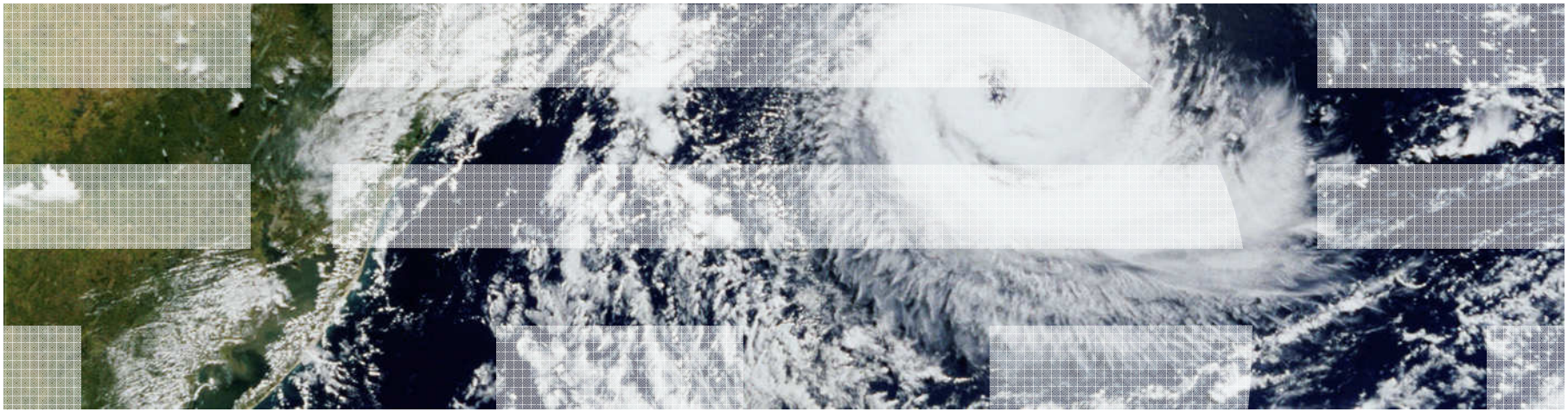
Dr. Pitipong JS Lin
9th NSTDA Annual Conference, Green Supply Chain: The Key to AEC Sustainable Production, 2 April 2013

IBM Experiences on Transforming the Supply Chain



Presentation Topics

Background

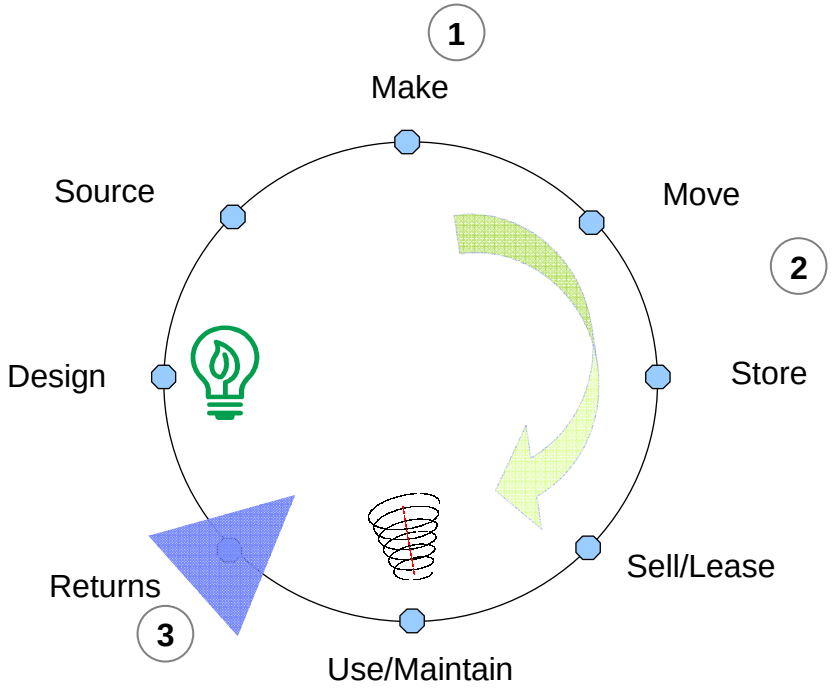
- Overview of IBM Sustainability Initiatives
- IBM transformation required fundamental supply chain changes
- Smarter Supply Chain Analytics

Case Studies

- 1. Smarter Buildings
- 2. Supply Chain Scenario Modeler
- 3. Asset Reutilization Optimizer

Key Takeaways

- The Principle of “Smarter”
- Smarter Analytics
- 12 Ideas to Make Your Supply Chain Greener



Overview of IBM Sustainability Initiatives

1976

Think, the company magazine, devoted an entire issue to IBM's energy conservation and environmental programs

1971

T.J. Watson Jr. issued IBM's first corporate policy on environmental protection

45% 1990-2007

Between 1990 and 2007, IBM's global energy conservation actions reduced or avoided CO2 emissions equal to 45% of its 1990 emissions..

1990

Think devoted an entire issue to IBM's environmental programs – beginning IBM's annual Corporate Environmental Reporting

1991

Established IBM's Product Stewardship Program

1989

IBM offers its first product take-back program

1992

IBM becomes charter member of Energy Star program

1997

IBM became the first major multi-national to earn a single global registration to the ISO 14001 environmental management system standard

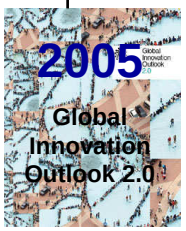
1994

Established Global Materials Recovery Center Network for product re-use and recycling

2006

IBMers "jam" on innovations for a better planet, and IBM invests $20M

- Big Green Innovations
- Intelligent Utility Network



95% 1987-2007

Reduction in hazardous waste generation since the 1987 base year of this pollution prevention metric

98% 2007

Amount of IT product and product waste processed by IBM's Product End-of-Life Management operations that was reused or recycled

2007

Intelligent Utility Network
Intelligent Transportation Sys
Project Big Green

2007…

IBM transformation required fundamental supply chain changes

Multinational era

- Silo'ed structure focused on divisional and country alignment
- Each division had its own manufacturing
- Each country had its own procurement and cash collection
- 36 plants with more than 300 Operations Centers

Globally integrated enterprise

- Horizontally integrated process and organization
  - Procurement
  - Manufacturing
  - Fulfillment
- Multi-enterprise collaboration
- 9 plants and ODM partnerships and 5 Consolidated Global Operations Centers

Snapshot: The ISC today

- Broad scope of Supply Chain: Pre-sales through cash collection
- Manages **$35B+ of spend** for IBM: Hardware, Software, Services, Solutions
- Manages another **$20B+ spend** on behalf of clients
- Cash collection of **$100B+**
- **Over 3.5M visits** to Customer Fulfillment eTools
- **Self service capabilities for all customers and Business Partners** (100+ countries, 30+ languages)
- **23,000 suppliers** connected online in 100 countries
- 98% of **invoices are electronic**

Across the industry, application of analytics is transforming supply chain from cost center to value center

Multinational Era

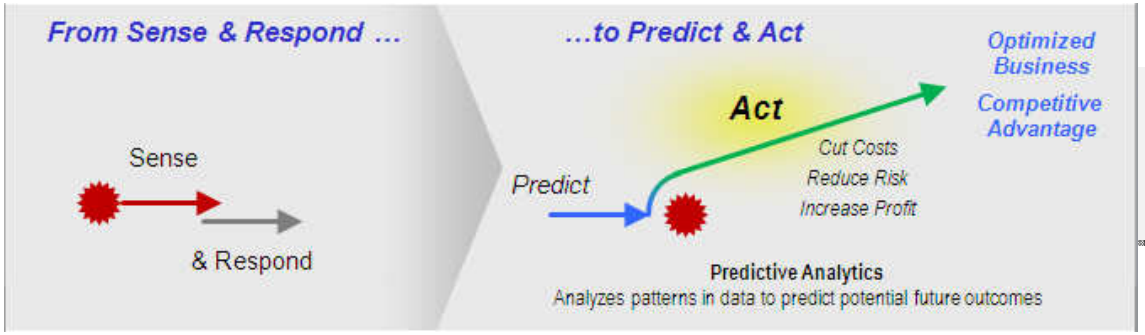
- **Point solutions to cost & serviceability issues**

Globally Integrated Enterprise

- **Enterprise-wide effectiveness & efficiency**

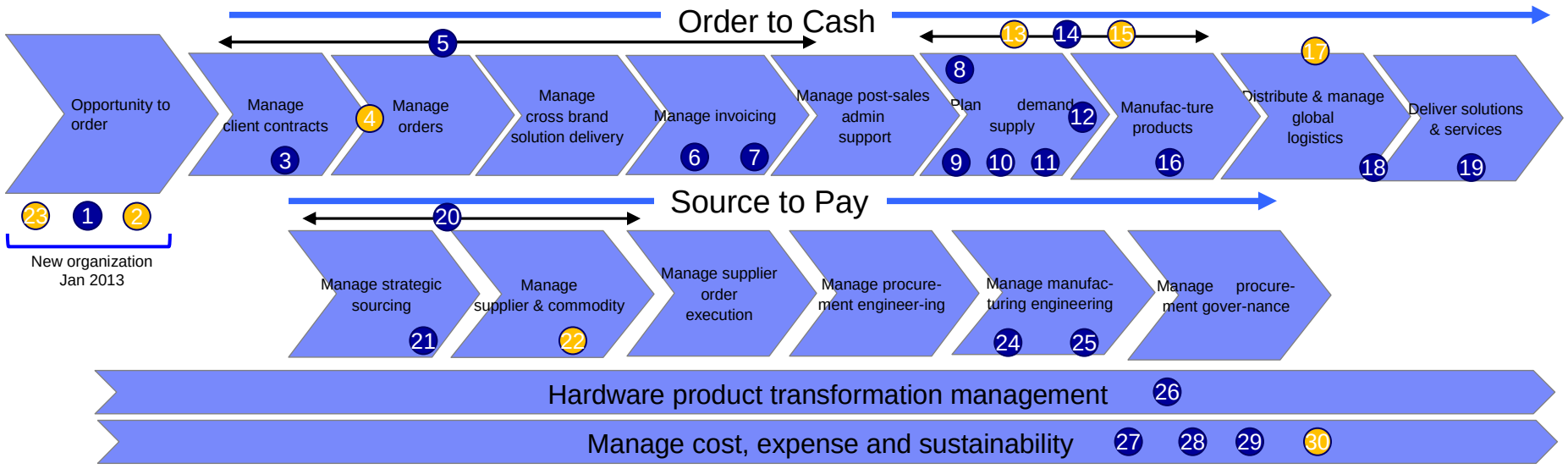
Smarter Supply Chain

- ✓ **End-to-end, multi-enterprise visibility & optimization**
- ✓ **Source of competitive advantage**
- ✓ **Client satisfaction and bottom line performance**



Advanced Analytics…key to thriving in an ever more complex world

ISC portfolio of SC analytics; high value, multi-enterprise solutions



1 IBM Price Analysis Tool
8 IBM Buy Analysis Tool (hub min/max downstream)
23 Pipeline Yield Assessment
2 Annuity Services / Propensity to Buy
13 Smarter Demand Shaping/abcd
12 Critical Parts Management
3 Shipped but Uninstalled (Analysis & Alert)
6 A/R Collections Optimization – NBA
7 A/R Collections Optimization – growth markets
5 Global Client 360 Dashboard
9 Forecast Accuracy Initiative
10 New Product Parts Planning (NP3)
11 Supply Capability Engine
16 Smarter Manufacturing – Progile
17 Fuel Surcharge Hedging

18 Global Logistics Loss & Damage
19 CVA-T Temporal Causal modeling / ICMA
14 e2e Inventory Optimization
15 Supply Chain Transparency (SCT)
21 Advanced Airline Analytics
22 Catalog Data Optimization
24 Quality Early Warning System
25 Asset Reutilization
20 Supply Risk Management
26 Product Management Transformation
27 Environmental Reporting Tool
28 Global Logistics Carbon Mgt Solution
29 Green Sigma
4 Transaction Center Optimization (Labor)
30 Software license mgt, reconciliation, optimization

Legend
- Implemented / extension
- Development

2013 Investment & Development

Analytics + Sustainability can drive value: increasing the bottom line, and at the same time, reducing environmental impacts

TIME

- "IBM resells a third of the used equipment it gets back from corporate leases in online sales and auctions. "It's a **profitable** business for us,""

  — How do you Junk your Computer?, Time

- "IBM itself saves tens of millions of dollars a year by plucking used spare parts for its own."
- "'Reverse Logistics' **…**"**optimization**" software helps IBM decide what price to sell used machines and parts for, based on market conditions and the product's condition."

  — IBM Wrings Profit Out of Used Computers, Pushes Leasing Program, Bloomberg

Bloomberg.com

AMR Research

- "…. While IBM is providing an important service that prevents pollution and excess landfill use, the GARS business unit also acts as a **profit center**."

