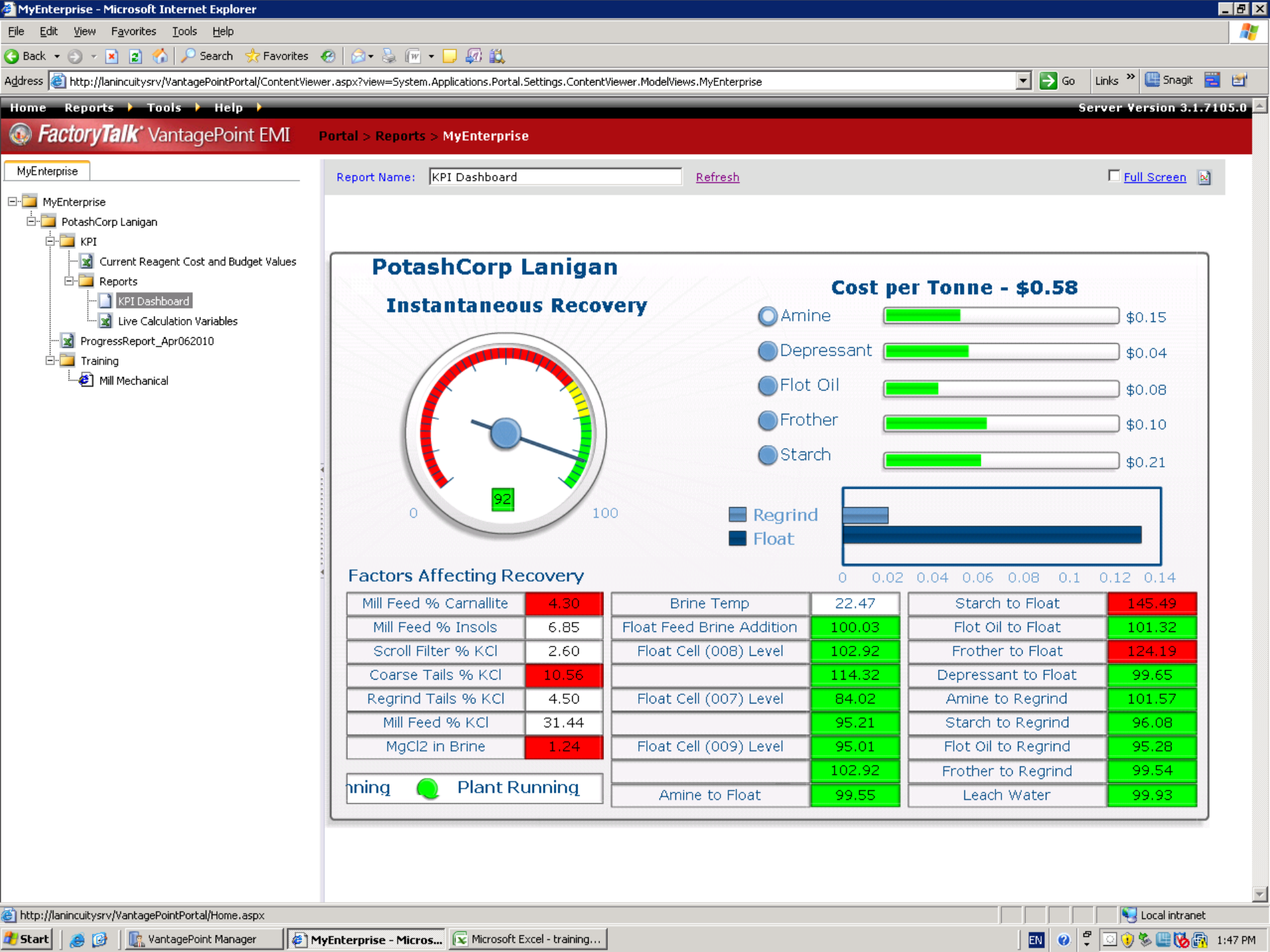
- MyEnterprise
  - PotashCorp Lanigan
    - KPI
      - Current Reagent Cost and Budget Values
      - Reports
        - KPI Dashboard
        - Live Calculation Variables
    - ProgressReport_Apr062010
    - Training
      - Mill Mechanical

