Energy & Store Development Conference

E+SD 2013

FMI™

THE VOICE OF FOOD RETAIL

Energy & Store
Development Conference

E+SD 2013

The Evolution Of Energy Management Systems

Introduction

- **Electrical Engineer By Education**
  - **BSEE University of KY**
  - **MSEE University of MO**
- **30 Years Designing Electronic Controls**
  - **HW & SW Design**
  - **Boeing, Mark Andy Inc., Emerson**
- **17 Years Industry Experience (Emerson)**
  - **Engineering & Product Management**
- **Organizations**
  - **NAFEM, LONMark, NACS**

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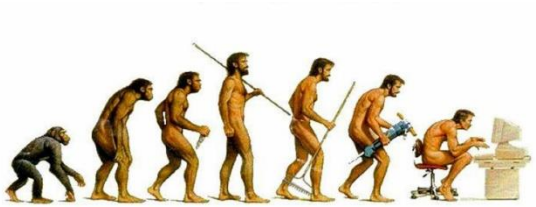
Discussion Topics

Islands Of Control → **Integration & Supervisory Functions** → **Getting Your Money's Worth** → **And Beyond: What's Next?**

Background & Evolution of Controls; The Transition To Electronics



How The EMS Came To Be & What It Does Today

Using All The Capabilities In State of the Art Systems

What's Driving Next Generation Systems Development

Definitions

Energy Management System (EMS)

Building Automation System (BAS)

Facility Management System (FMS)

- **Slight Differences In Meaning Across Industries**
- **Generally BAS Implies Broader Integration**
- **Refer To A Collection Of Hardware & Software To Monitor And Control The Mechanical, Electronic & Lighting Systems**
- **Installed At A Single Site**
- **For Our Purposes, These Are The Same Thing**

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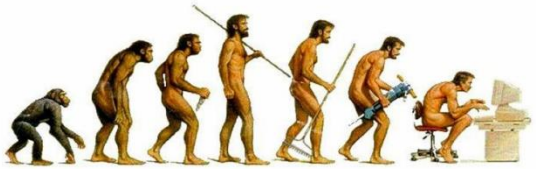

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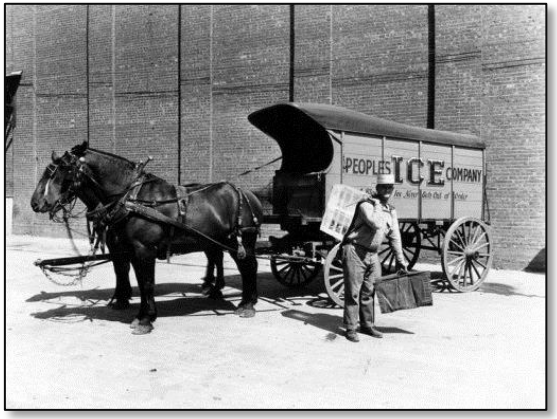
Early Refrigeration & HVAC Systems
Essence Of Simplicity!

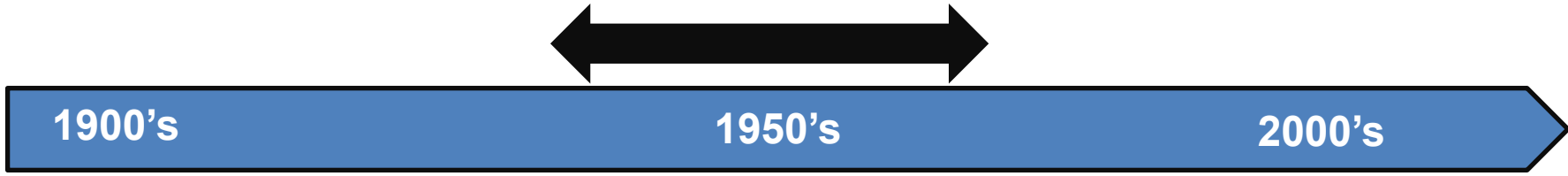


Things Were Simple Then!

1900's | 1940's-1970's | 1970's-1990's | 1990's-2010's

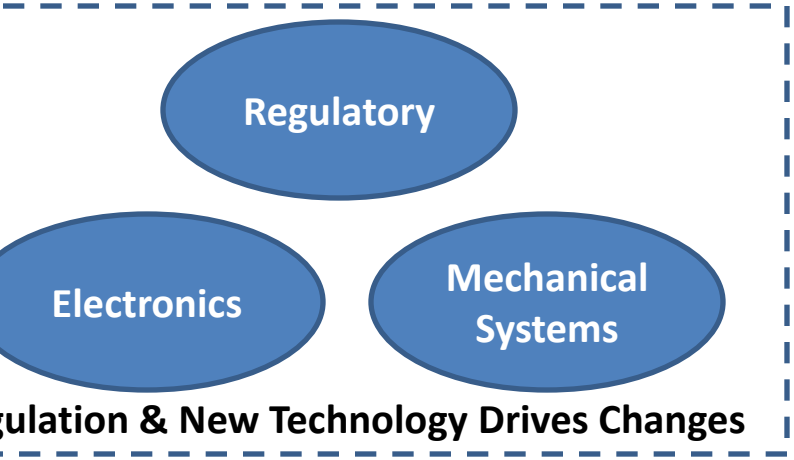
Systems Evolved With Emphasis On Mechanical Controls

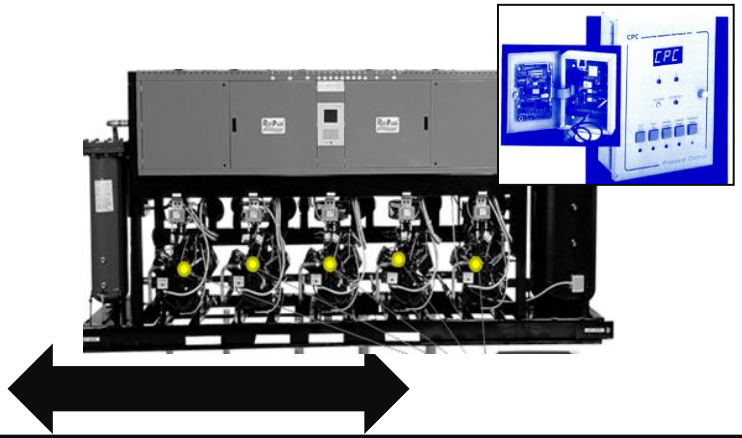
- **Early Refrigeration Systems Transitioned From "Refrigerators" To Rack Based Systems**
- **Typically Mechanical Control Systems Operating Independently**
  - **Defrost Time Clocks**
  - **Thermostats**
- **Adjustments Made Directly On Equipment**
- **Difficult to "Tune" Or Optimize**
- **No "Cross System" Integration Or Optimization**
- **Limited Temperature Monitoring**



Technology & Regulatory Concerns Drive Improvements In Systems And Better Control

- **Advances In Sensing Technology & Electronics Enable Cost Effective Electronic Controls**
- **Electronics Platforms Enable Improved Control & Optimizations For Energy And Maintenance**
- **Regulatory Drivers Force Energy & Refrigerant Considerations**
- **Case Temperature Monitoring For Food Safety & Compliance**





1900's 1950's 2000's

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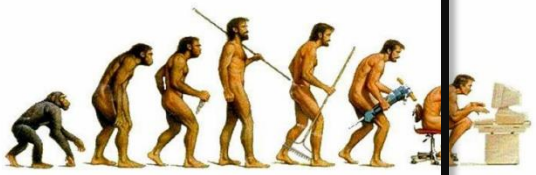


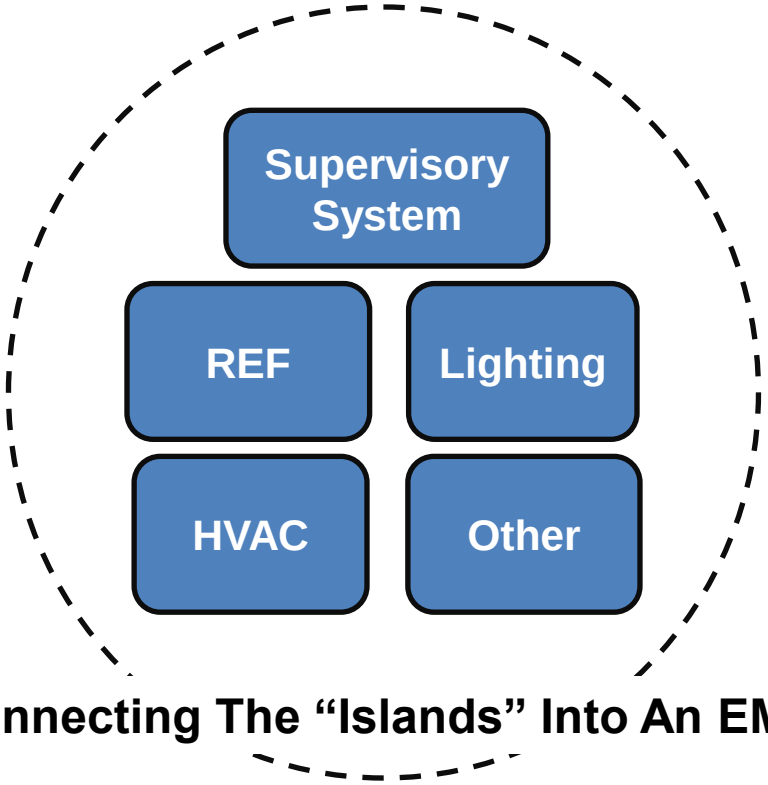
How The EMS Came To Be & What It Does Today