  — Big Green: IBM and the ROI of Environmental Leadership, AMR Research

- "With detailed, demand-driven market pricing algorithms, IBM knows the market value of refurbished IT assets, componentized assets and every raw material in the assets. IBM can choose the correct level to which it should demanufacture or remanufacture to **maximize the profitability** of the used asset."

  — Big Blue Helps SMBs See Green, Yankee Group

yankee group

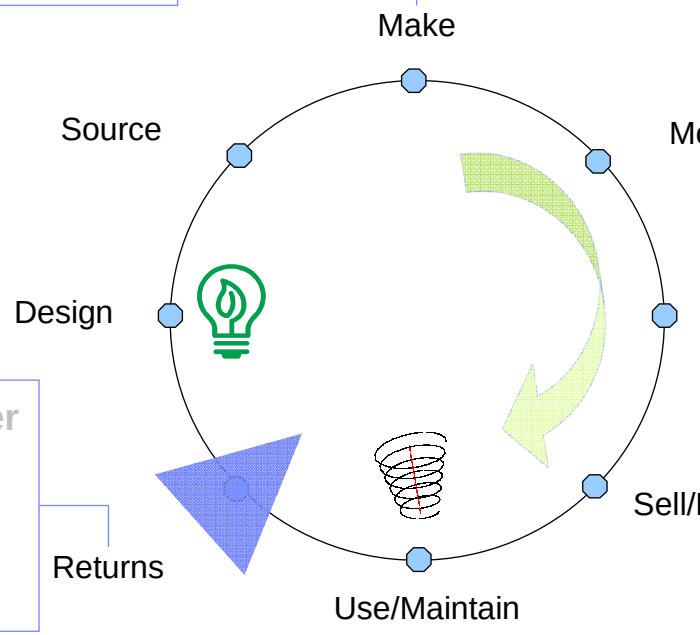
Case Studies

1

Smarter Buildings
A smarter way to manage real estate and facilities

2

Supply Chain Scenario Modeler
Models the entire supply chain and provides the capability to determine the financial and environmental impact



3

Asset Reutilization Optimizer
Applies advanced analytics to a stream of returned products to determine optimal, timely disposition

What are smarter buildings?

Smarter Buildings are well managed, integrated physical and digital infrastructures that provide optimal occupancy services in a **reliable**, **cost effective**, and **sustainable** manner.

Risk	Data	Action	Innovation	Cost
Continuous performance based monitoring delivers reliability and efficiency	Accurate data drives enhanced performance across the entire portfolio	Immediate action delivers comfortable and productive buildings for occupants	Visibility of entire portfolio delivers optimal property portfolio decision making , growth and globalization	A refined building portfolio that performs optimally

How it works

1. Sensing-Monitoring

Ensure there is no back sliding

Monitor

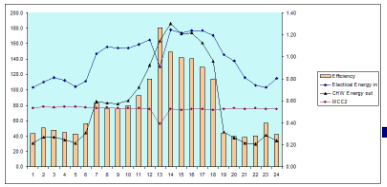
Collect

Report energy use & associated CO_2 emissions

Targeted data acquisition

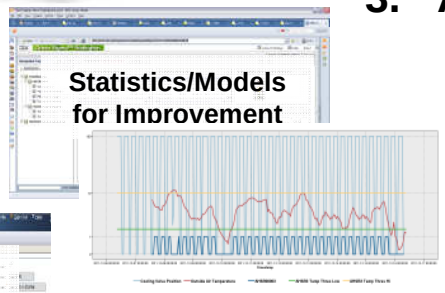
Enterprise Reporting Feed

2. Data Store



Meta-data model
- **Contextualization**
- **Interrelationships**

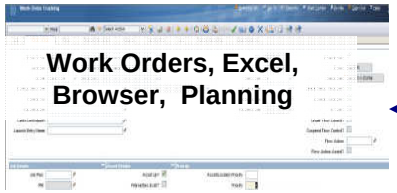
3. Analytics



Identify equipment & areas of energy waste

Identify

Identified Improvement actions/projects



Provide the management system to address and track

Act

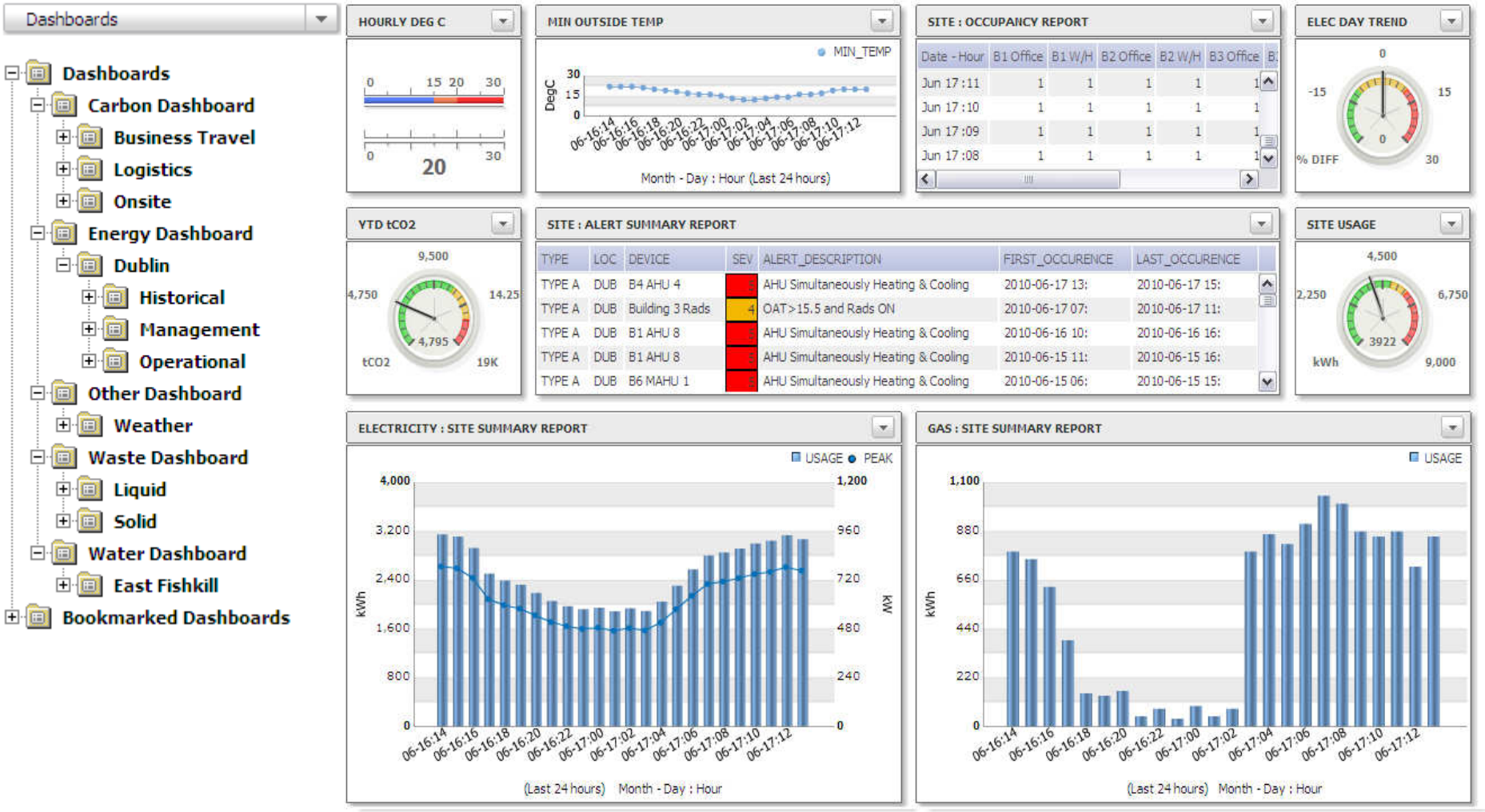
4. Improvement

Observe & track benefits & savings

Improve

5. Sustainability & Reporting

Dashboard for Energy proactively monitors KPI data, alerts and trends, and enables drill-down analysis…



IBM Rochester pilot roll out

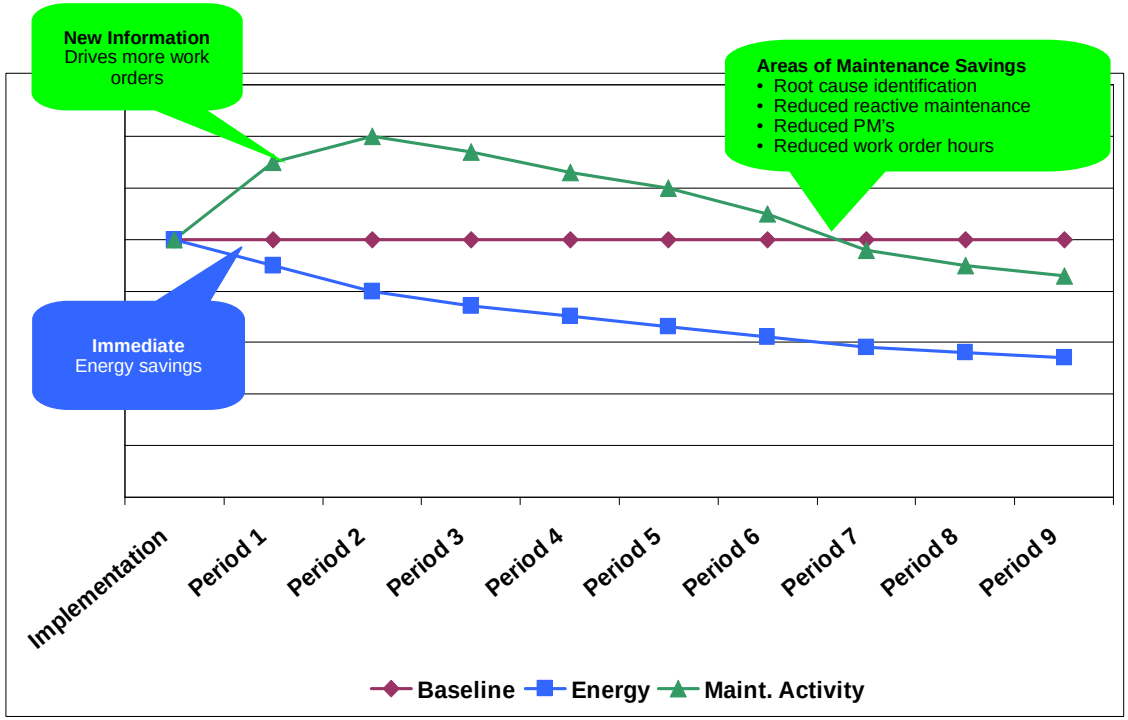
Rochester, MN

- **Property Characteristics:**
  - 3.3M sq ft multi-building mixed use light industrial campus
  - Facilities date to the 1950s
- **Scope:**
  - BMS/metering integration
  - HVAC sensors/metering point integration
  - Lighting management
  - Perimeter pre-heat
  - Chiller optimization
  - Advanced analytics
  - Dashboard for energy, carbon, maintenance, space, etc.