PotashCorp Lanigan
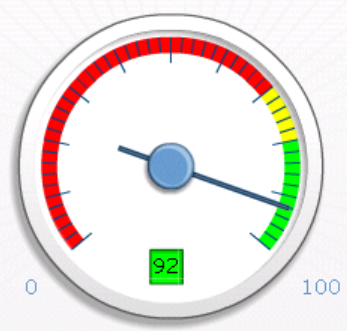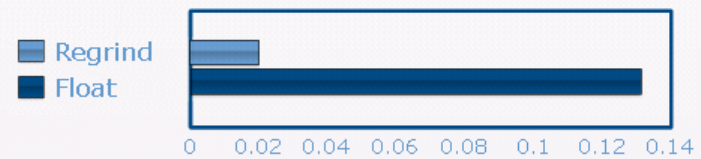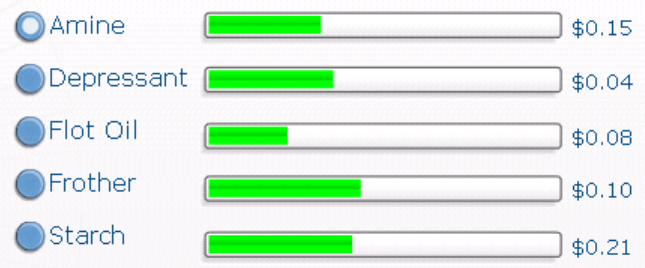
Instantaneous Recovery

92

0   100

Cost per Tonne - $0.58

Reagent		Cost
Amine		$0.15
Depressant		$0.04
Flot Oil		$0.08
Frother		$0.10
Starch		$0.21

Regrind
Float

0   0.02   0.04   0.06   0.08   0.1   0.12   0.14

Factors Affecting Recovery

Factor	Value	Factor	Value	Factor	Value
Mill Feed % Carnallite	4.30	Brine Temp	22.47	Starch to Float	145.49
Mill Feed % Insols	6.85	Float Feed Brine Addition	100.03	Flot Oil to Float	101.32
Scroll Filter % KCl	2.60	Float Cell (008) Level	102.92	Frother to Float	124.19
Coarse Tails % KCl	10.56		114.32	Depressant to Float	99.65
Regrind Tails % KCl	4.50	Float Cell (007) Level	84.02	Amine to Regrind	101.57
Mill Feed % KCl	31.44		95.21	Starch to Regrind	96.08
MgCl2 in Brine	1.24	Float Cell (009) Level	95.01	Flot Oil to Regrind	95.28
			102.92	Frother to Regrind	99.54
nning Plant Running		Amine to Float	99.55	Leach Water	99.93

FTVantagePoint Dashboard

Tabs to select the different summary reports

Actual vs Target graphs
(hovering over a specific
line shows values)

PotashCorp Lanigan

| | Current Date | 05/20/10 | 9:21:25 AM |
| | Report Date | 03/05/2010 | Select Date |

Mine Summary Report | Hoist Summary Report | Mill Summary Report

Tonnes Mined

Day Shift
Night Shift
Daily Summary

Daily Summary
Performance: 35,748
Comparative: 29,925

0 5,000 10,000 15,000 20,000 25,000 30,000 35,000 40,000

Total Borer Cutting Hours

Day Shift
Night Shift
Daily Summary

5 10 15 20 25 30 35 40 45 50

Mining Rate (TPH)

Day Shift
Night Shift
Daily Summary

1,000 1,200 1,400 1,600

MTD Tonnes (in 1000's)
Sample Sub Title

Mined
Hoisted
Milled
Product

0 20 40 60 80 100 120

Support Equipment Available

	Available	Owned
Water Trucks	2	2
Scoops	11	13
Rehab Machines	2	4
Production Bolters	8	8
Personnel Carriers	23	26
Ore Trucks	4	4
Forklifts	13	15
Construction Bolters	2	3

Safety Training and certification Matrix

Over View Training Status of Critical Items

As of December 31 / 2009	Payroll #	RE4 Emergency procedures	RE5 Hazard Identification	RE9 Lockout Procedure	RE18 Personal Protective Equip.	ME3 Forklift Truck	CONFSP0 Confined space	ME12 Genie Lifts	RAD0 Nuclear Gauges	HC Hearing Conservation	Safharn Fall Protection	GE23 Fire Extinguishers	GE8 Asbestos Handling	Core values	GE34 Safety Handbook	GE65 Harassment policy	EMPCOND1 Employee Conduct	GE21 WHIMIS	ENVAWARE	ARCFLSH1	RE17a Reagents general warning	GE19 Utility Knives	RE5a Hazard Recognition	ARCFLSH0
Lane Knorr	4600																							
Paul Sinclair	8162																							
Andrew Lucarelli	5178																							
Ron Roach	74302																							
Robert Lozinski	51458																							
Jim Benson	5603																							
Doug Engen	22806																							
Collin Haight	30973																							
Ian Jantz	40980																							
Terrill Johnson	42242																							
Russ Kachur	42598																							
Brian Leffler	49370																							

FTVantagePoint Dashboard – Safety Training

Overview Training Status of Critical Items

Mill Maintenance Mechanical / Site Services / Pipefitters / Welders / Boilermen

Legend:
- Yes (green)
- No (red)
- N/A (blue)
- Retraining required (orange)

FTVantagePoint Dashboard – Safety Training

The Risk Management solution offers pro-active safety and security services by utilising the intelligent network to automate disparate systems.