Using All The Capabilities In State of the Art Systems

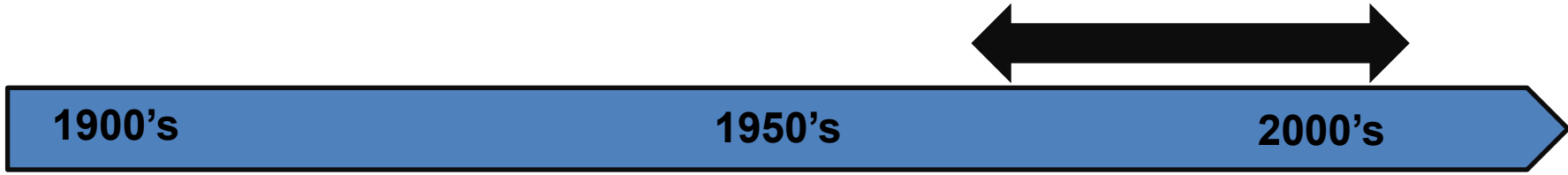
What's Driving Next Generation Systems Development

"Islands Of Control" Integrated To Form A Complete Energy Management System

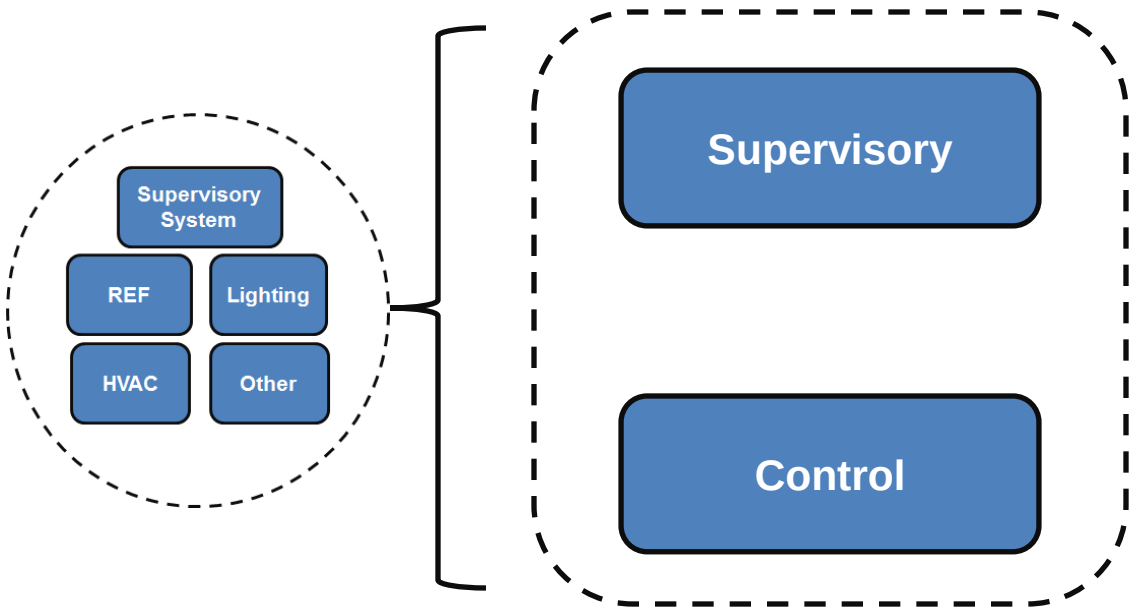
- **Individual Systems Tied Together**
- **Information Sharing Across Systems**
- **Emergence Of "Supervisory Functions"**
- **Integration /Control Advancements Similar To Auto Industry Evolution**
  - **Communication Technologies**
  - **More Sensors**
  - **Smarter Control**
  - **Use Data To Drive Actions**



Connecting The "Islands" Into An EMS



Layers And Functions Of An EMS



Hardware Can Be Combined Or Separated

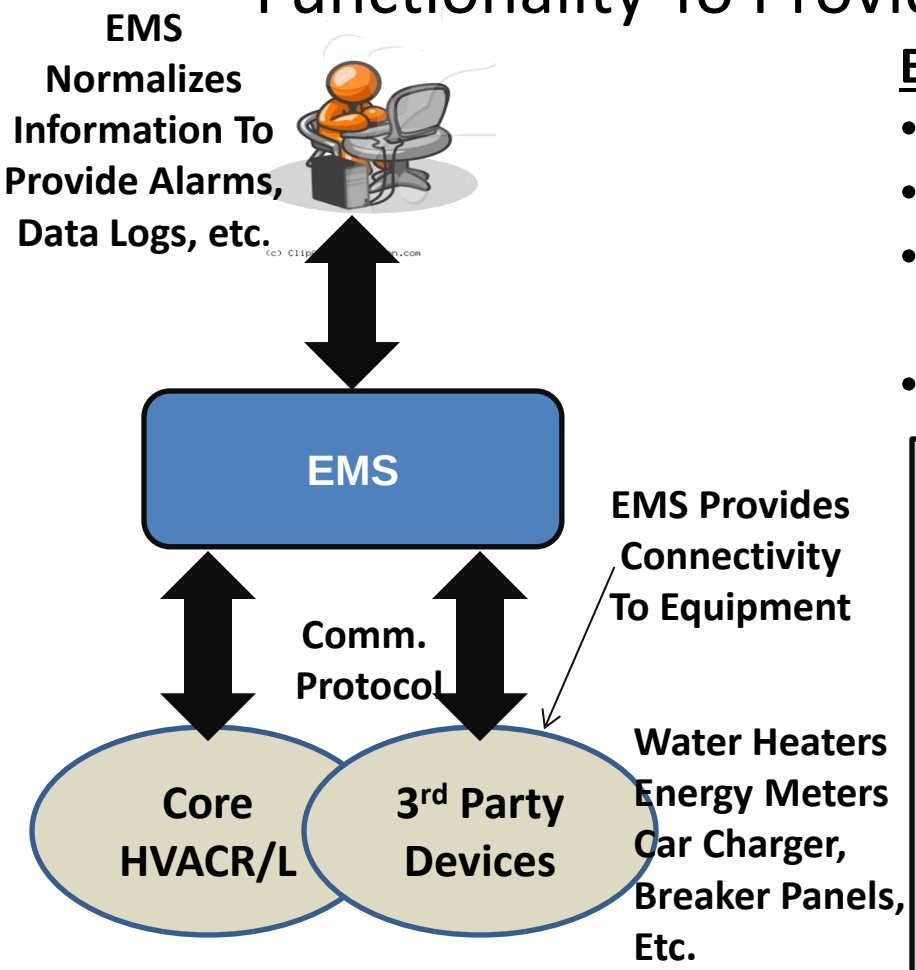
Key Elements

- **Remote User Interface**
- **Site Information**
- **Data Feed**

- **On Site User Interface**
- **User Management**
- **Data Logging**
- **Alarming**
- **Cross System Coordination**

- **Control Algorithms**
- **Inputs & Outputs**
- **Sensors & Transducers**
- **Equipment Interface**