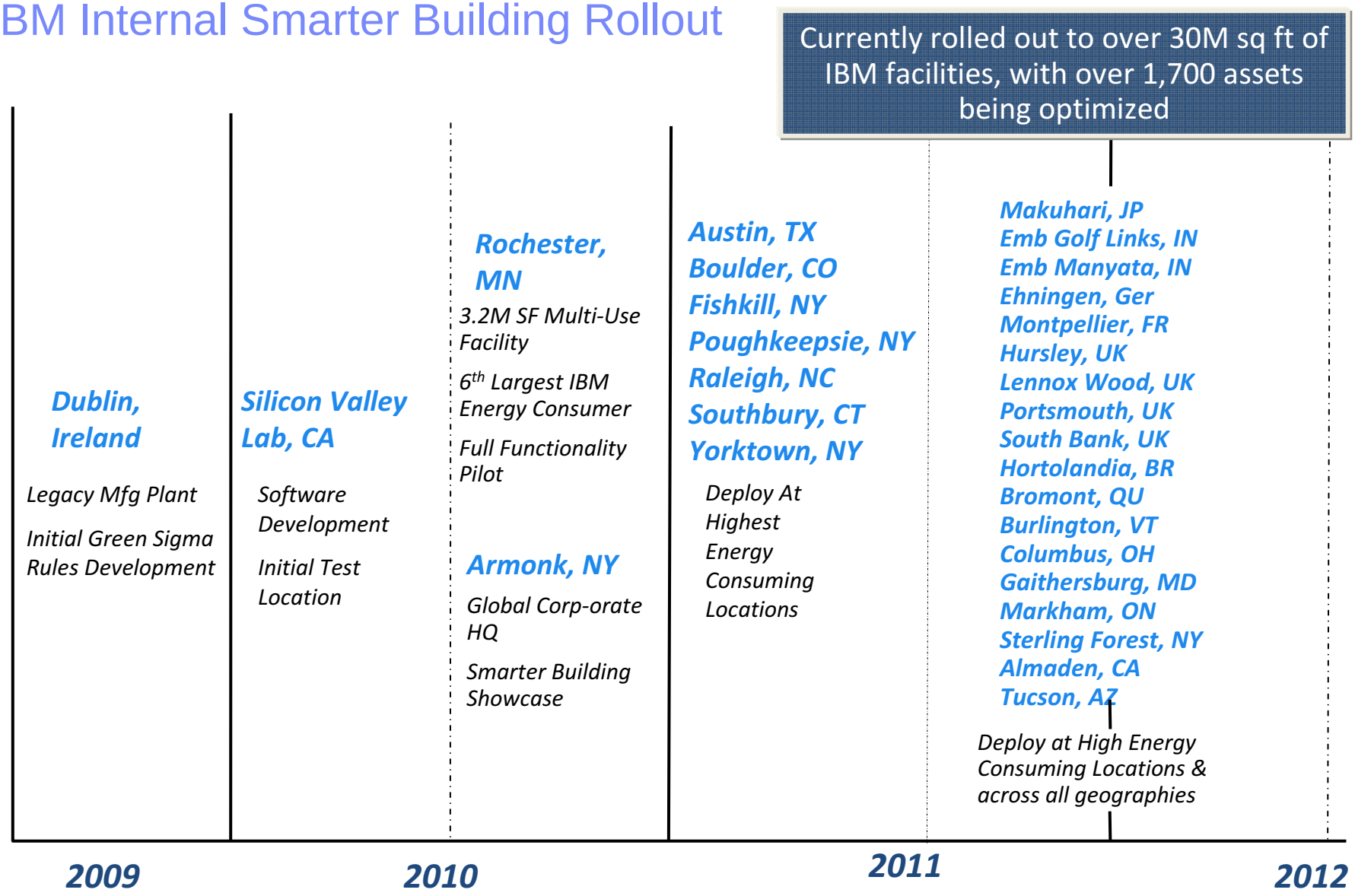
IBM internal Project

IBM Rochester, 3.3M sq ft multi-building mixed use light industrial campus. Facilities date to the 1950s. Consistently achieved year on year energy reductions of 5% to 7% over the last 10 years.

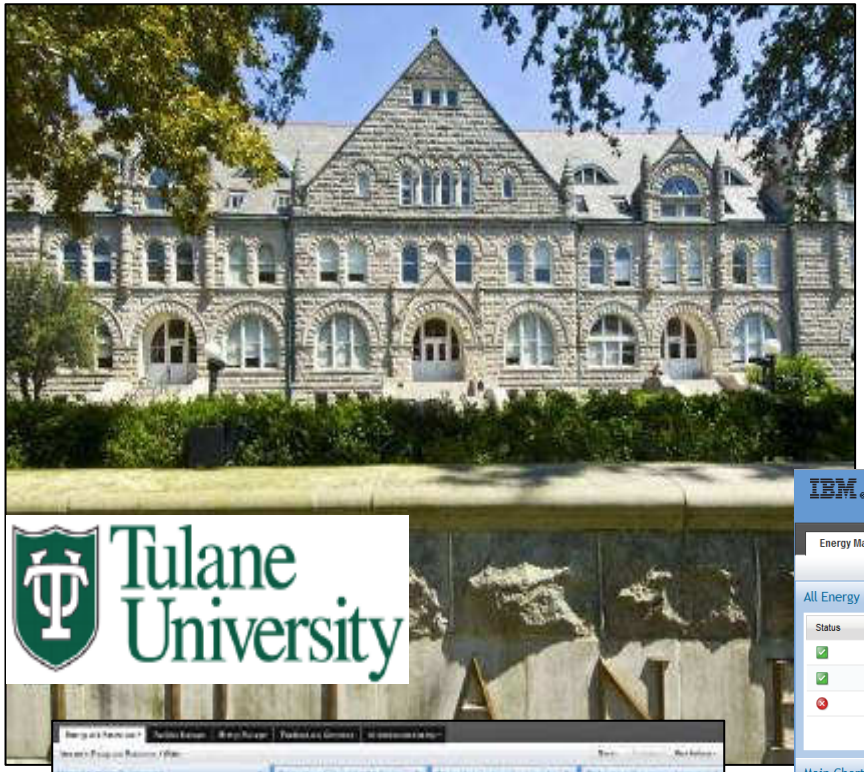
- Reactive maintenance decreased by 16%
- Hours per work order reduced by 34%
- Total number of work order hours decreased by 49%
- Energy cost reduction on equipment monitored of between 10-15%



IBM Internal Smarter Building Rollout

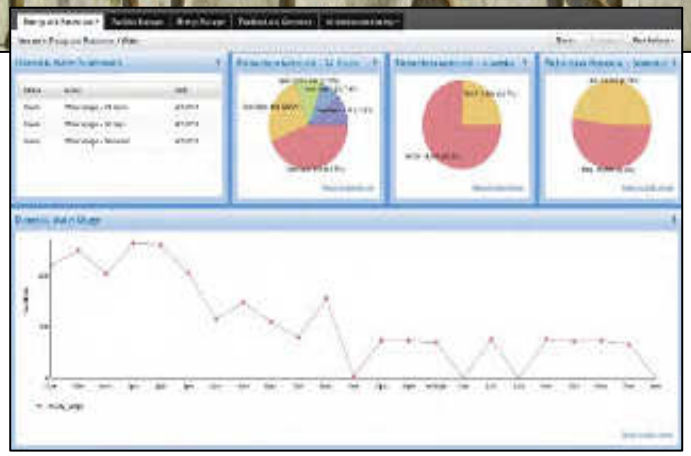


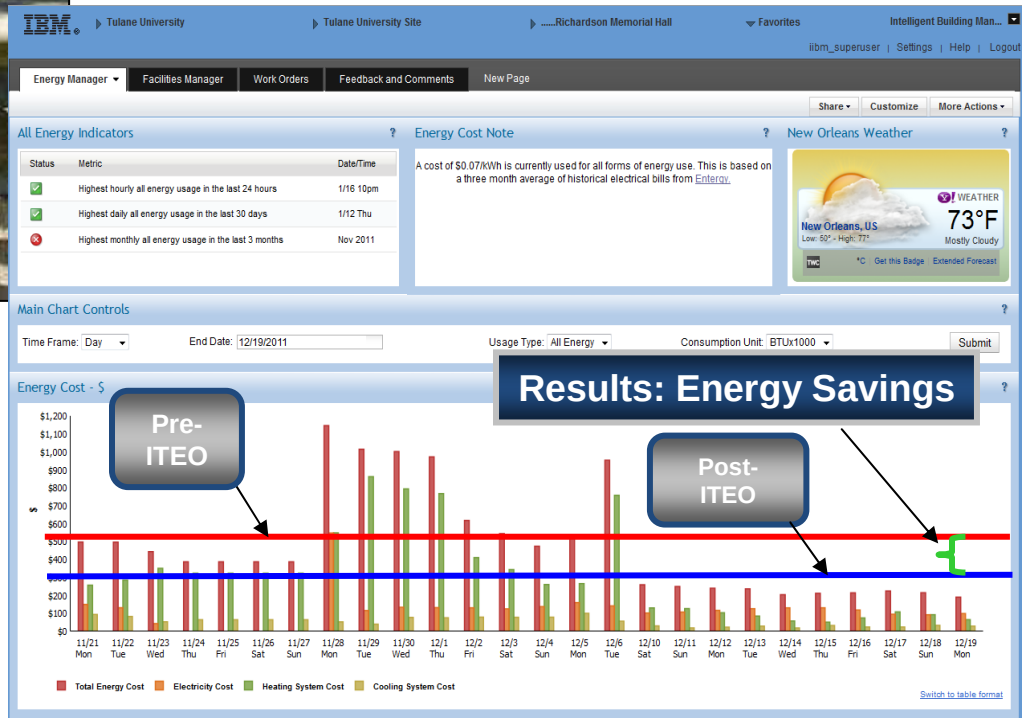
Client Project Tulane University/New Orleans (USA)



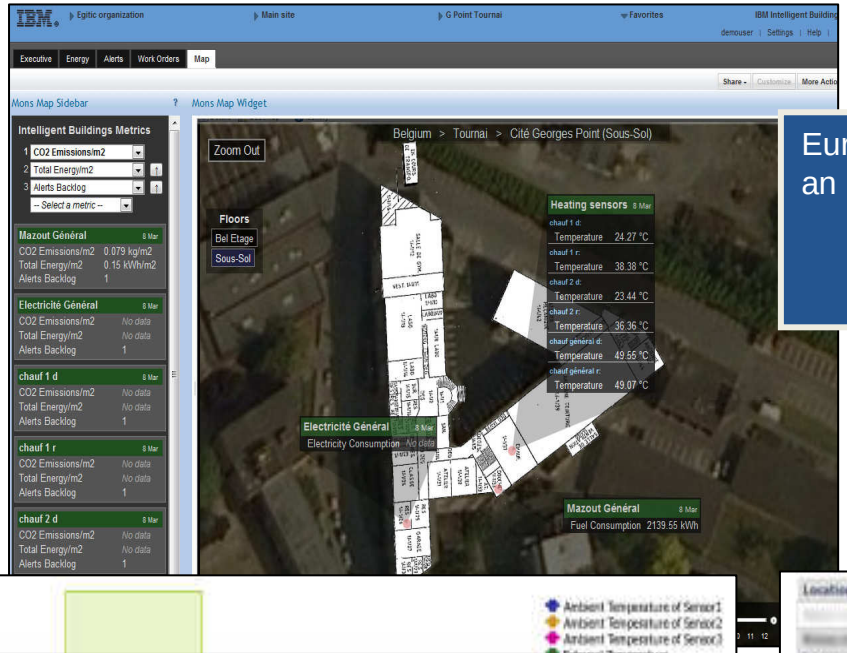
Goal to solve building shortcomings with the most effective and energy-efficient approach:

- 100 year-old Richardson Memorial Hall
- Connect existing systems to collect metered data
- Use advanced analytics to gain insight in building condition
- Bring together disparate data to drive better decision making
- Collection and analysis of heating, air conditioning, electric usage, and water consumption





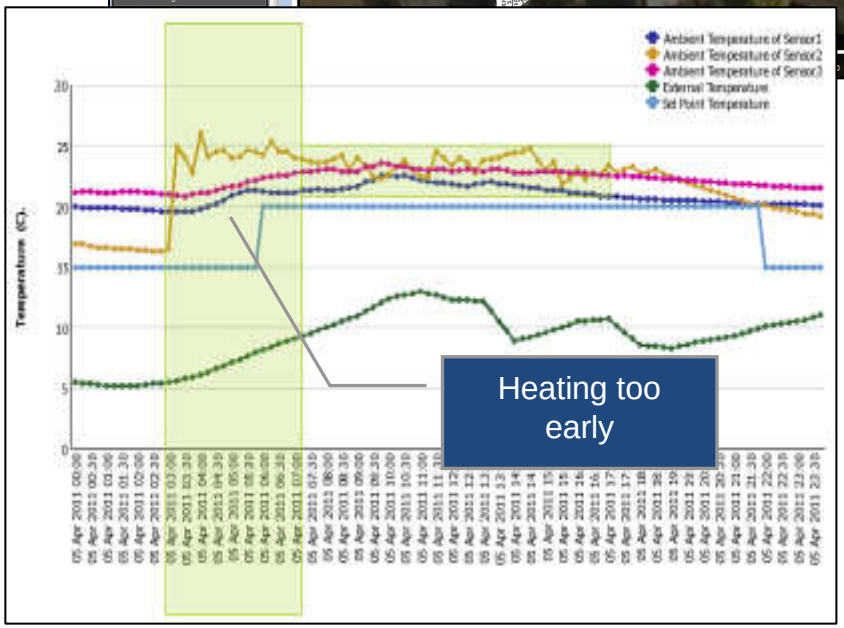
Project EuroGreenIT – Public Sector Buildings (Belgium)



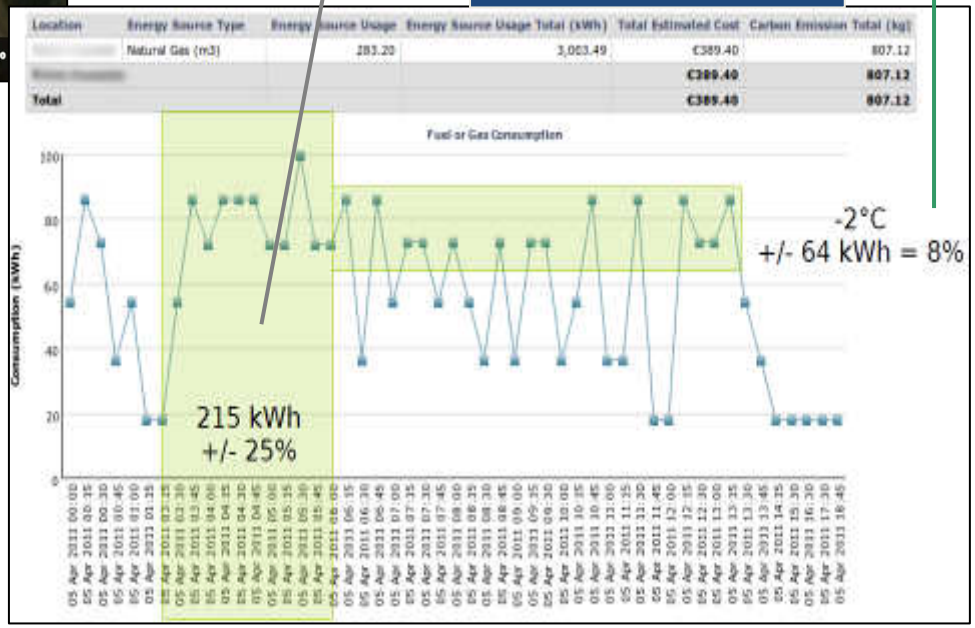
Euro Green IT partnered with IBM and Dapseco to deliver an IBM Tririga Energy Optimzation proof of concept:

- buildings with little to zero instrumentation.
- 3 schools / 30000 m²
- 2 administrations / 9000 m²)

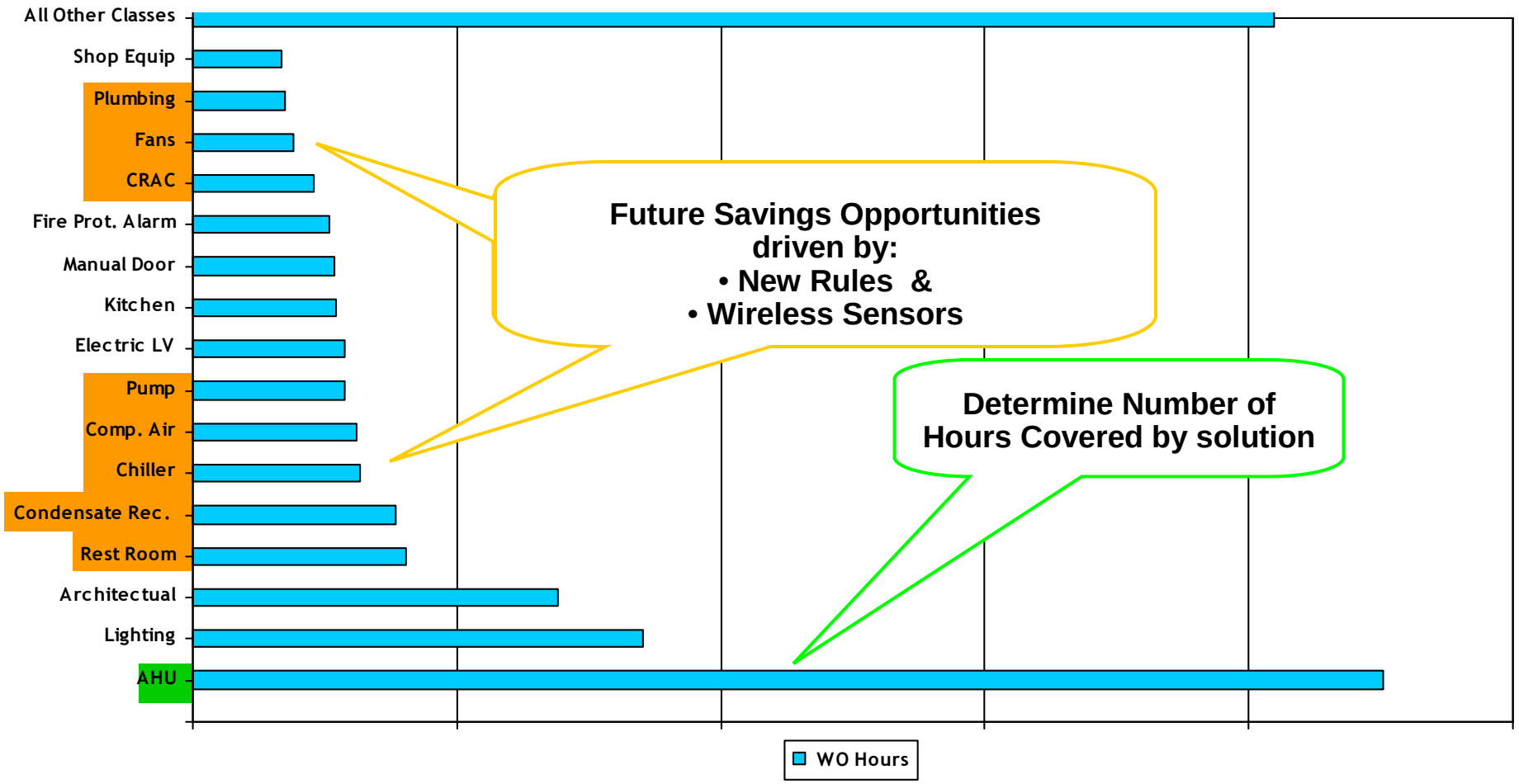
Savings example



Heating too early



Areas of Future Opportunity



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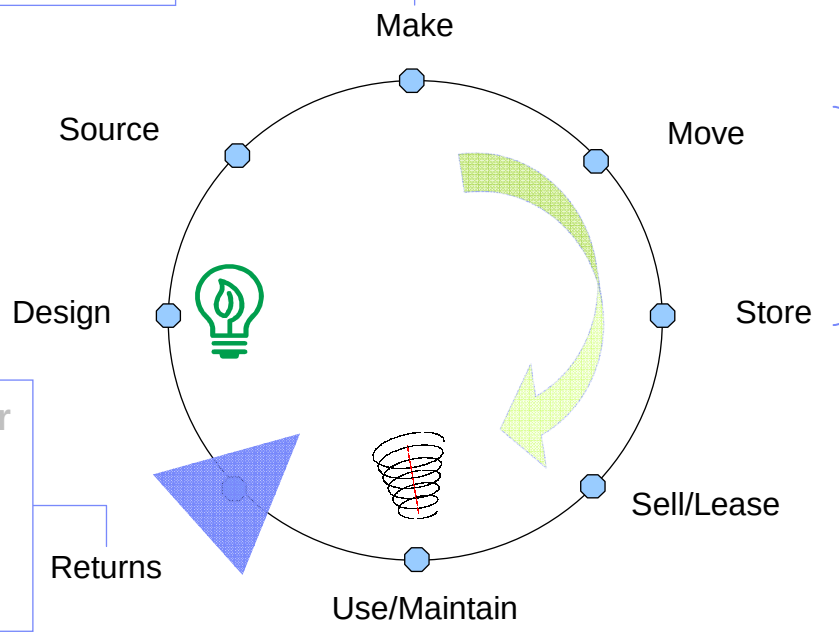


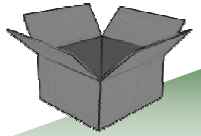
3

Asset Reutilization Optimizer
Applies advanced analytics to a stream of returned products to determine optimal, timely disposition

Where is the Carbon in the Supply Chain?

Everywhere! Supply Chain activities create significant carbon emissions, making supply chain an important focus for clients seeking to reduce their carbon footprint

Suppliers & Manufacturers



Customers & Channels

Flows: Product, Process, Information, Cash

Design	Plan	Source	Make	Deliver	Service & End-of-Life
PLM	**SC Strategy**	**Procurement**	**Integrated Ops**	**Logistics**	**Integrated Ops**
•Design for the Environment •Carbon footprint thinking throughout product lifecycle design	•How can the total network be optimized considering service, cost, "green" tradeoffs •What CO2 impact is there from various inventory concepts & planning methodologies	•How can we best measure a supplier's carbon impact (product, packaging, upstream logistics) and ultimately compliance with carbon reduction requirement? •How should we evaluate carbon offsets?	•What operations strategy (facility location, operating model) provides the best trade-off between cost, service, carbon? •Is there a role for sustainable factory / facility mgmt?	•What distribution network strategy (facility locations, sizes, transport modes) provides the best tradeoff of cost, service and carbon? •How can packaging be reduced and recycled?	•How can field service operations reduce carbon footprint with better routing and parts inventory tracking? •Feedback loop to engineering to reduce impact •Various strategies to reduce impact throughout lifecycle

Asset Management

Sustainable facilities management: Green building & renewable energy; carbon footprint asset management; Asset utilization (Real-time data on energy usage; Carbon dashboard)

Finance

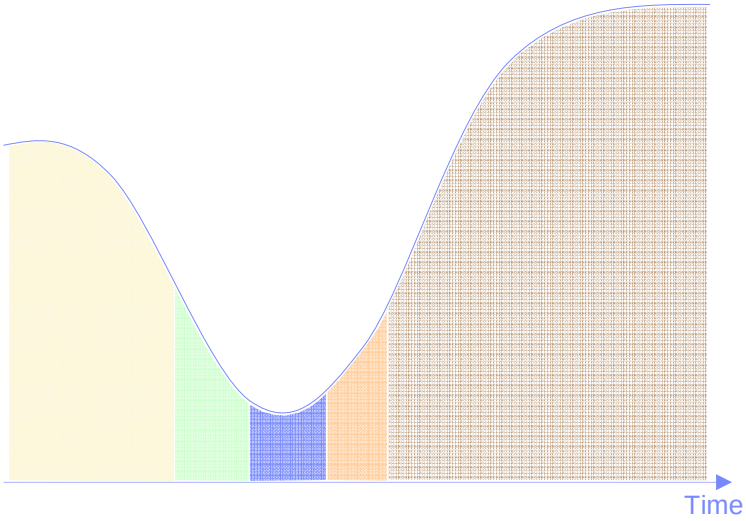
Paperwork Reduction; Environmental Cost Accounting; Environmental Tax Benefits Tracking

Carbon Analysis needs to be seen from a total Product Lifecycle View

As a general guideline, carbon reduction analysis needs to be driven by the size of the opportunity and its potential for change

