IBM Smarter Buildings: Buildings as Power Plants
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NCSL ENERGY SUPPLY TASK FORCE

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Enable and Accelerate **Application of Information to Decisions**

INSTRUMENTED  INTERCONNECTED  INTELLIGENT  SMARTER

- Billions of Signals a Year
- Open Data Architecture
- Integrate External Sources
- Meaningful Actions from Big Data & Deep Data Analytics
- Lower Cost
- Higher Efficiency
- More Productive
- Longer Life
- Higher Performance

IBM Confidential
Why is IBM Smarter Analytics unparalleled in the industry?

Broad and integrated portfolio of information and analytics capabilities
- Largest investment in analytics software and solutions with over $16B in acquisitions since 2005
- Enterprise Class Big Data Platform as part of a comprehensive Information Management Foundation
- Analytic Capabilities that scale from personal to enterprise to next generation systems that reason and learn
- Decision management solutions that embed predictive analytics into business processes

Proven experience accelerating time-to-value and delivering breakaway results
- Over 9,000 experienced strategy, analytics, and technology experts and consultants around the globe
- Proven solutions & use cases across industries and functions, from 1000's of client engagements
- Thought leadership and practical insights from the IBM Institute for Business Value
- Jumpstart services and eight global IBM Analytics Solution Centers to help organizations get started
- World's number 1 IT captive financier. (IBM Global Financing)

Comprehensive delivery options to compliment capabilities and lower TCO
Broad range of implementation models, including:
- System Integration, Consultancy, Transformation
- Application Management Services
- Appliance, Hardware, Cloud, Mobile

Advanced technology and expertise applying innovation to real world problems
- First-of-its-kind breakthrough innovations, including IBM Watson
- World's largest math department in private industry since 1960
- Nearly 600 analytics patents per year and first in patent ranking
Citizens are placing **increasing demands** on leaders

**Evolution of Value**

- Security
- Convenience
- Opportunity
- Prosperity

**Time**

- Buildings, Roads
- Water, Energy
- Jobs, Education
- Lifestyle, Health

For the first time in human history **the majority of the world’s population lives in urban areas.**

- **3 billion people** – half the world’s population – live in cities
- Almost **180,000 people** move into cities each day
- **Two-thirds of all people** will live in cities by 2050

WorldBank.org
Smarter Cities solution portfolio is expansive

Prioritized Industries

- Public Safety
- Government
- Transportation
- Energy
- Healthcare
- Water

Solutions

Planning and Management
- Operations insight
- Law enforcement and public safety
- Building management

Infrastructure
- Transportation management
- Water management
- Utility Network management
- Asset Management

Human
- Social program management
- Citizen health and safety
- Educational outcomes

Industry Partner Solutions

Smarter City Operations

Consulting and Services, Advanced Research, Workload Optimized Systems and Flexible Delivery Models
Real results are being achieved

City of Dubuque
real-time monitoring pilot achieves 6.6% decrease in water consumption over 9-week period

Metropolitan Police (UK) utilized social network analysis to dismantle an organized crime group, making over 140 arrests with 70% conviction rate

Rio de Janeiro, automated alerts of changes in flood and landslide forecast to reduce reaction times in emergencies

Analyzing data to perform proactive maintenance, DC Water & Sewer Authority achieves ROI of 629% in 2 months

Singapore Land Transport Authority can forecast traffic conditions up to 60 minutes into the future to help prevent traffic congestion

Las Vegas Metro Police turned to IBM for help in improving public safety through analyzing data to recognize patterns

Patterns for Leveraging Information, Anticipating Problems, Coordinating Resources
How Can Buildings Connect & Operate More Effectively & Efficiently?
The challenge is getting the right information to the right people at the right time

- **Portfolio**
  - Real Estate Mgmt

- **Asset Mgmt**
  - Lifecycle Operations

- **Energy Use**
  - Demand Mgmt

- **Building Services**
  - Maintenance

- **Occupancy**
  - Space Mgmt

- **Tenant Services**
  - Help Desk

- **Waste Mgmt**
  - Trash/Water/Recycle

- **Compliance**
  - Environmental reports

- **User Specific**
  - Health, Logistics, etc.