- **Worker Safety**
- **Automated Procedures**
- **Audit Trail**
- **Governance & Compliance**

Entry Points

Security Administration

Rules

Information on Alarm Decisions

Status Information

Systems Control & Security Rules

Zone Control

Support Area

Exit Points

Work Permits, Safety Training, Procedures etc..

Central Security Monitoring

CISCO
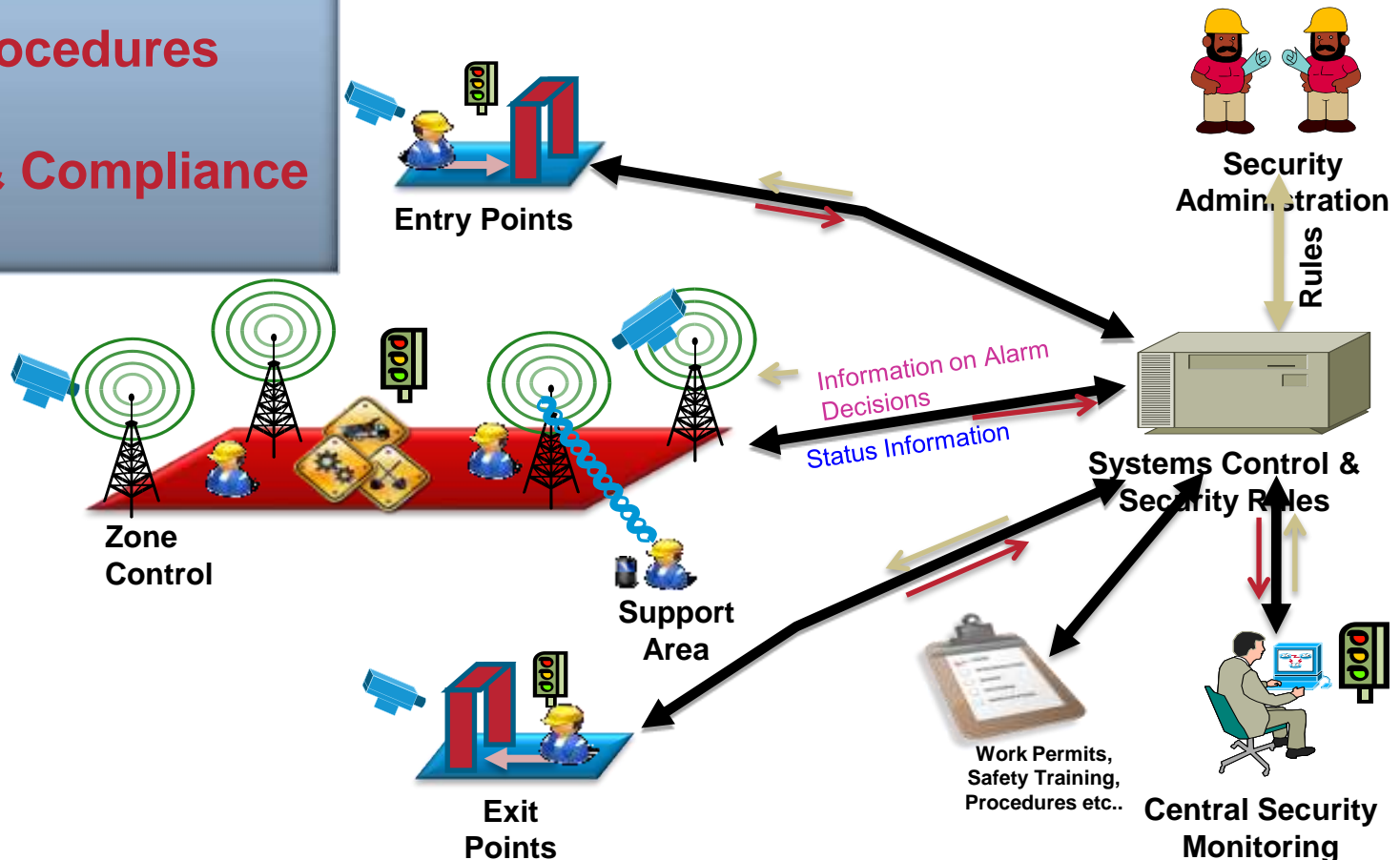
Market Challenges
Address Market Challenges with Convergence-Ready Solutions

Improve **PRODUCTIVITY** with better asset utilization and system performance
- Develop a standard set of engineering objects you can use across all of your applications
- Merg...
  make...
- Decr...
  integ...
- Take...