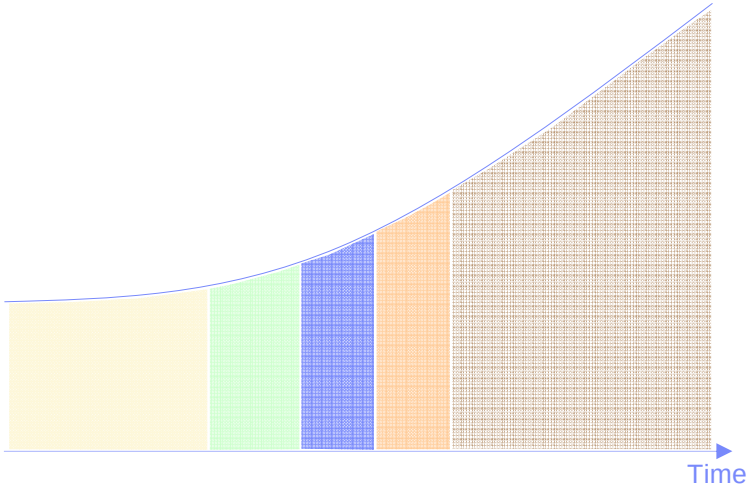
Carbon Footprint

Phased Supply Chain Lifecycle View



Carbon Footprint

Cumulative Consumption View



Components Sourcing

Inbound Logistics

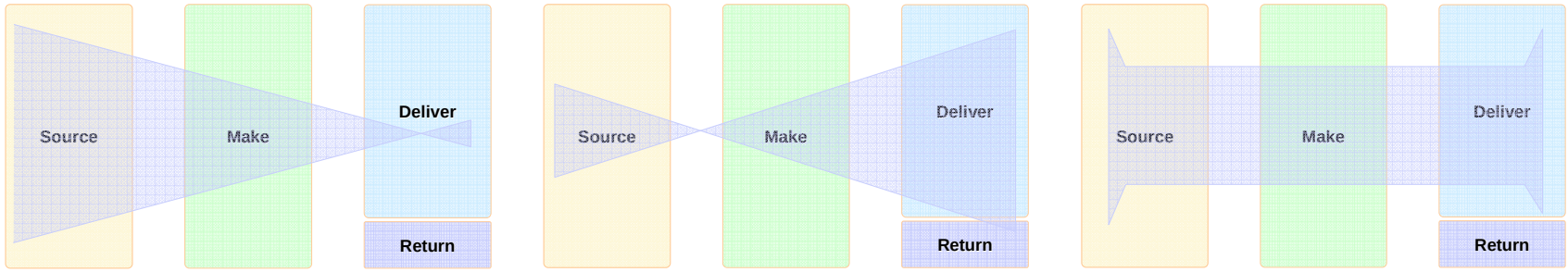
Manufacturing Operations

Outbound Logistics

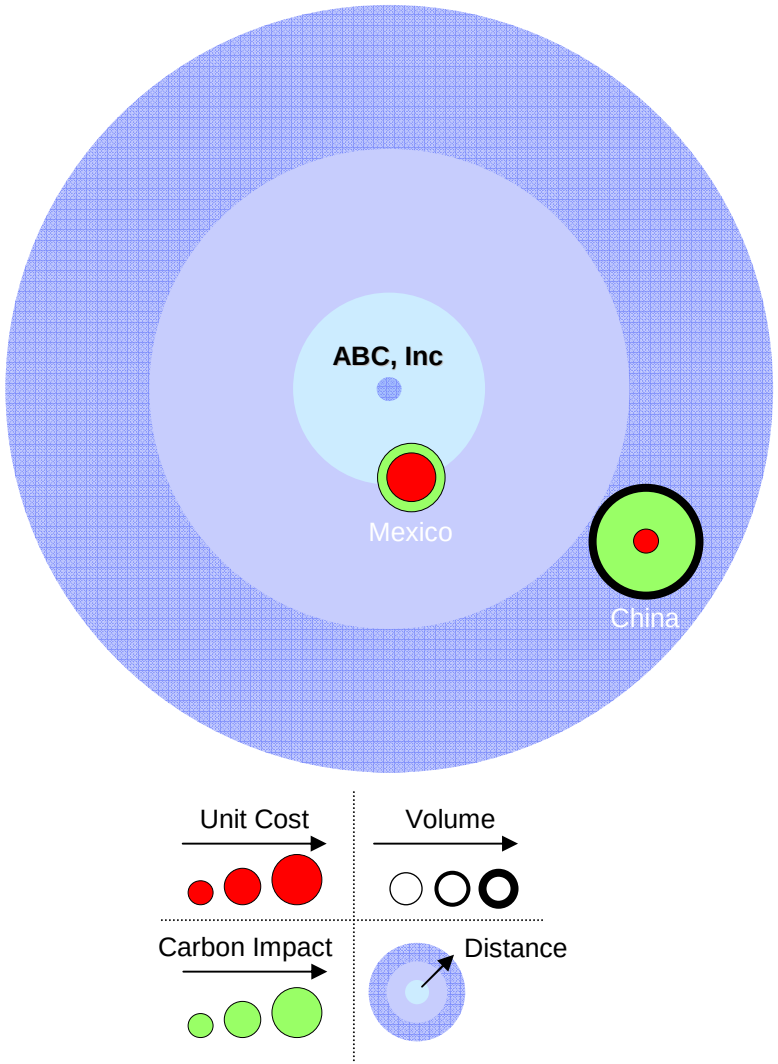
Service and Use

Determining our Focus Area

- A-Shaped – primarily an assembly operation (e.g. an assembly shop where most of the core machining is done by contractors) and where the focus of the analysis should be on the “Source” side
- V-Shaped – primarily a distribution operation (e.g. amazon.com receiving items in pallets and shipping them in units) and where the focus of the analysis should be on the “Deliver” side
- I-Shaped – classic manufacturing environment with a large number of sourced components and finished product configurations and where all processes need to be analyzed with particular focus on the “Make” process (e.g. process industry, chemicals, discrete manufacturing, etc.)



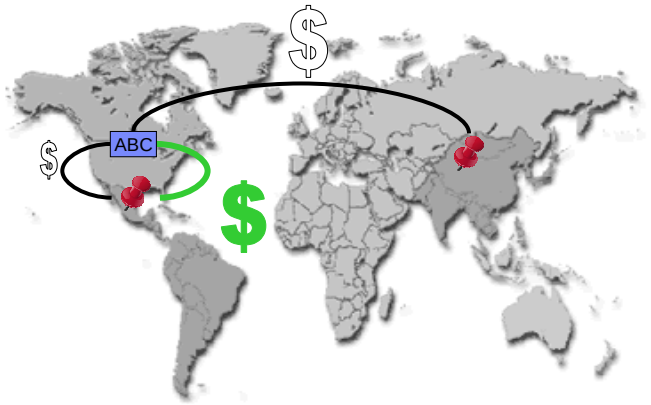
Sustainable Supplier Strategy Development



As-Is

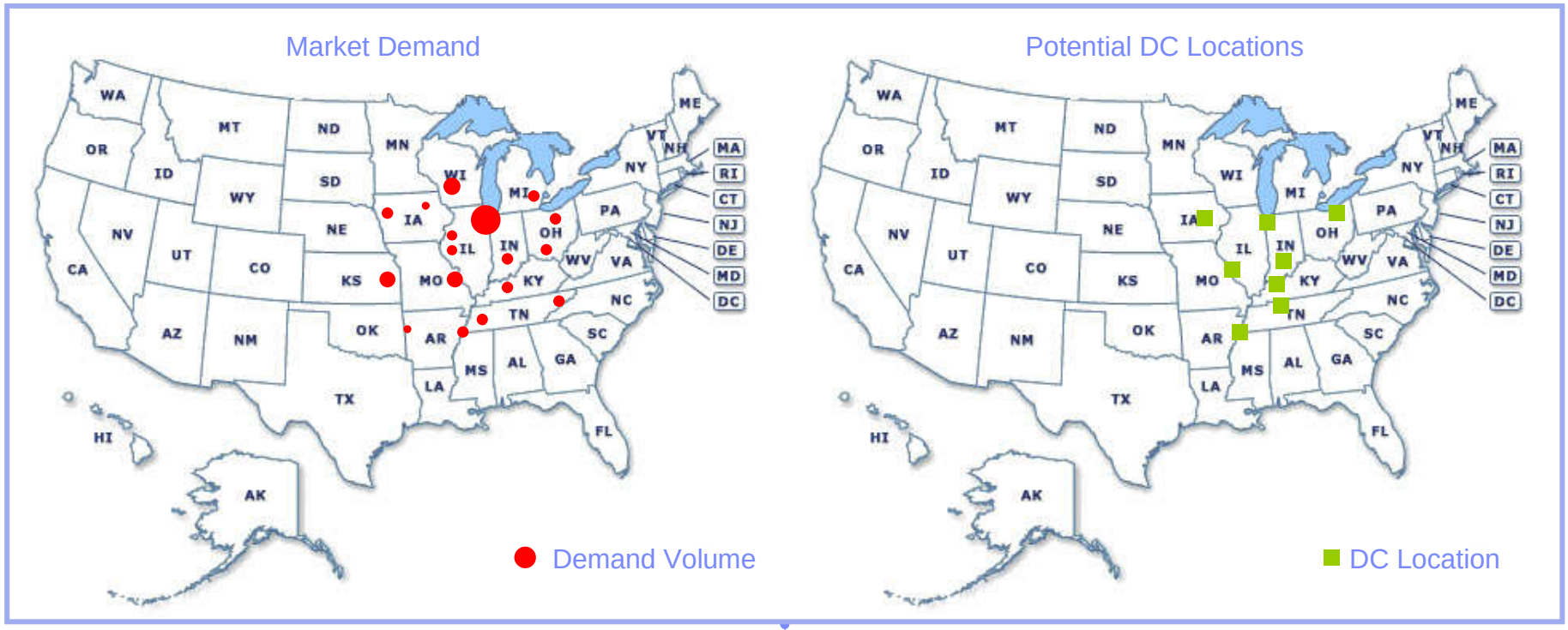
Classic Value Equation =
Least Production Cost *despite* the Transportation Cost

To-Be



***New "Green"* Value Equation =**
Actual Cost (Production + Transportation) **+** Corresponding Carbon Cost

Network Optimization Strategy



Classic Optimization Approach

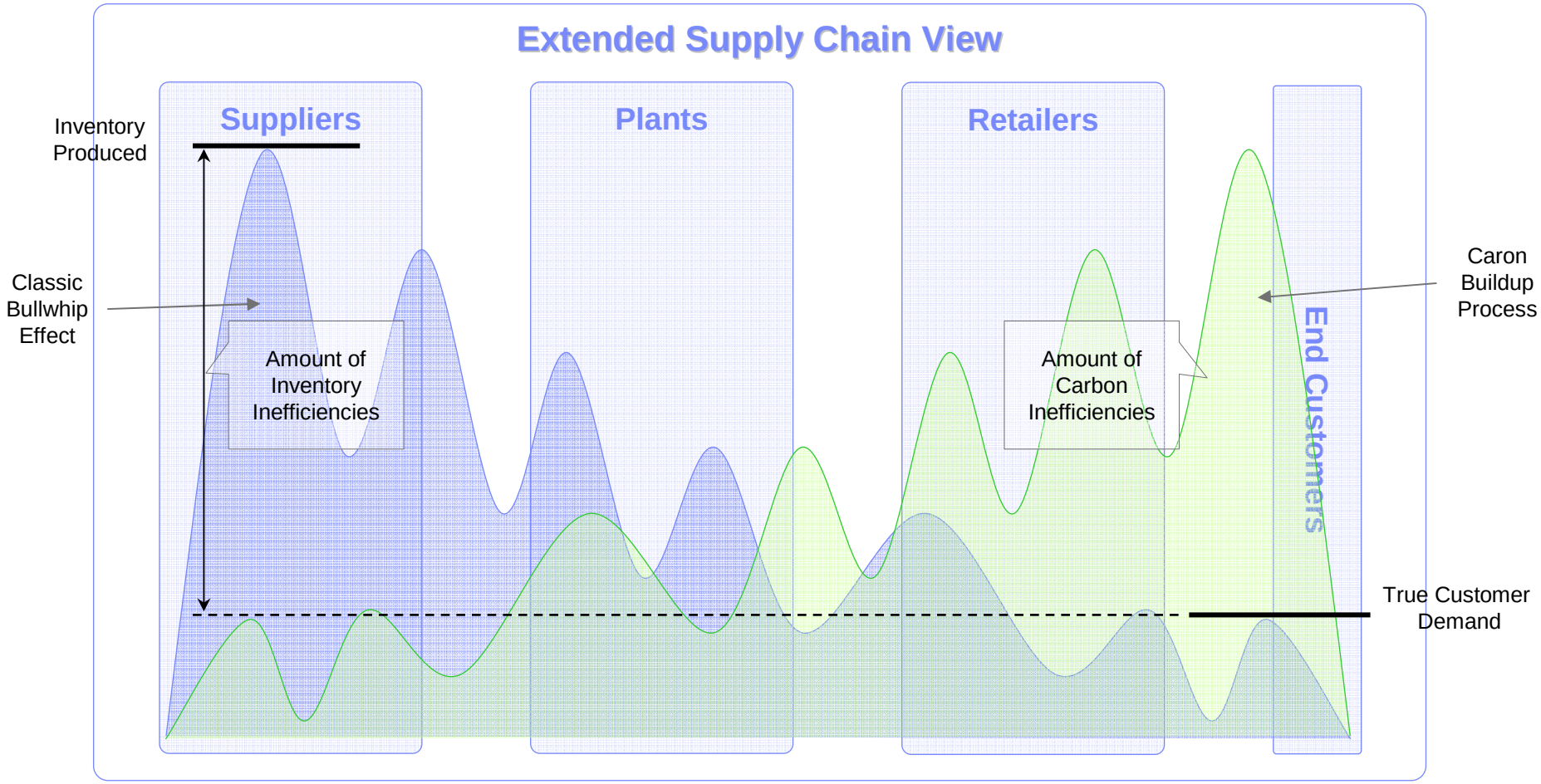
Minimize Total Cost – select DC's so as to minimize the total DC and transportation costs of meeting demands

vs

***Green* Optimization Approach**

Minimize CO_2 Emissions – objective function changes from minimization of total cost to minimization of total CO_2 emissions (equivalently, total miles traveled)

Carbon Buildup Effect



Supply Chain Scenario Modeler (SCSM) - Overview

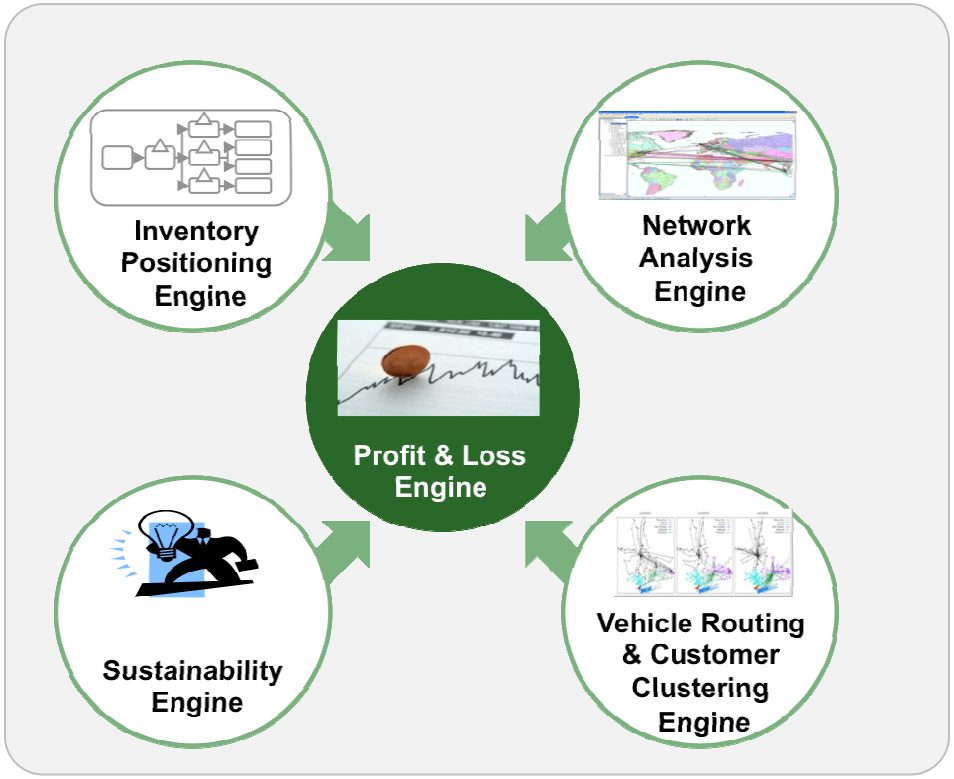
Supply Chain Scenario Modeler (SCSM)