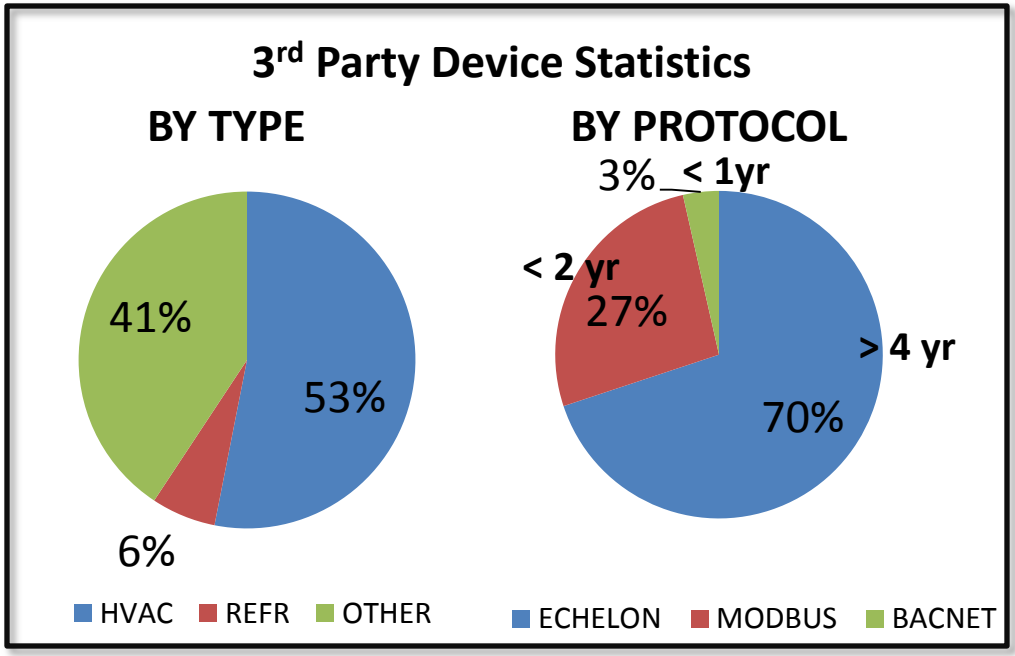
Integration Of "3rd Party" Equipment Leverages EMS Functionality To Provide Control & Information



Note: Statistics based on Emerson's E2 support (113 Devices)

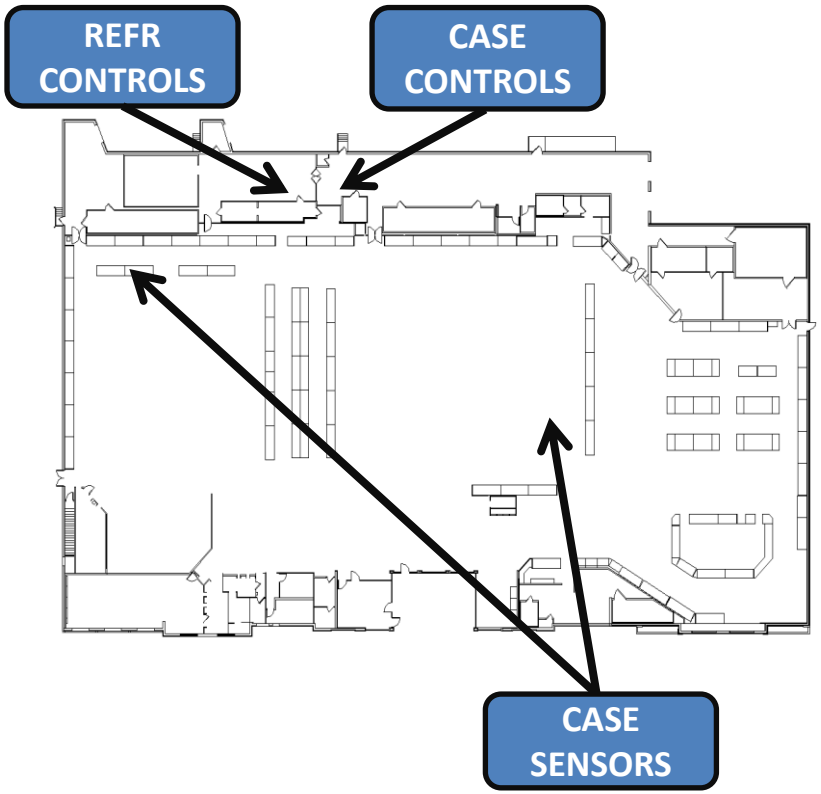
Benefits

- Common User Interface Across Site
- Remote Access
- Normalized Information (Alarms, Logs, etc.) Using EMS Infrastructure
- Operational Visibility



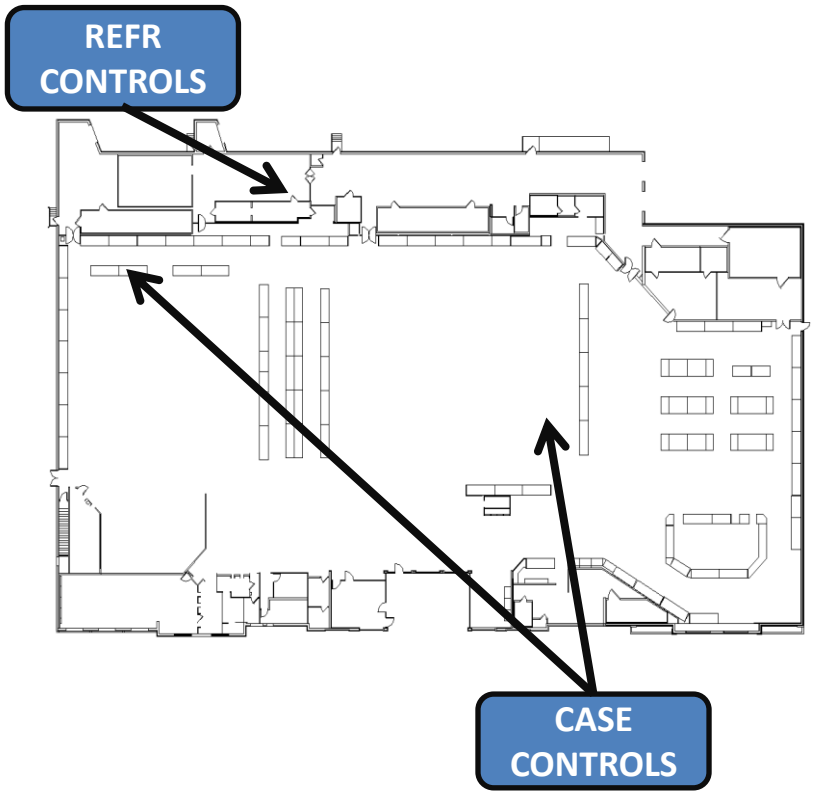
EMS Supports Different Control Architectures

Centralized Control Architecture



- Control Elements At Refrigeration Rack Or Electrical Panel
- "Home Runs" For Sensors