- **Building Systems**
  - Building & Communications Services

- **Access/Security**
  - Badge in, Cameras, Integration
  - Perimeter, Doors, Floors, Occupancy

- **Energy**
  - Smart Meters, Generators, Demand Response

- **Elevators**
  - Maintenance, Performance

- **Facade**
  - Active and Passive

- **Fire**
  - Functionality checks, Detector service

- **HVAC**
  - Fans, Variable Air Volume, Air Quality

- **Lighting**
  - Occupancy Sensing

- **Water**
  - Smart Meters, Use / Flow Sensing

- **Air Quality**
  - Sensors, HVAC Automation

- **24/7 Monitoring**
  - Condition Monitoring, Parking Lot Utilization

- **Occupants & Operators**

- **Externalities**

- **Weather**
  - Current, Precise Predictions

- **Public Safety**
  - Communications, Alerts, Actions

- **Utilities**
  - Demand Mgmt, Cost Control, Grid Integration

- **Community Services**
  - Transportation, Traffic, Events

- **Commercial Potential**
  - Advertisement

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Evolution of ‘Green’ to Financially Beneficial Model

The Challenge: Transparency, Accessibility, and Relevancy to Varied Stakeholders in Real Time

- Evolution of Better Information Drives New Actions
  - Practices
  - Comparative Ratings
  - Metered & Verified Performance

- Action Based on Analytics and Transparency
  - ASHRAE 90.1, 170, etc.
  - Life Cycle Cost / Total Cost of Ownership
  - ENERGY STAR Portfolio Manager
  - EO 13327, 13423, 13514

- ‘…if cost effective’
Integrated Buildings – Emerging Course of the Industry
The Convergence of IT, Building Management and the Enterprise
IBM Optimizes Enterprise Controls From Real Asset Information

IBM Connects Proprietary Systems, Aggregates Unprecedented Volume, Velocity and Variety of Data, and Applies Analytics to Deliver Net New Value from Real Estate and Facilities Data

**Sustainable Enterprise Management**
- Optimize real asset’s support of enterprise mission
- Harvest valuable BI from facilities data warehouse
- New controls from correlated enterprise activities
- Asset class performance evaluations

**Intelligent:**
Apply business intelligence operations to enterprise data warehouse, forming unprecedented correlated sustainability information and controls.

**Interconnected:**
Enables prioritized, monetized actions for work flow and process management resulting in reduce energy and labor costs.

**Instrumented:**
Automap connections across proprietary data sources. Analytics from comprehensive event correlation yields missed savings from undetected waste.

Integrated CMMS to Optimize O&M Procedures
- Prioritize and initiate corrective actions
- Monetize energy & labor savings
- Automated Work Order tracking
- Monitoring-based commissioning

O&M Process and Operational Rules

**Big Data Analytics**
- Connect building assets
- Targeted data points
- Automated fault reporting

**Wrapping Around a State of the Art Graphic User Interface & User Experience**

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Case Study: General Service Administration - Building Analytics

Challenge

- Reduce energy and mechanical operations costs
- Refine building operations to meet President Obama’s mandate to make buildings 30% more energy efficient by 2015
- General Service Administration manages 354 million square feet of real estate in 8,603 buildings – given this scale, the savings opportunity is high (as is the cost of inaction)

Solution - GSAlink

- A building analytics system designed, built, and operated by IBM Global Business Services (GBS) and comprised of:
  - IBM TRIRIGA
  - Skyfoundry SkySpark
  - Tridium Niagara
- GSAlink is integrated with GSA's BASs, GSA's smart meter system, the GSA business intelligence system, and a GSA Region’s CMMS

Customer Value

- GSAlink collects and analyzes building sensor data to gain intelligence and provide insights that were previously unavailable, enabling building management teams to reduce energy consumption and optimize facility operations
- GSA is targeting annual energy and mechanical opex savings of 15 million dollars by deploying the solution to 30M square feet of real estate

Status

- 55 buildings (~33M square feet of building space) are currently integrated and live on GSAlink
- GSA is realizing substantial energy and mechanical opex savings by taking action on the operating faults that GSAlink is detecting

Industry: Government

Profile: GSA is the government’s landlord, providing office and other workspace services for the federal government. GSA helps federal agencies build and acquire office space, products, and services by contracting with federal and commercial sources.

Featured Products & Services: IBM Global Business Services, IBM TRIRIGA, Skyfoundry SkySpark, Tridium Niagara
IBM Energy Optimization Analytics and Feedback Loop: The Basis of Real Time Commissioning

1. **Condition Monitoring**
   - Near real time data capture from BMS
   - Sensors / feeds across domains
   - Asset level performance monitoring

2. **Data Store**
   - Trending analysis
   - Data warehouse
   - Meta data and business rules

3. **Analytics**
   - Alerting
   - Business Rule Trends
   - Computational modeling
   - Creation of insights that feed decisions and actions

4. **Corrective Actions**
   - Optimized base-line energy use
   - Maintenance and operations activity
   - Operational cost savings
   - Capital cost avoidance
   - Reduced energy use
   - Client satisfaction

5. **Report Transparency**
   - Enterprise & Operational Dashboard
   - Drilldown capability
   - Alert Summary
   - Work Order Management
   - Maintenance of optimized position (no back sliding)

Physical System

Human System

Targeted data acquisition

Meta-data model
- Contextualization
- Interrelationships

Identified Improvement actions/projects

Feeds to other systems:
- Work Orders, Excel, Browser, Planning

IBM Energy Optimization Analytics and Feedback Loop: The Basis of Real Time Commissioning