SCSM Objectives:

- Link operational decisions to “Board Room” view (P&L impact estimation)
- Integrate key supply chain planning areas in one model (inventory, network, routing)
- Provide extensive “what-if” analysis across the supply chain
- Model sustainability in broader sense (operational, financial, environmental)

Benefits: $100M in working capital savings (McKesson – Pilot Implementation)

SCSM leads to supply chain optimization



A sophisticated analytics tool that models the entire supply chain and provides the capability to determine the financial and environmental impact of changes to any element within that supply chain

SCSM at A Large Pharma Distribution Company

Large Pharma Distribution Company

> 30 sites

> 25,000 customer locations

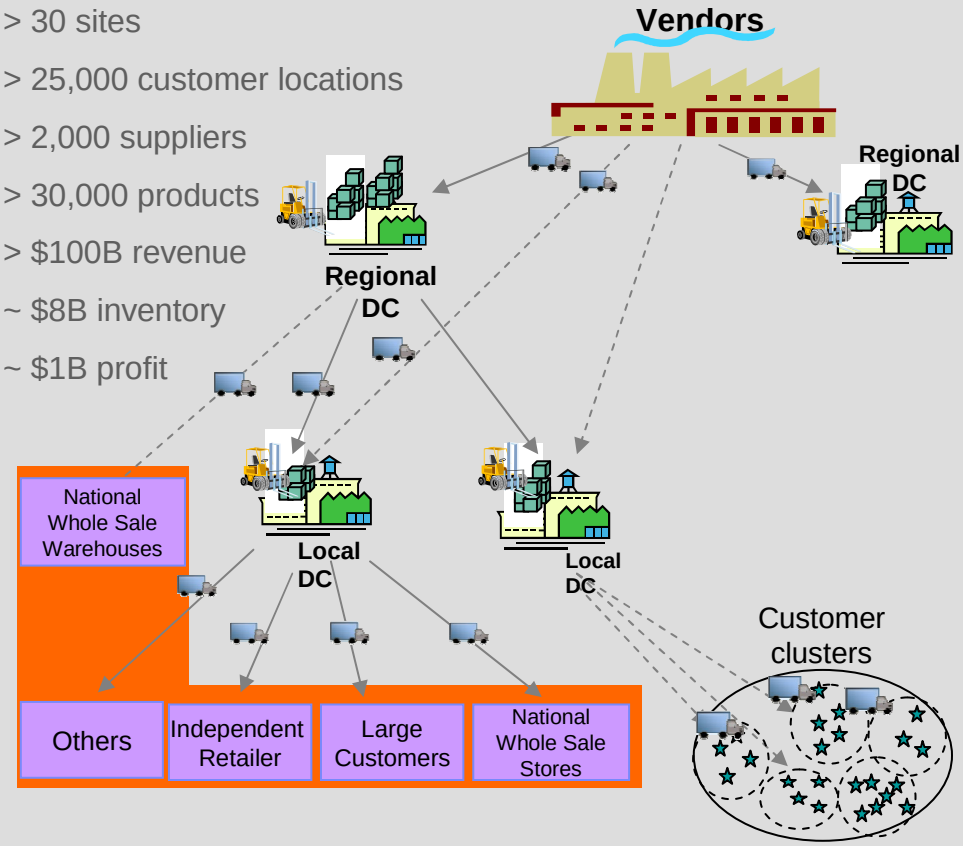
> 2,000 suppliers

> 30,000 products

> $100B revenue

~ $8B inventory

~ $1B profit



SCSM

Results:

- **Improved Piece Service Level**
  - 90% to over 99% for products included in scenario
- **DSI Reduction**
  - 20+ Days (50%) for products included in scenario
- **Working Capital Reduction:**
  - $100M

Case Studies

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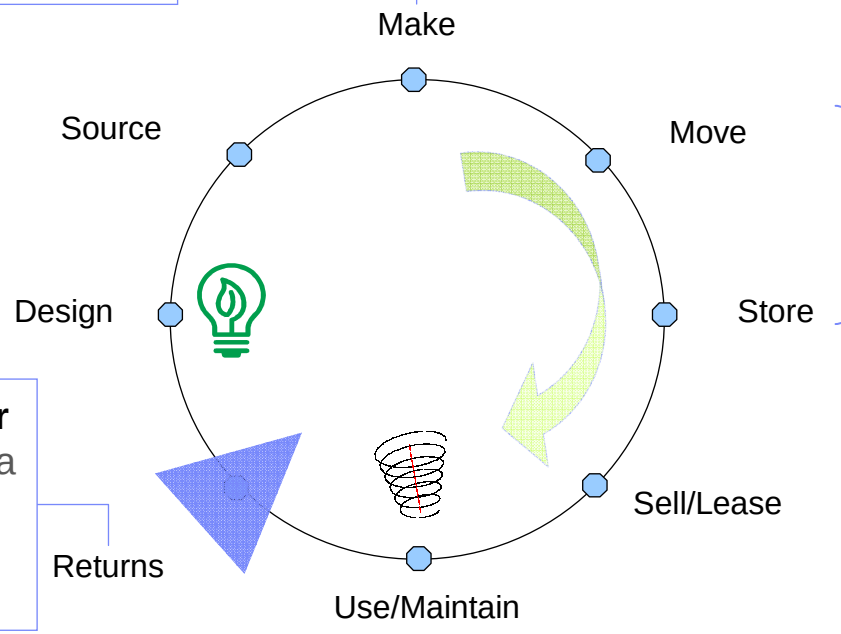
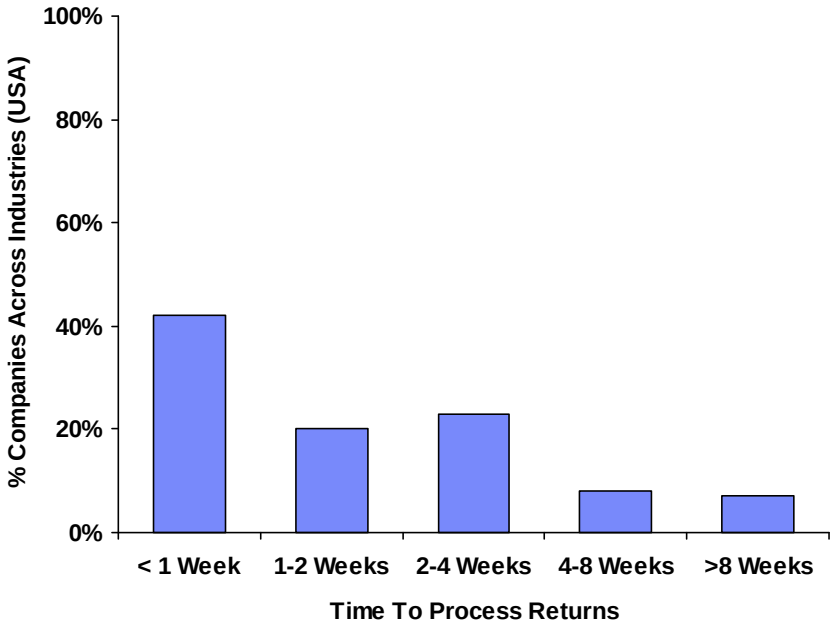


3

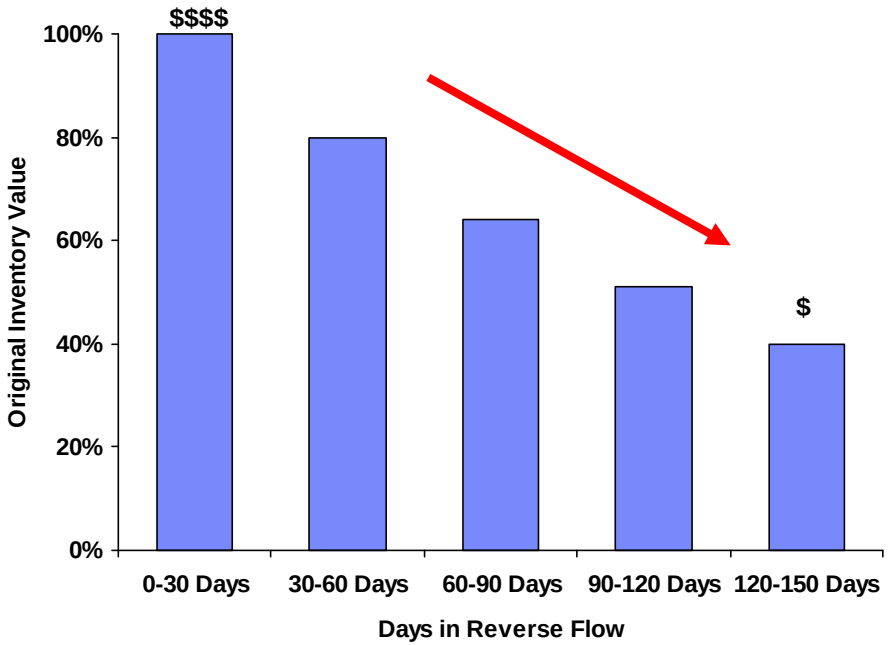
Asset Reutilization Optimizer
Applies advanced analytics to a stream of returned products to determine optimal, timely disposition

Impact of inefficient reverse logistics processes across industries

Longer returns processing cycles …



… depreciate inventory value

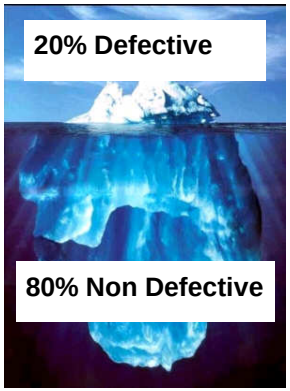


- **In the technology industry some items lose value every 10 days**
- **Financial information and cross-functional collaboration is critical in reducing returns processing cycle time and reducing depreciation in value**

Source: Working For Chief Financial Officers, Corporate Strategy Board

Reverse Logistics – Opportunities

- US consumers returned $ 200 Billion (more than the GDP of 66% of countries in the world)
- Leading companies spend approximately 9% of sales on returns



- Only 20% of new product returns are actually defective

- Returns are not like wine – value does not increase with age
- Some items lose value every 10 days

- Integrating returns requirements in early design is an attractive mechanism for achieving environmental improvement and profitability - a win-win

Opportunity:

- **<u>$128 - $160 Billion opportunity</u> for value recovery in US consumer products companies**
- **<u>Increase profits by 3-7% of sales</u> by improving their reverse logistics capabilities**

Reference:
1. Aberdeen Group – Industry Best Practices in Reverse Logistics
2. Manufacturers Save By Leveraging Returns; HBR

IBM is organized in three, global functions to facilitate the return and reuse of assets – both purchased and leased

Plans inventory reuse from purchased returns (e.g. replacement parts)

Manages leased equipment

Integrated Supply Chain (ISC) Division

IBM Global Financing (IGF)

Global Logistics Control Tower

Manages physical return and redistribution

The key was to build operations that could answer key questions to achieve three main objectives

Objective #1
Generate additional revenue from the return of assets

- What types of machines are being returned?
- What is the volume of returns over a given period?
- Are the returned machines viable as a whole?
- Are the component parts viable?
- Is there a lease or purchase market for pre-owned equipment or parts?
- Is re-sell value competing against “new buys” and parts sales?

Objective #2
Lower raw material costs by harvesting parts from recovered assets

- Can asset component parts be recycled into manufacturing/maintenance processes?
- How will costs vary in accordance with volume? What costs are fixed vs. variable?
- Are there potential economies of scale?
- Can we capture costs in our price points?