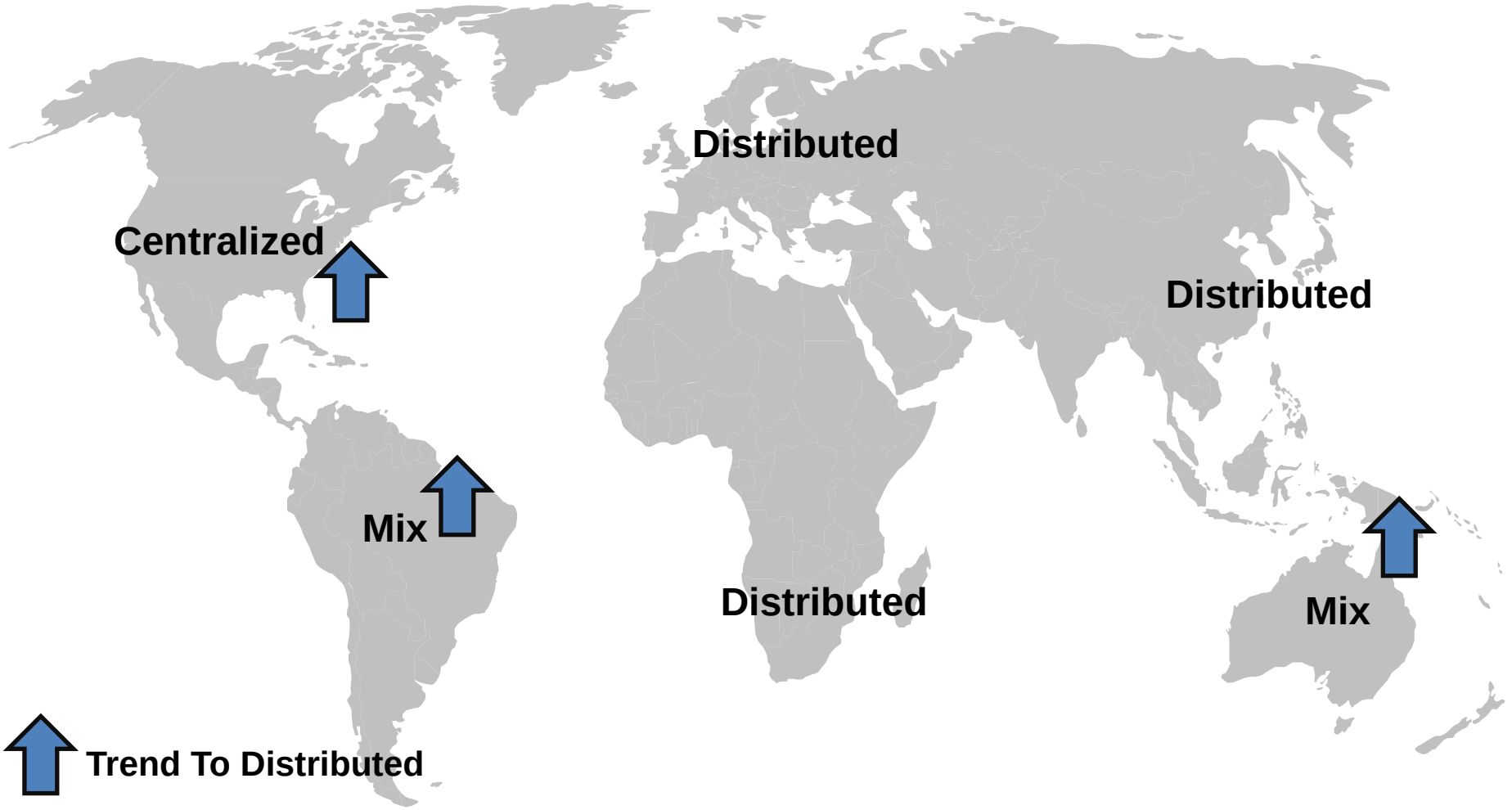
Distributed Control Architecture



- Control Elements At Case
- Communication "Daisy Chain" To EMS
- Load Control At Refrigeration Case

Installation Costs Similar Across Architectures

Predominant Control Architecture Varies By Region: CO2 Impacting Future



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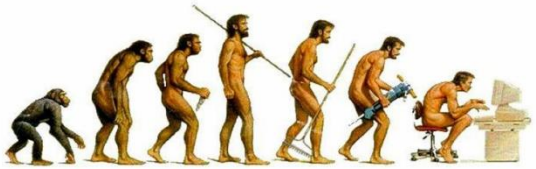


How The EMS Came To Be & What It Does Today

Using All The Capabilities In State of the Art Systems

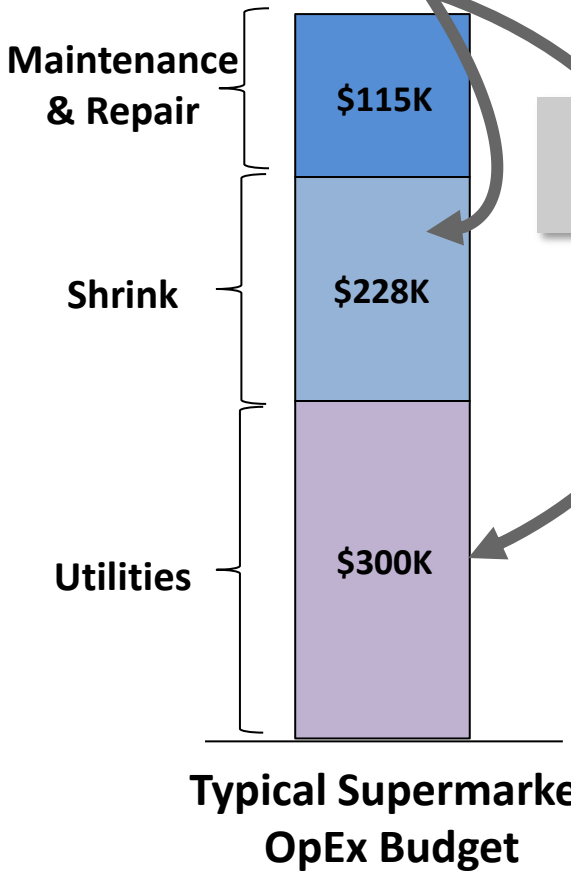
What's Driving Next Generation Systems Development

Energy Management & Maintenance Key To Operational Excellence And Profitability

Maintenance Practices

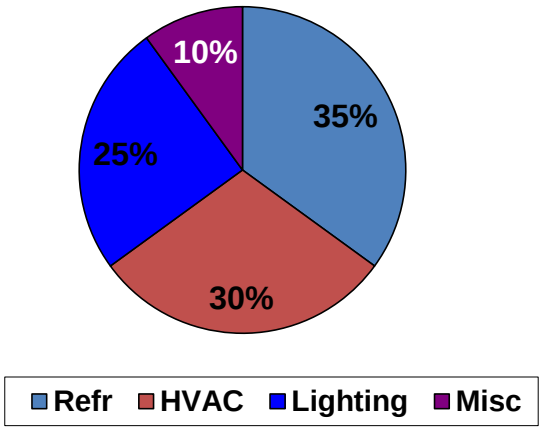
Directly Affect On Energy Usage & Food Loss

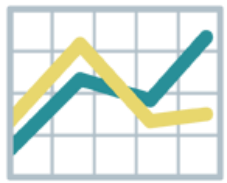
Impact Top Line Sales & Bottom Line Profit