Role Based Analytics & Visibility

Physical System

Human System

IBM Energy Optimization

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IBM Expands and Validates Monitoring Based Commissioning

Typical Industry Reductions 7-20% w/ Physical and Periodic Service ECM’s

- Building Systems
- Envelope
- Utility Distribution
- Periodic Retro-Commissioning: Occasional re-tuning to recover from system changes and errors over time

Additional 15+% Savings from Monitoring-Based Commissioning (MBCx) enabled by IBM Analytics and Real Time Data

- Persistence
- Metering and Trending
- Continual New Learning of Previously Hidden ECM Opportunities Post-Commissioning
- Initial Performance Assessment Lessons

Baseline Energy Spend

Energy Use

Goal

Drift after Commissioning

Unclaimed Energy and Labor Savings

New Goal

Time

IBM Confidential
Smarter Buildings technology generates significant returns

- **85% higher occupancy**
  Facility utilization increased by up to 85% with 210% higher annual savings in Total Cost of Occupancy.
  
  [Aberdeen Group]

- **75% lower work order costs**
  Cost of a single work order reduced up to 88% — a savings of 62% from the industry average.
  
  [Aberdeen Group]

- **40% less energy**
  Energy usage reduced by up to 40% and maintenance costs by up to 46%.
  
  [World Business Council for Sustainable Development; IBM]
Building a Smarter Energy Future

NCSL ENERGY SUPPLY TASK FORCE
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The Evolution of the Energy Value Chain

Traditional Energy Value Chain

- Coal/Natural Gas
- Hydroelectric
- Nuclear

Transformed Energy Value Chain

- Solar
- Energy Storage
- Wind
- Coal/Natural Gas
- Hydroelectric
- Nuclear
- Solar
- Wind
- Plug-in Vehicle

Utility

Drive transformation of Policy and Business models

Consumer
Power Flow
Periodic Information Flow
Continuous Information Flow

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Our customers are exposing us to their greatest challenges
Transform the utility network

Transform electric grid, gas, and water infrastructures from rigid, one-way systems to dynamic, automated, and reliable information networks.

- Gain observability over the utility network, and automate control functions
- Enable participation and interaction between all participants in the utility network
- Integrate and analyze information, including data on real-time conditions, and act on insights to balance supply with demand
- Use rules, constraints and intelligent agents to optimize the network

Progress/maturity over time

- Basic Functionality
- Participant integration and collaboration
- Network visibility and automation
- Network responsiveness
- Network optimization

Continuously orchestrate the network and all its participants.
Energy Grand Challenges @ IBM Research

- Li-Air Batteries with 500 miles range
- Zero-Emissions DC
- Supercomputing & Grid Simulation
- Smart Grids
- Earth-Abundant Soln-Processed PV
- Concentrator PV
- Smart Buildings
- Smarter Energy Platform
Smarter Analytics for Energy and Utilities

Industry Imperative

- Align organization and processes to deliver the right products and solutions to each customer
- Enable more efficient customer sales and service interactions
- Minimize fraud

Smarter Analytics Outcome

- Improve generation efficiency and reduce operating expenses
- Maximize power generation uptime through predictive maintenance
- Reduce outages and downtime
- Optimize maintenance and operational activities
- Time of use pricing flexibility
- Comply with information privacy and retention regulations

Where We’ve Done It

Endesa
- Reduced energy consumption by an anticipated 20%; control costs using real time monitoring

Red Electrica de Espana
- Decreased production costs by 1-2% resulting in a savings of €50,000 - €100,000 per day

CenterPoint Energy
- Reduced frequency and duration of power outages
Smarter Energy Research – IBM Core Competencies

Application Domains

- Smart Grids
  - Large Scale Grids
  - Microgrids
- Renewables
  - Grid Integration
  - IP Partnerships
- Grid Operations
  - Outage Planning
  - Wireless M2M
- Electric Vehicles
  - Grid Integration
  - IP Partnerships
- Smart Buildings
  - Building Analytics
  - Ecosystem Develop.

IBM Focus

IBM Research Core Strengths

Smarter Energy Platform

- Analytics, Models & Optimization
- Advanced Computing
  - Semiconductors & Nanotechnology
  - Internet of Things Technologies

Advanced Materials & Processes
Machine-to-Machine Systems & Solutions
Centralized Decision making via Model-Driven Control Centers
Smarter Energy in Practice – Model-Driven optimization enables substantial electricity (>20%) generated through renewable energy
The Utility of the Future: The Role of Data, Analytics, Modeling, Simulation, Optimization and Advanced Computing

Informed Decision Making with Automation

Portfolio of Analytics & Optimization Applications

Broad Ecosystem of Analytics Applications

HW/SW Infrastructure Architected for Massive Data & Interoperability

Smarter Energy Platform

Best Technologies and Innovations

Q&A