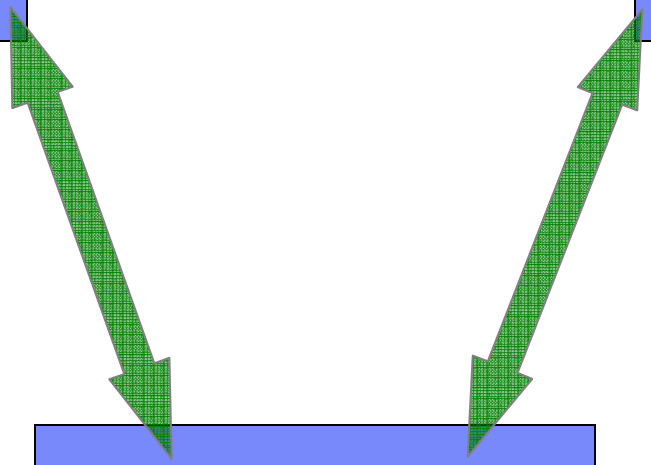
Objective #3
Reduce environmental impact of asset disposal

- Which parts can be recycled / reused?
- Of the parts that can’t, which are a hazard?
- What is the optimal method to minimize use of hazardous materials and to minimize exposure when handling?
- What is the optimal method of return to minimize carbon emissions from unnecessary transportation?
- Can these parts be redesigned to mitigate environmental concerns?

This optimization is enabled by a number of tools that IBM has developed since 2000

Integrated Supply Chain (ISC) Division

- *Asset Reutilization Optimizer* – Non Traditional Demand Supply Integration to optimize supply based on a part's profit contribution
- *SPSS Tool** – Models strategic returns (e.g. long lead time) on future products that haven't shipped yet; done with the NPD process



Global Logistics Control Tower

IBM Global Financing (IGF)

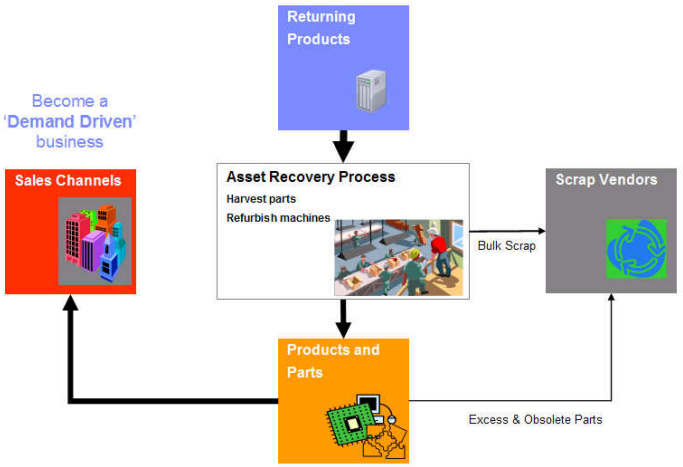
- *ICFS* – Leasing portfolio system, keeps inventory activity (machine level-detail); Module on back-end manages end of lease process to forecast likely returns; interfaced to GARS SAP
- *GARS SAP* – Manages inventory once returned; Aligns demand for spare parts to supply coming back from lease for reuse

Summary: Reverse supply chain captures used returns to create new value

The Solution

The solution applies advanced analytics to a stream of returned products to determine optimal, timely disposition. Analytics weigh the cost/benefit of refurbishment, disassembly and cost avoidance if parts are used in manufacturing. Solution provides waste reduction-related sustainability benefits

Asset Reutilization Optimizer



Collaboration

Solution developed in collaboration with IBM Research & IBM Global Asset Recovery Services (GARS). The optimizer uses Software Group ILOG CPLEX engine

Key Benefits

- Expands IBM addressable market into lower price point, certified, pre-owned segment
- Cost avoidance when recovered part is used in IBM manufacturing or as service part
- Value recovery from used parts sold into secondary mkts
- Waste reduction & associated cost saving & improved environmental performance

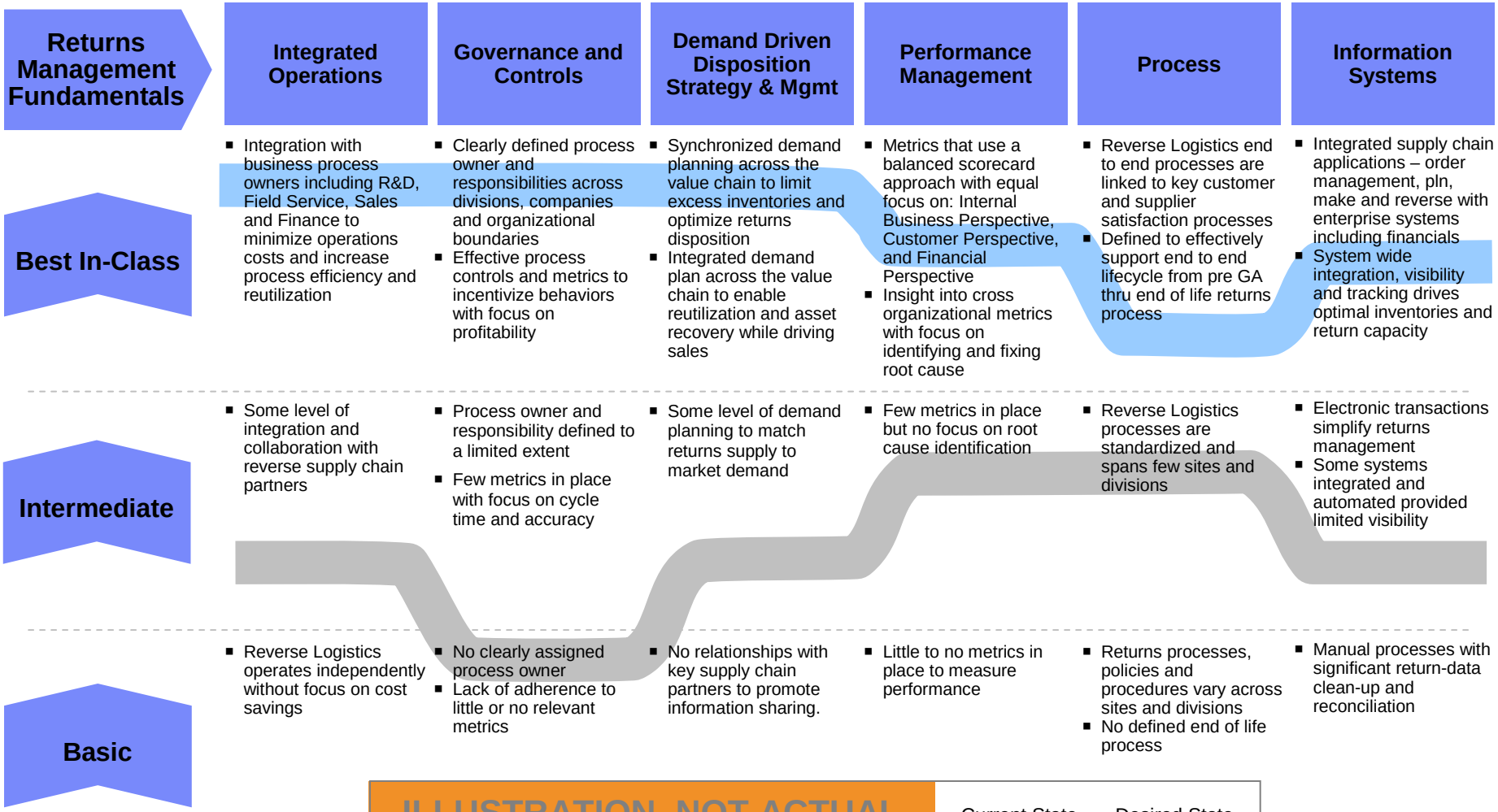
Over $100M* annual impact in savings and recoveries from the full machine and parts asset recovery programs in ISC

Recipient of prestigious **PM100 award in 2010**, presented for leadership in manufacturing innovation

*Note: conservative number, true impact is significantly higher, but confidential

Capability maturity model is used to assess the attributes present in returns management and reverse logistics processes

Focusing on areas with largest gaps will result in improvements across multiple dimensions of returns management and maximize the return on investment



Presentation Topics

Background

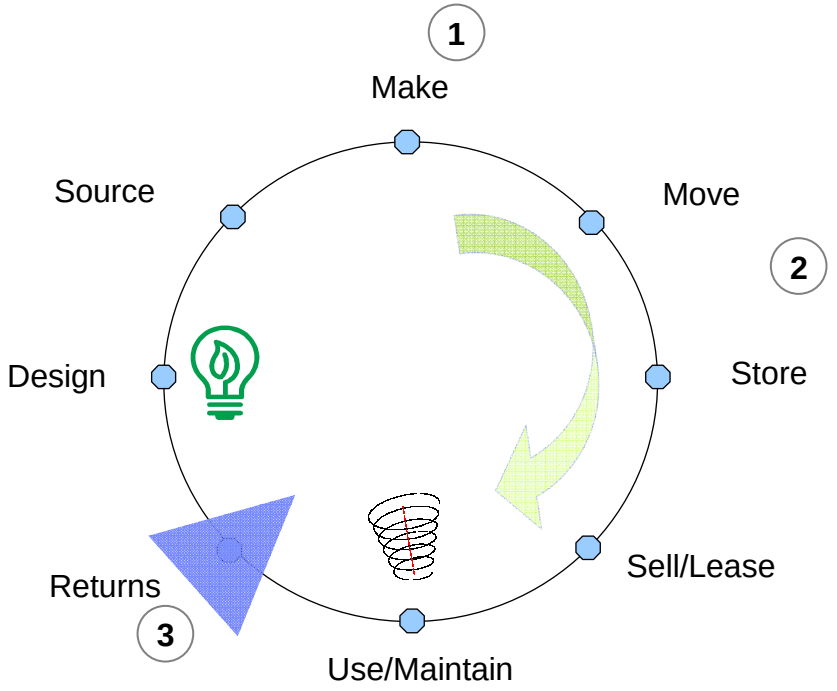
- Overview of IBM Sustainability Initiatives
- IBM transformation required fundamental supply chain changes
- Smarter Supply Chain Analytics

Case Studies

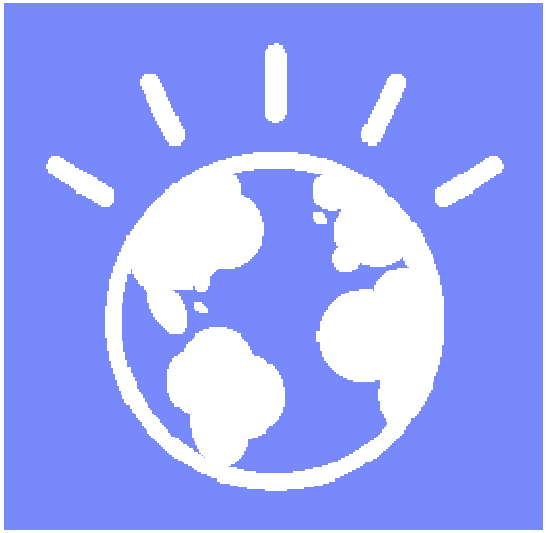
- 1. Smarter Buildings
- 2. Supply Chain Scenario Modeler
- 3. Asset Reutilization Optimizer

Key Takeaways

- The Principle of “Smarter”
- Smarter Analytics
- 12 Ideas to Make Your Supply Chain Greener



The **Principle** of "Smart"