Typical Supermarket OpEx Budget

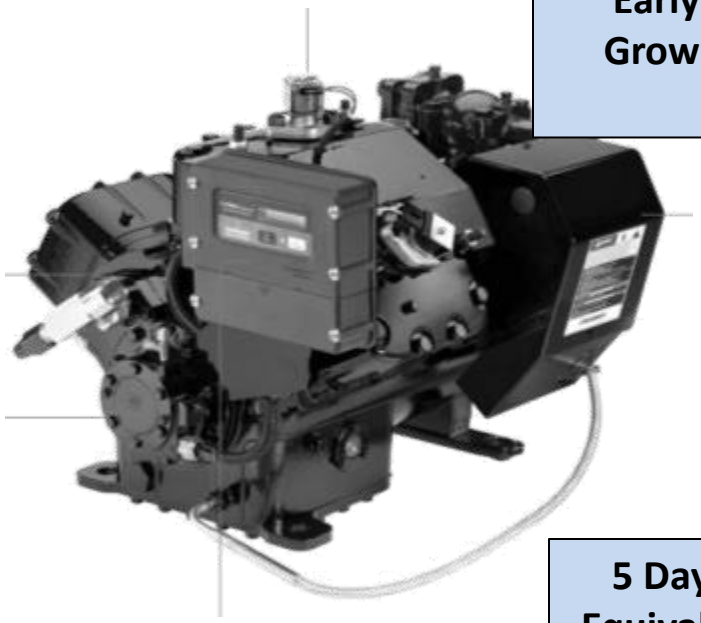
Typical Utility Breakout



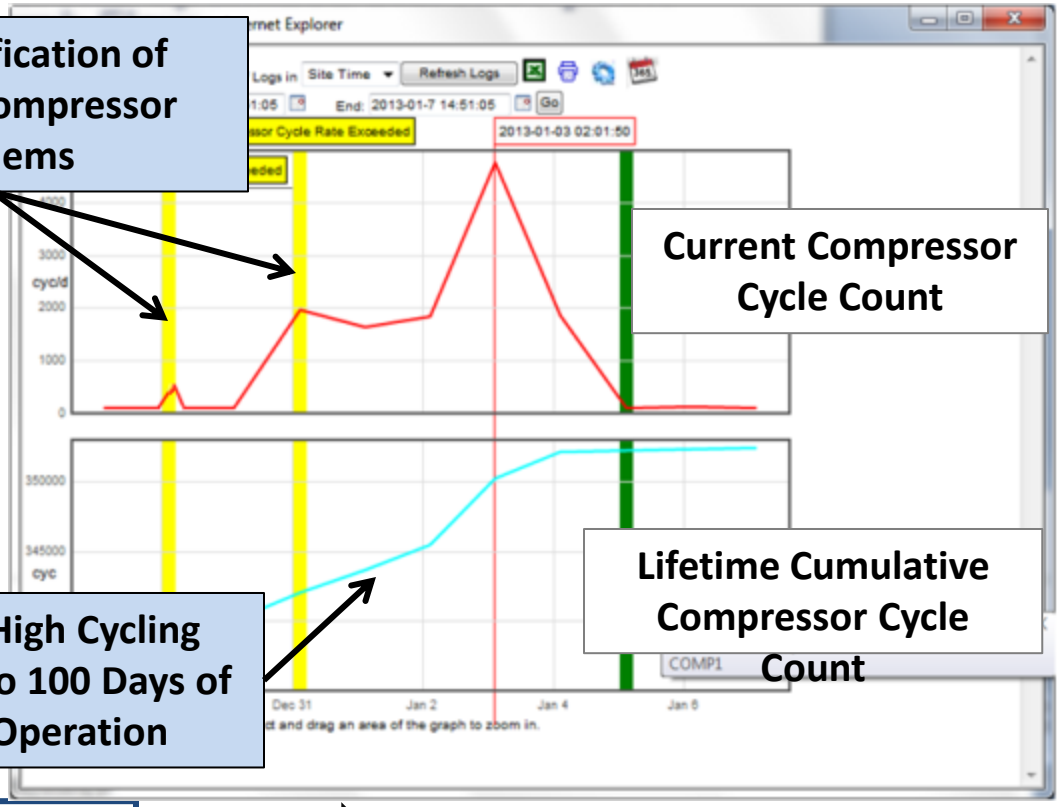


Source: FMI 2000 Supermarket Study Referenced by all business.com

EMS Provides Operational Visibility Utilizing Control Data



Early Notification of Growing Compressor Problems



Current Compressor Cycle Count

Lifetime Cumulative Compressor Cycle Count

5 Days of High Cycling Equivalent to 100 Days of Normal Operation

Customer Motivations

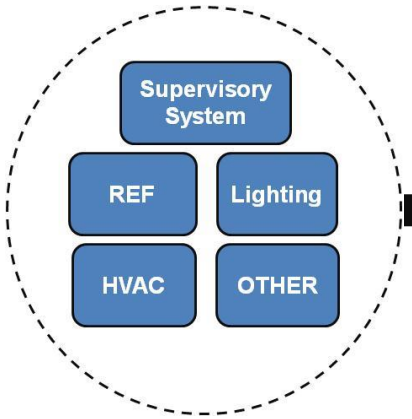
- **Enhance Operational Life Of Compressors**
- **Avoid Unplanned Downtime**
- **Reduce Total Cost Of Ownership Of Store Infrastructure**

Results

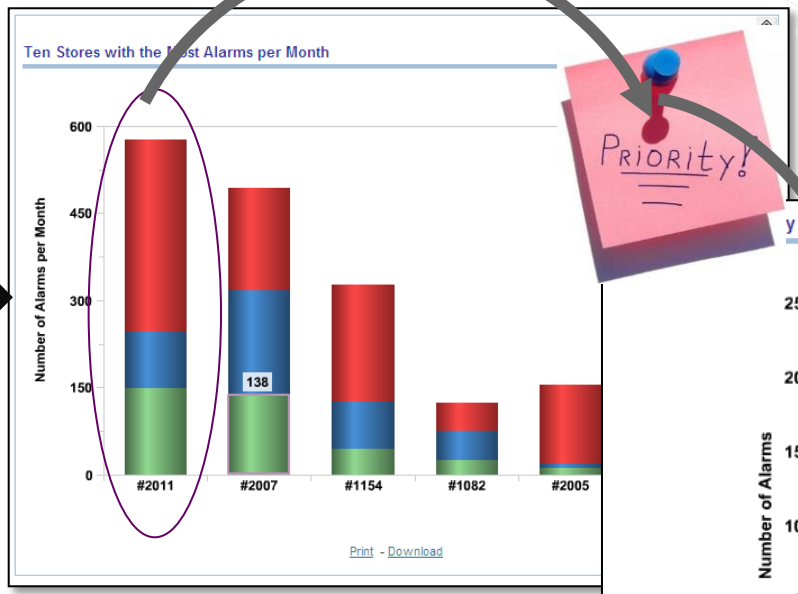
Average 1-3 Compressor Replacements Per Store Per Year Avoided

~ Savings $3K-$10K/Year/Store

Use EMS Alarm Information To Prioritize Maintenance Activities

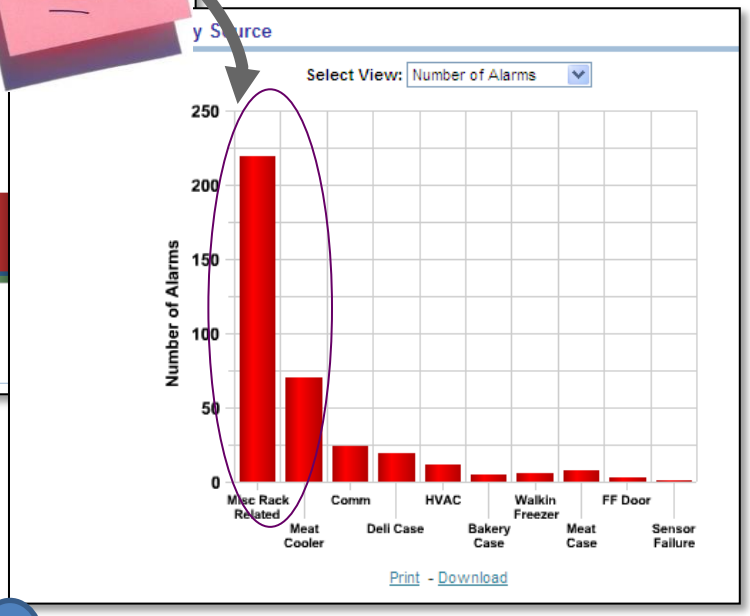


1 **EMS Generates Alarm Data**



2 **Data Correlated To Show Top 10 Sites Generating Alarms Across Enterprise**

4 **Technician Dispatched To Address Problem**



3 **Alarm Drilldown Shows Problem Area At Site**

EMS Can Automate Food Temp Monitoring For Compliance Purposes

FDA FOOD SAFETY MODERNIZATION ACT

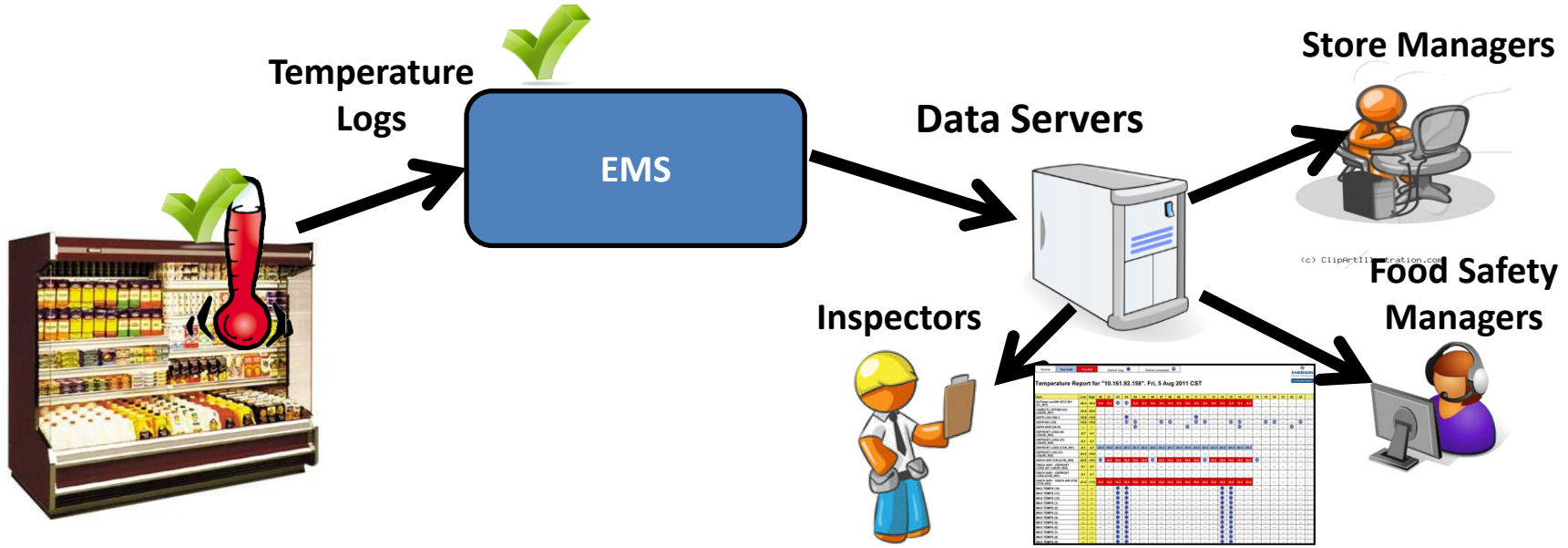
Manual Process

- "Walk" The Store Periodically
- Manually Record Temperature
- File For Access As Necessary
- "Hope" There Are No Errors Or Omissions

Automated Process

- Requires One Time Setup
- Can Run Automatically
- Eliminates Errors
- Provides Secure Access To Information
- Life Cycle Cost Advantage