Promote **GLOBALIZATION** with easy access to actionable, plant-wide information
- Easily extract, share and use information across your enterprise and around the world directly

Cultivate **INNOVATION** with increased system flexibility and technical risk mitigation
- Invest less time in development so that you can spend more time creating new intellectual property

Support **SUSTAINABILITY** with extended product lifecycles and better asset utilization
- Reduce waste by specifying a system in a footprint that meets your needs
- Reduce energy costs with by eliminating the need to "over-design"
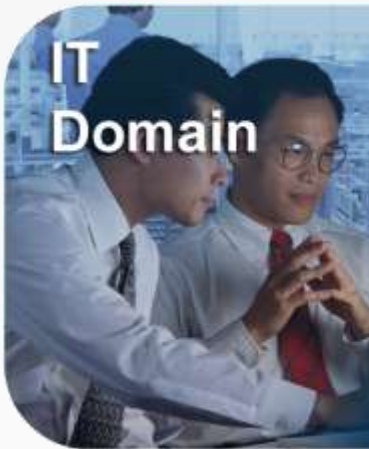- Streamline required assets and simultaneously reduce storage, energy costs, and waste materials

Real-Time Information
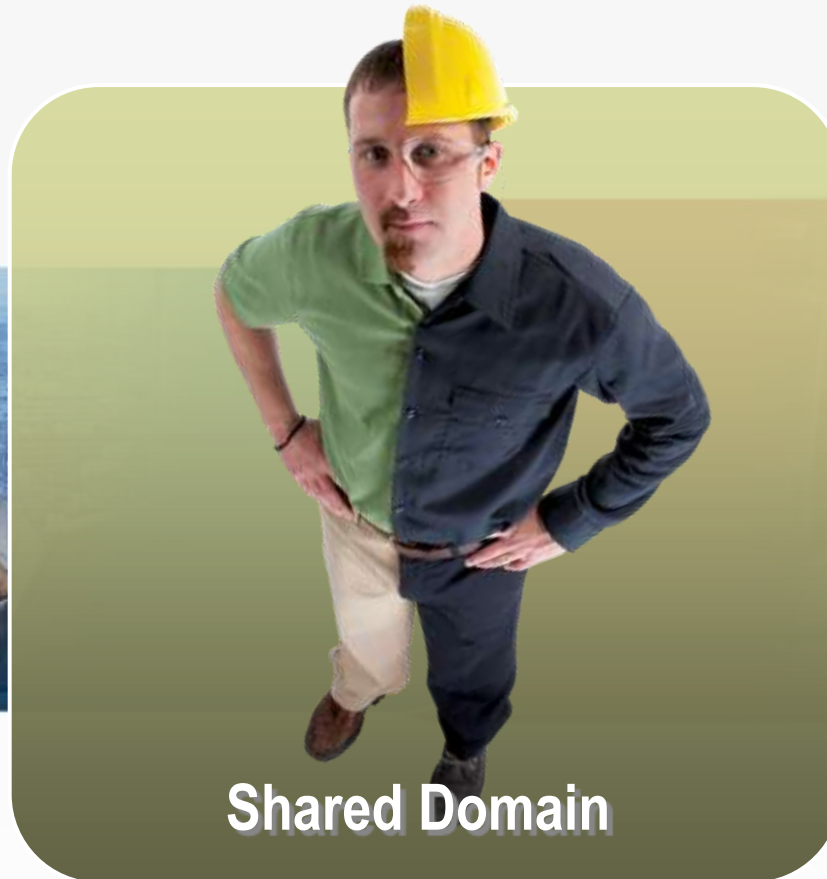## Actionable Information Shared by Your Control and Business Systems
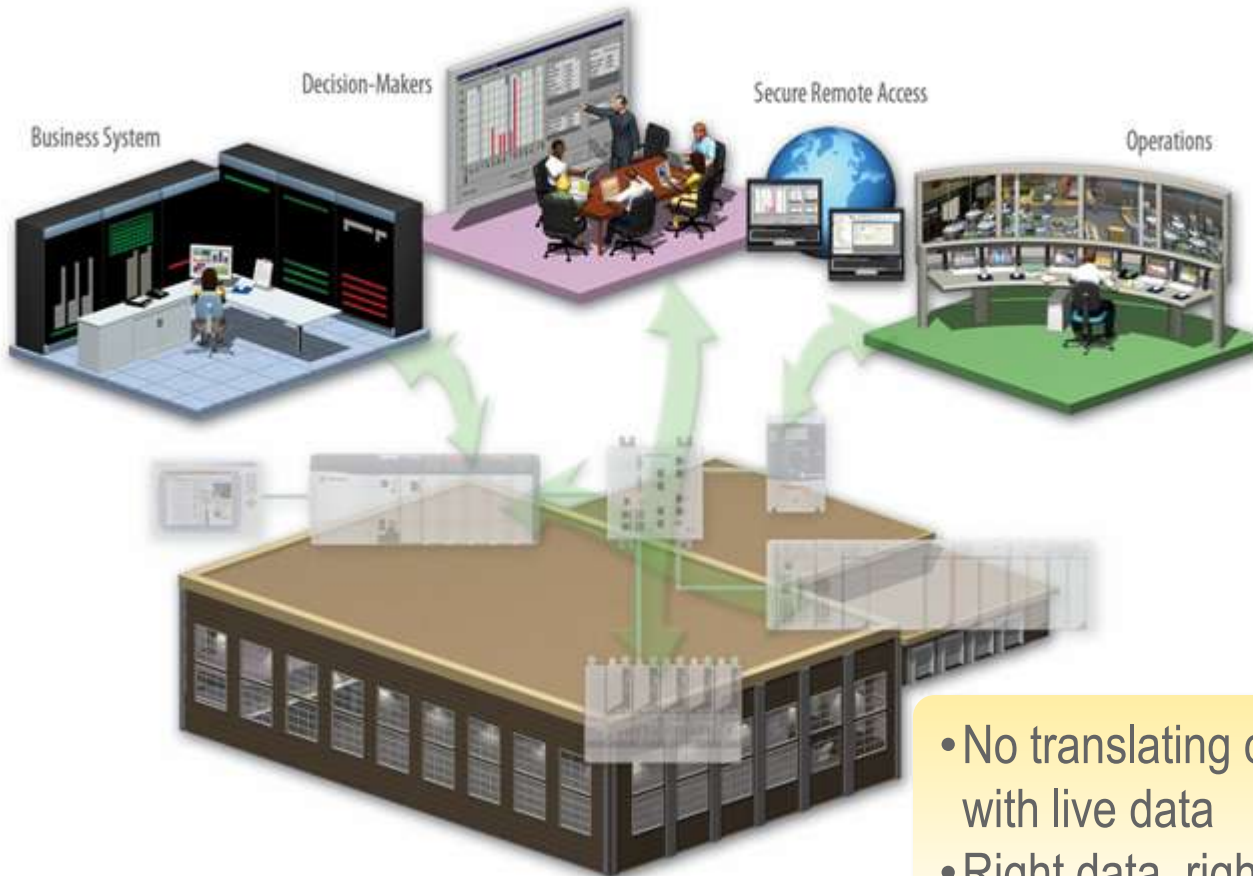
- No translating or duplication necessary with live data
- Right data, right place, right now
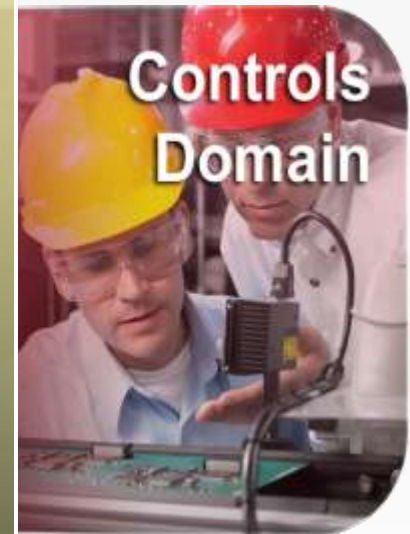- Improved accuracy and performance

IT Domain

Shared Domain

Controls Domain

PEOPLE   TECHNOLOGY   PROCESSES & INNOVATION

Minewide Convergence of Control and Information

Pat Murray
June 2010

Allen-Bradley · Rockwell Software

Rockwell Automation