Use The EMS To Simplify Food Safety Initiatives



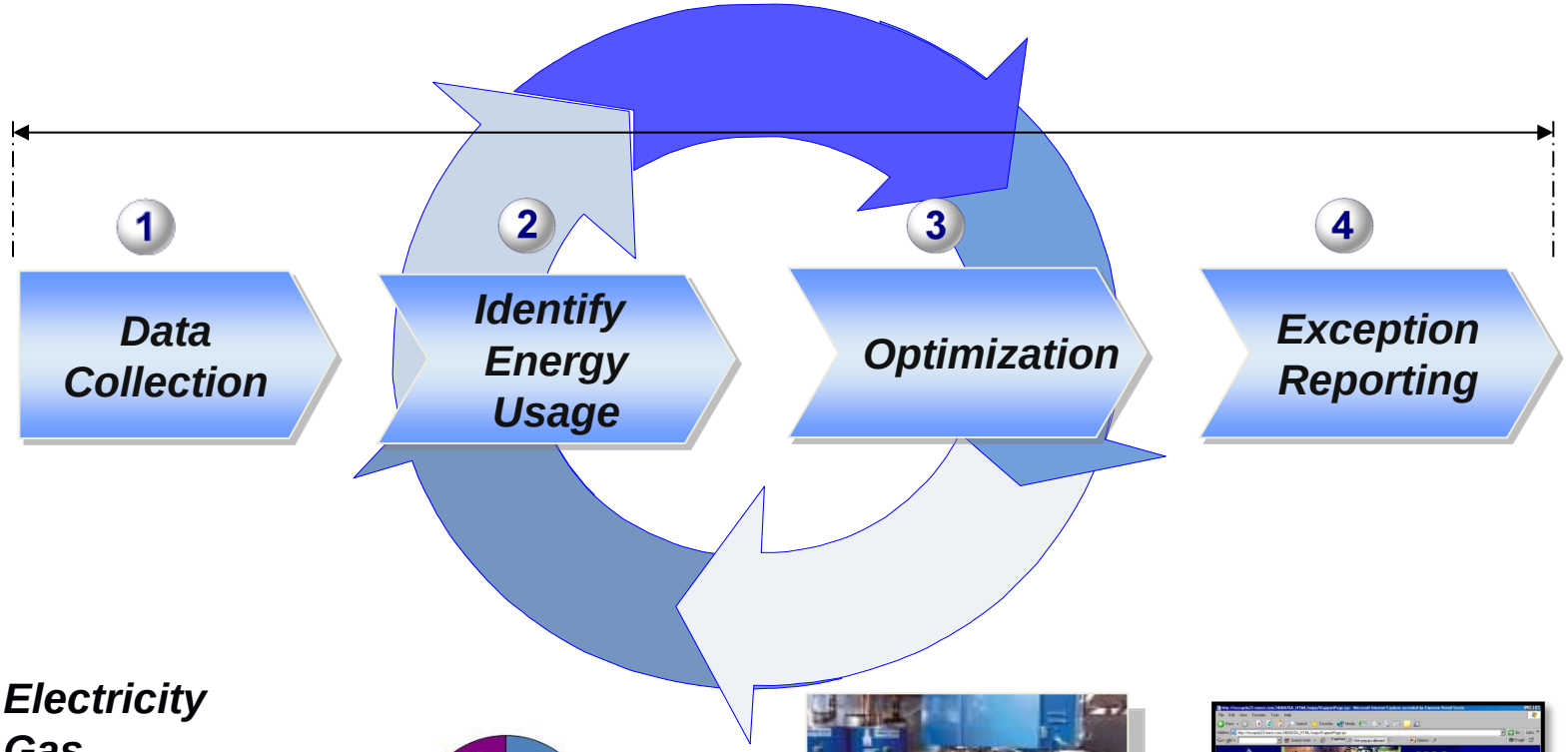
Refrigeration Control Systems Monitor & Control Food Temperature

<u>AND</u> Provide Information For Multiple Functions

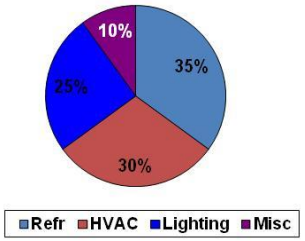
- ***Process Improvement***
- ***Regulatory Compliance***
- ***Problem Identification***

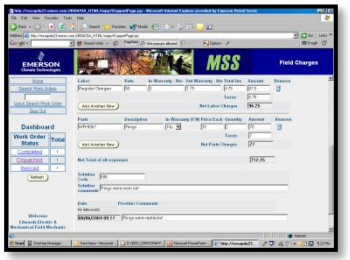
Installed Today

The 4 Stages of Energy Reduction



- *Electricity*
- *Gas*
- *Water*
- *Degree Day*
- *Ambient Temp*
- *Store Traffic*
- *etc*





Energy Reduction Is A Continuous Process

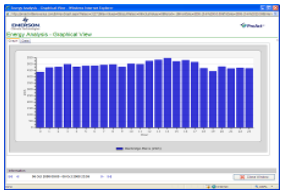
Utilize Advanced Capabilities Of EMS In Energy Reduction Program

Data Collection

Energy Meters Can Be Connected To EMS To Collect Energy Data

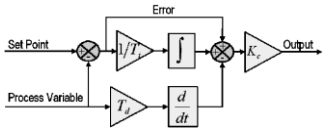
Identify Energy Usage

Results Can Be Analyzed & Correlated With Other Data From EMS



Optimization

Experiment And Implement New Control Strategies



Exception Reporting

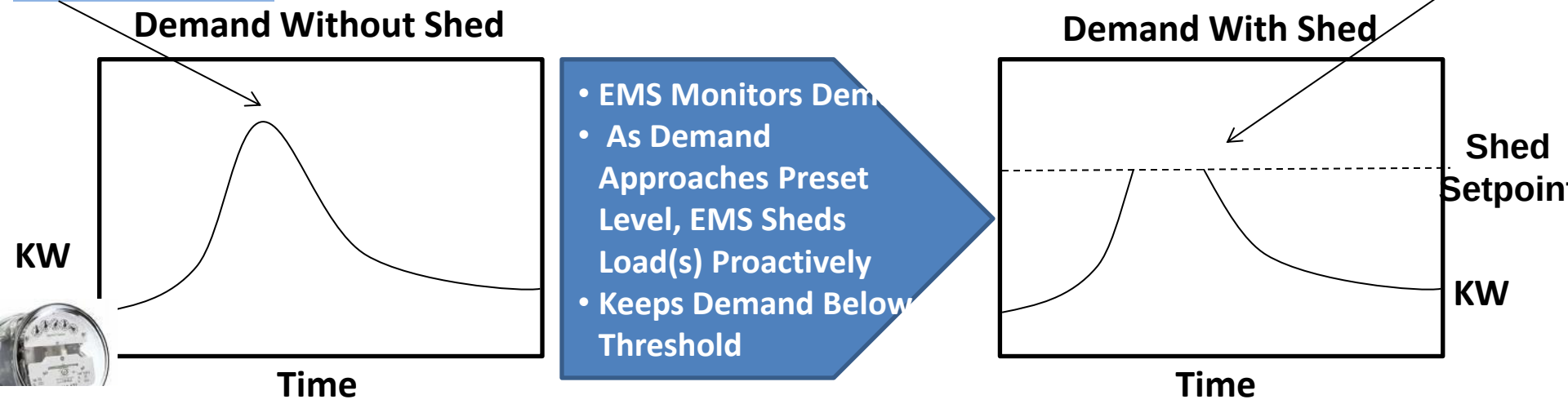
Alarms Track Abnormalities And Take Action

Monitoring & Control Capabilities Of EMS Key To Energy Reduction Programs

Utilize EMS To Limit Peak Demand

KW Peak Sets Demand Charges On Utility Bill

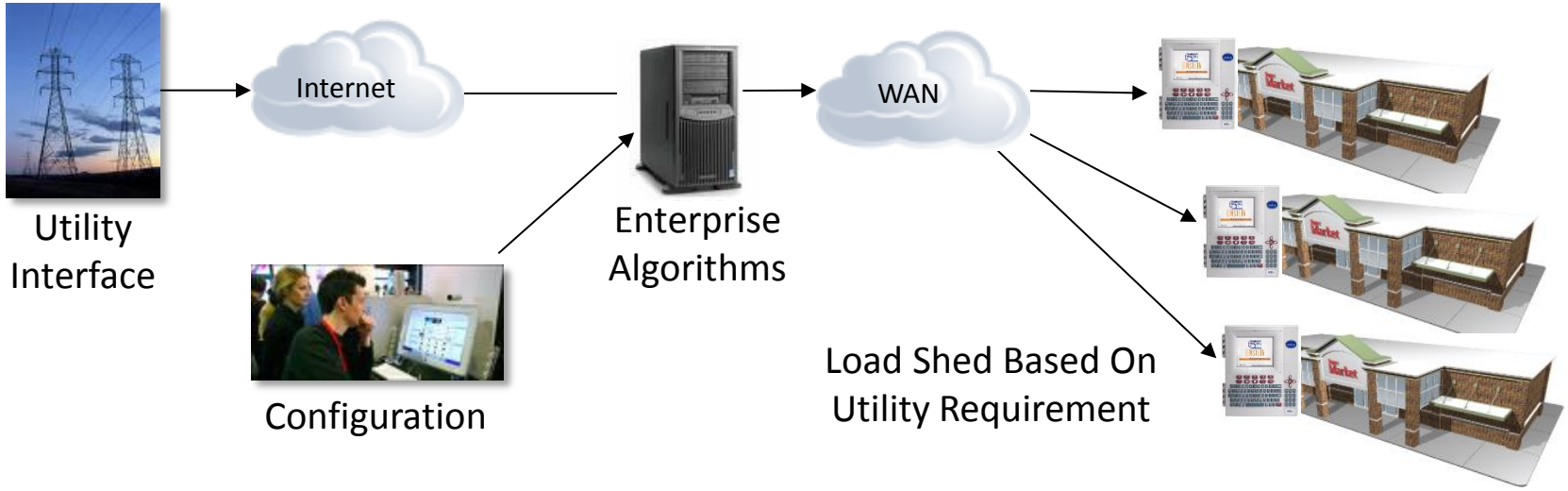
Load(s) Shed To Keep Peak Below Setpoint



Application	Typical Shed Action
HVAC Applications	Raise Cooling Setpoints. Lower Heating Setponits
Sensor Control	Raise Or Lower Cut in/Cut Out
Suction Groups	Raise Suction Setpoint
Lighting	Stage Circuits Off

Advanced Shed Algorithms (i.e. Rotational Shed) Allow Strategies Such As "Comfort First" To Minimize Disruptions

EMS Demand Management Infrastructure Enables Participation In Utility Demand Response Programs



- **Several Types Of Demand Response Programs Offered By Utilities**
  - **Emergency Capacity Programs; You Get Paid For Your Promise To Shed Whether An Event Happens Or Not**
  - **Price Based Programs; You Determine When To Shed Based On Real Time Pricing**
  - **Potential For Rebates To Fund Equipment Installation Or Upgrades**
- **Build On Existing Infrastructure (i.e. EMS, Network, etc.) For Most Cost Effective Solution**

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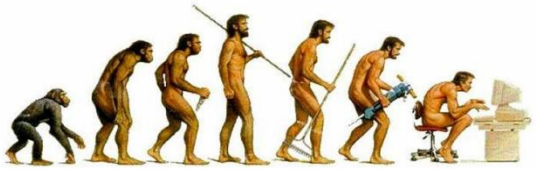

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What Driving Next Generation Systems Development

10 Trends In Smart Buildings

1. **Building Energy Management Hits The Cloud**
2. Co-opetition Is On The Rise In The Building Industry
3. Targeted Acquisitions Help Key Players Deliver Energy Services
4. Demand For Smart Building Products Will Soar (China)
5. US Energy Companies (ESCOs) Turn To Federal Sector
6. **Building Communications Protocols Are Converging**
7. **Demand Response Is Shifting Into Automatic**
8. **Submeters Find New Opportunities In Smarter Buildings**
9. Building Information Modeling (BIM) Is Transforming The Design Process
10. **The Interface Between Smart Building And The Smart Grid Is Blurring**

From Pike Research Report published 2012

Trends Drive 4 Key Areas

1. User Interface & Usability
2. Communication & Integration
3. Cloud Connectivity
4. Extensibility And Applications

Web Expectations Drive User Experience

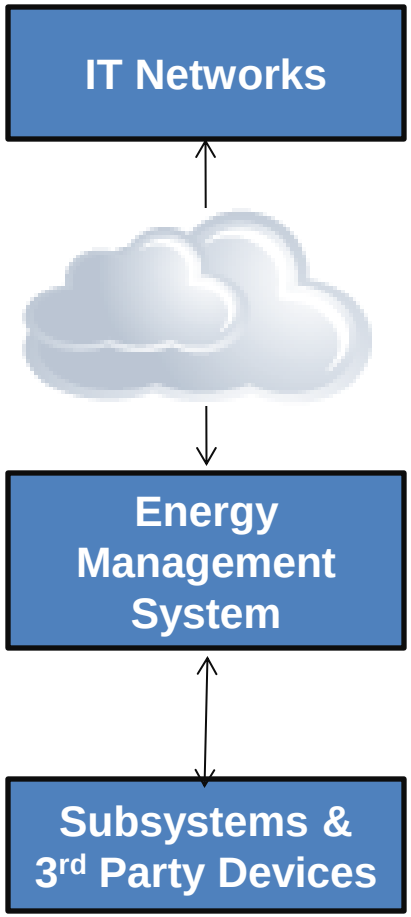
- **Web Technologies Drive Standards For All UI's**
  - **Web & Mobile Expectations**
- **Importance Of "View Anywhere" Capabilities**
- **Increasing Use Of Human Centered Design Techniques**
- **Personalized User Interface; Role Based UI Reduces Information Overload**
- **Increasing Use Of Charts And Graphics To Simplify Information**
- **Enterprise User Management Simplifies Administration**
- **Single View Across All Areas Of Facility**

Site Information Portal

REF HVAC Lighting OTHER

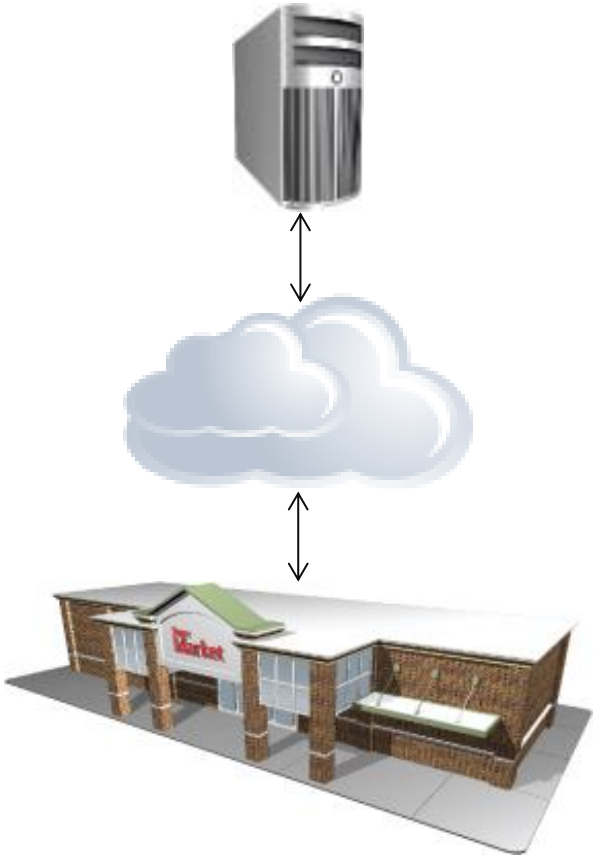
System Integration, Communication & IT Friendly

- **"IT Friendly" Will Be The Rule**
  - **Internet, M2M and Other Technologies Drive Best Practices**
- **Top Level Sub-System Integration Will Drive Interoperability**
  - **Not A Single Protocol (i.e. BACNet, Echelon, etc.)**
  - **Flexibility Key**
- **Wireless Technology Will Drive Installation Costs Down (Especially For Retrofits)**
  - **Additional Sensors & Data**
  - **Flexibility In Installation**



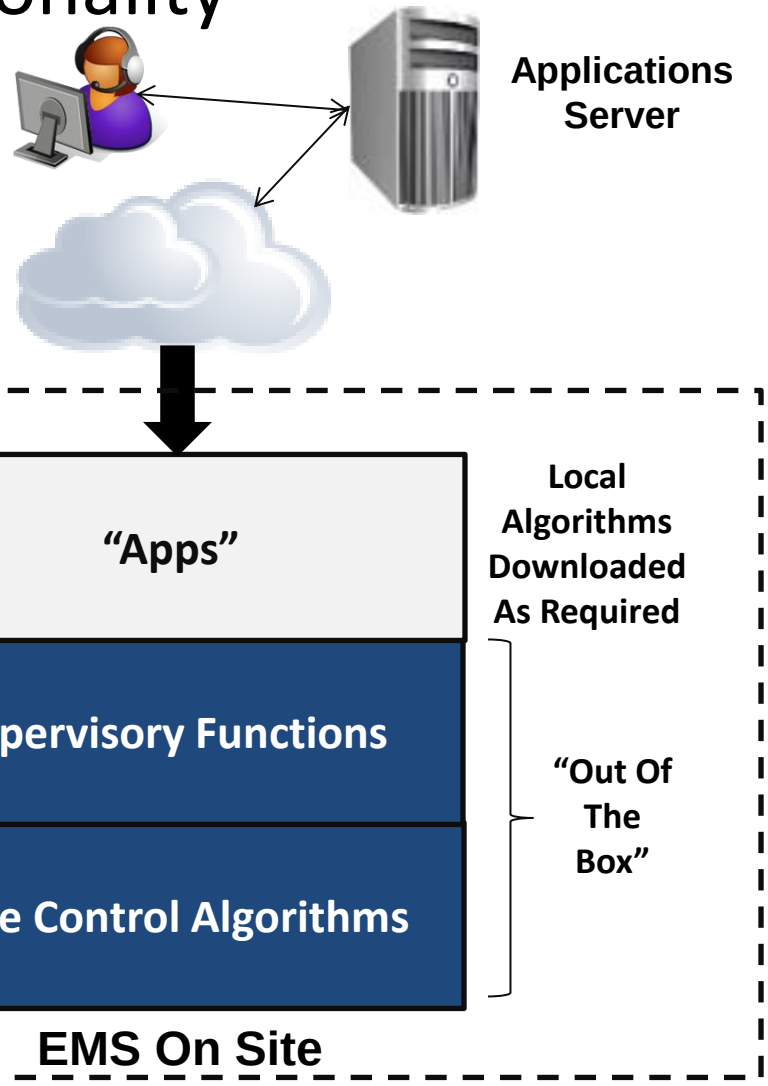
The Blurry Line Between A Site And The Cloud

- **Advanced Network Capabilities Create Seamless Cloud/Site Interface**
- **"Cloud" Applications Extend Capability**
  - **Data Storage, Enterprise Management**
  - **Building/Enterprise Analytics**
  - **Automated Backup/Restore**
- **Provisioning & Controller Management Automates Previously Manual Tasks**
  - **Firmware Updates**
  - **User Management**
  - **License Management**
- **Enterprise Analytics**
  - **Enable "Big Data" Analysis & Actions**



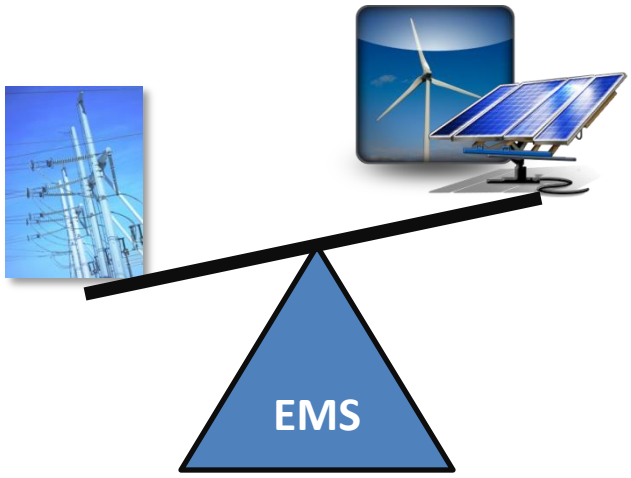
Extensibility:"Value Add" Capabilities Build On Base Functionality

- **Modular Architecture Enables Flexibility**
- **Allows Systems To Be Adapted To Specific Requirements And React To Changing Regulatory Landscape**
- **Automated Provisioning Manages Complexity**
- **Local Algorithms Manage Complex Data Analysis**
- **Enterprise "Roll Ups" Enable Big Data Type Analysis And Decisions**



Extensibility: Managing The Changing Energy Landscape

- **Supporting LEED Accreditation**
  - **Sub-meters On Key Loads**
- **Smart Grid Beginning To Drive Automated Demand Response**
  - **Provides Potential For Direct Connect From Utility To Building Loads**
- **Automated Energy Analysis With Normalization To Key Drivers**
- **Clean Energy Management**
  - **Net Zero Building Support**



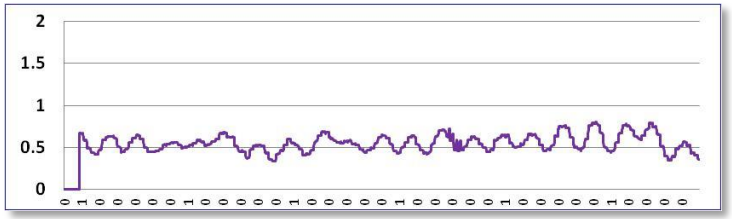
Balance Generation With Demand Management Based On Site Conditions

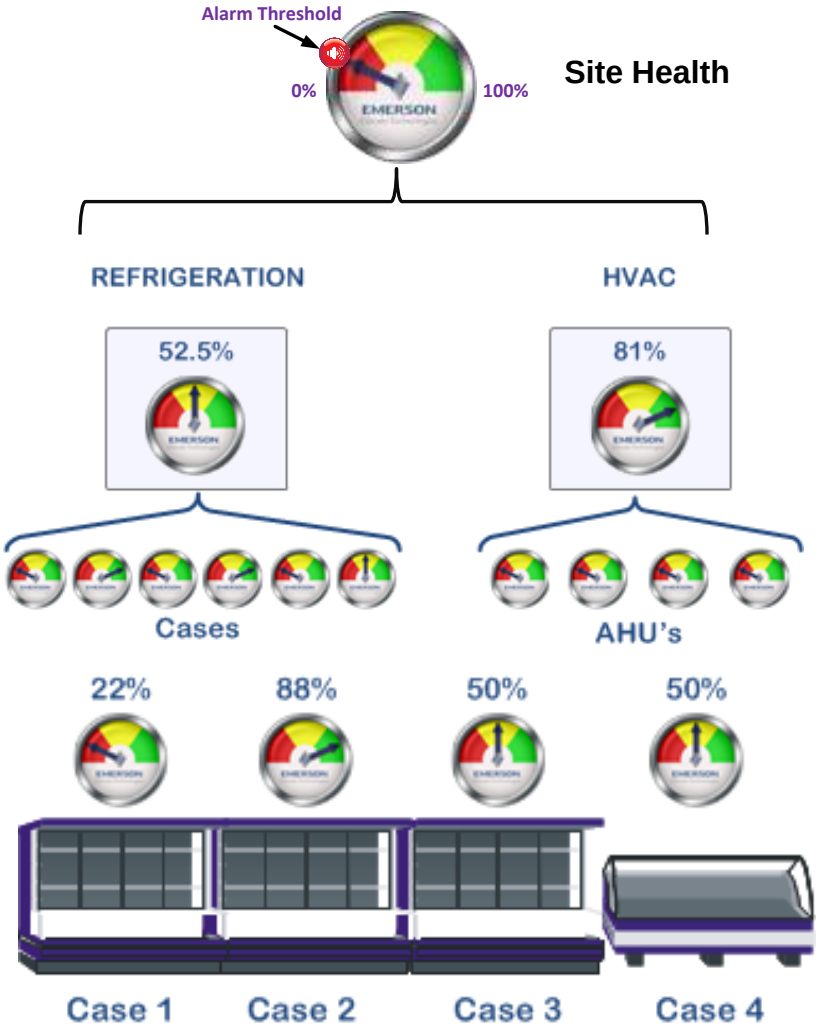
Extensibility: Diagnostics & Health Metrics

Aggregation Across Systems Creates Site Metric That Can Be Compared Across Sites

Aggregation Across Components To Form System Health

Algorithms Analyze Performance And Create "Health" Indicator





Discussion Topics

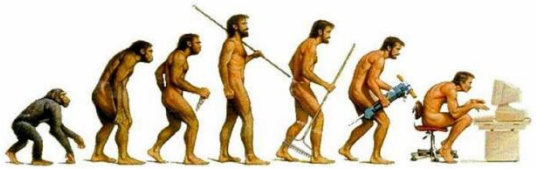
Islands Of Control

Integration & Supervisory Functions

Getting Your Money's Worth

And Beyond: What's Next?

Background & Evolution of Controls; The Transition To Electronics



How The EMS Came To Be & What It Does Today

Using All The Capabilities In State of the Art Systems

What Driving Next Generation Systems Development

Questions?

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