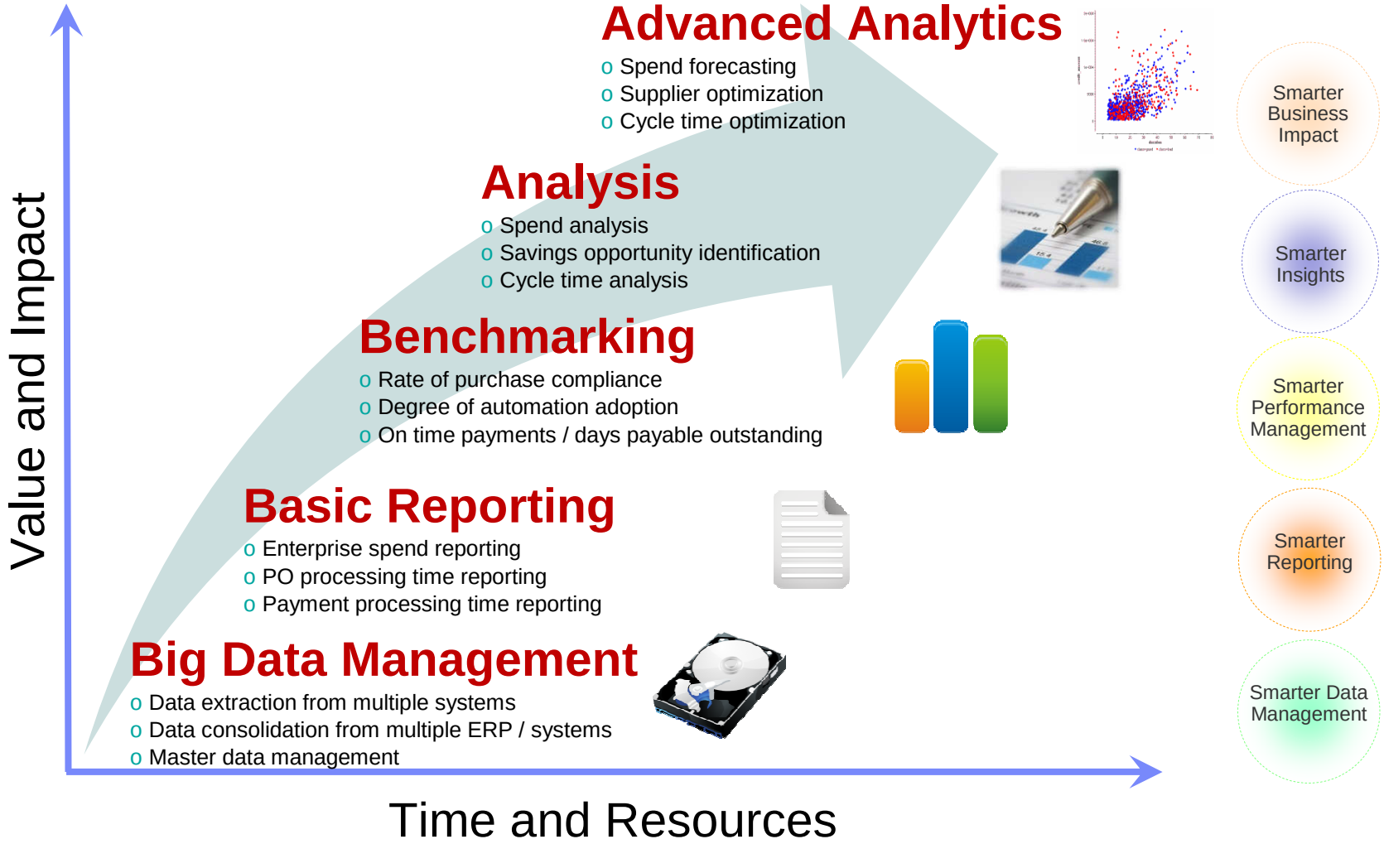
Smarter Planet

Our world is becoming
INSTRUMENTED

Our world is becoming
INTERCONNECTED

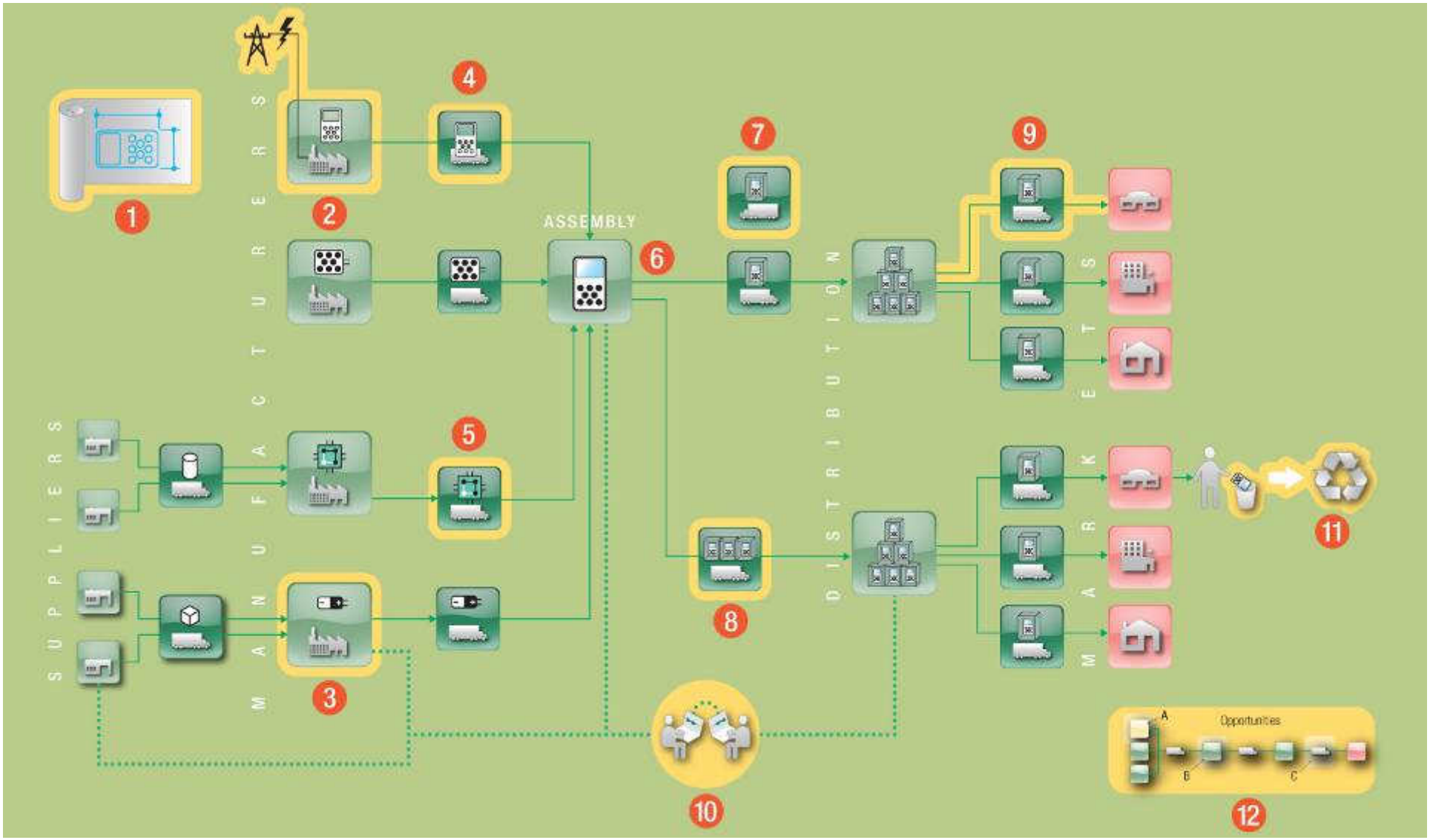
Virtually all things, processes and ways of working are becoming
INTELLIGENT

The greatest impact of analytics is realized when investment is made to incorporate it into the end-to-end process

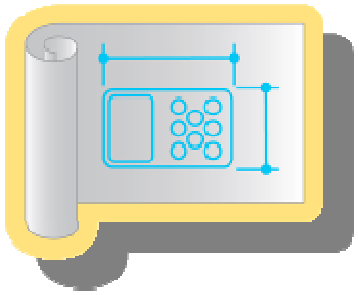


Based on : Competing on Analytics, Davenport and Harris, 2007

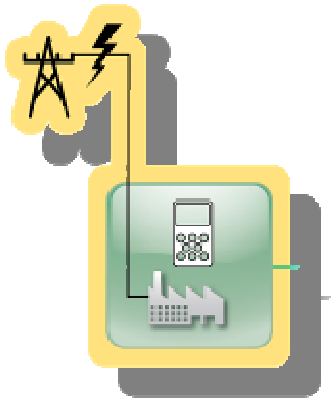
12 Ideas to Make Your Supply Chain Greener



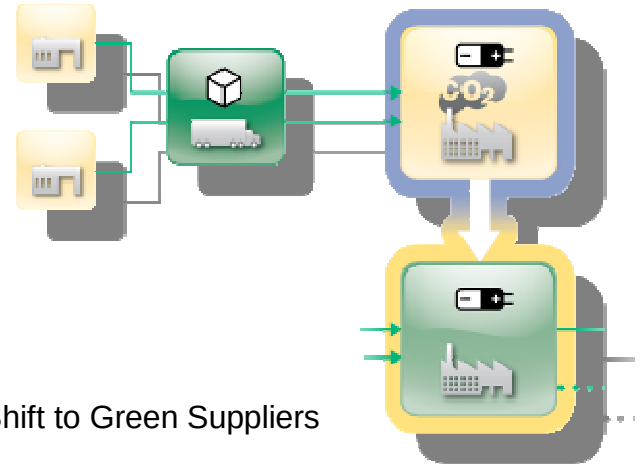
Exploring the Ideas



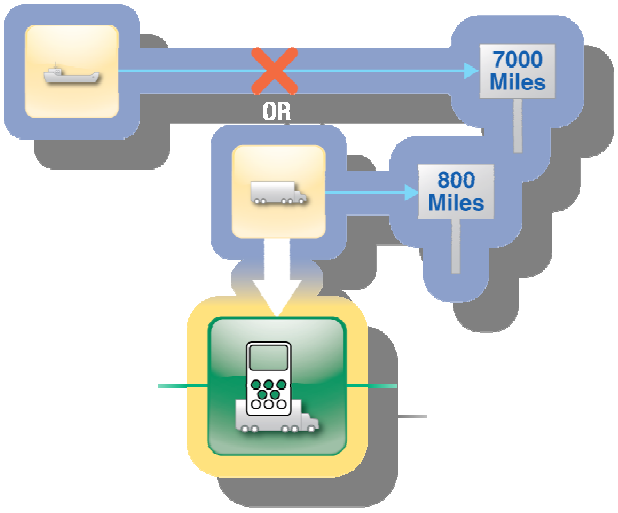
1 Redesign the product



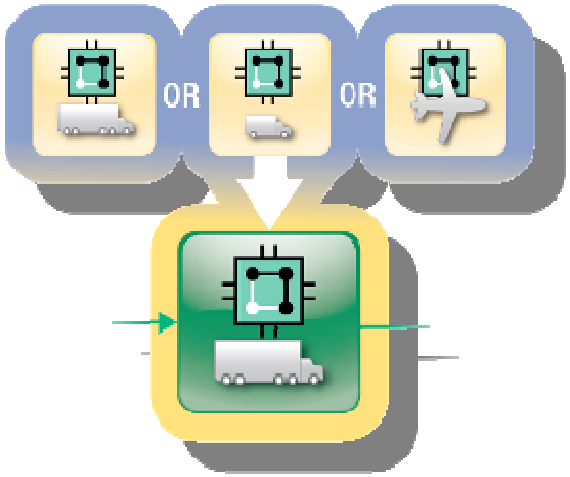
2 Reconfigure Manufacturing



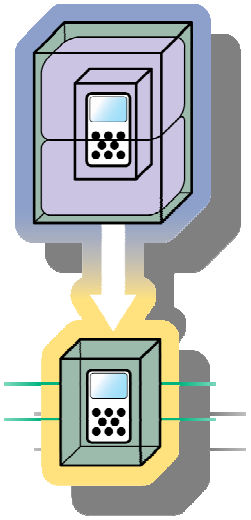
3 Shift to Green Suppliers



4 Shorten Distances

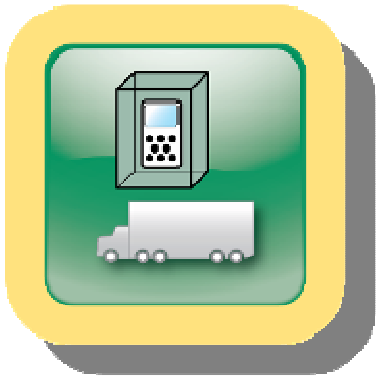


5 Alter service-level agreements

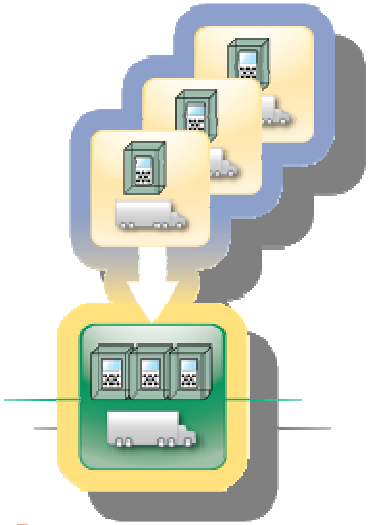


6 Shrink packaging

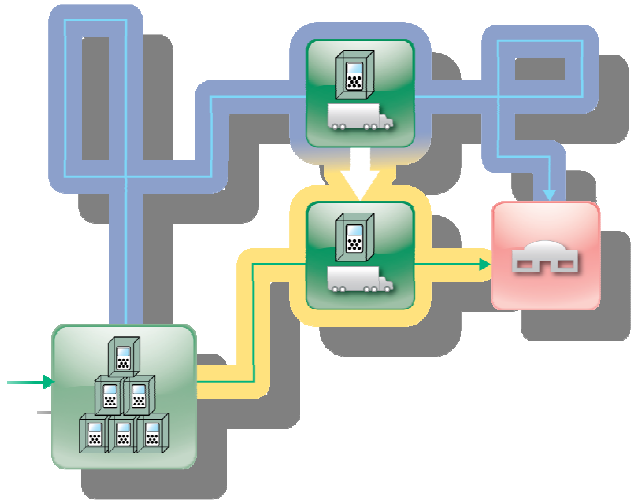
Exploring the Ideas (continued)



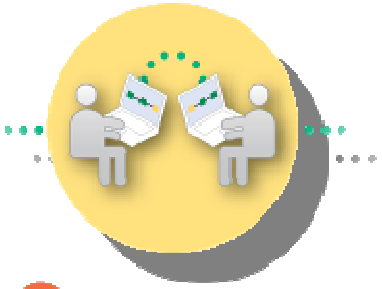
7 Plan for reverse supply chain activity



8 Consolidate shipments

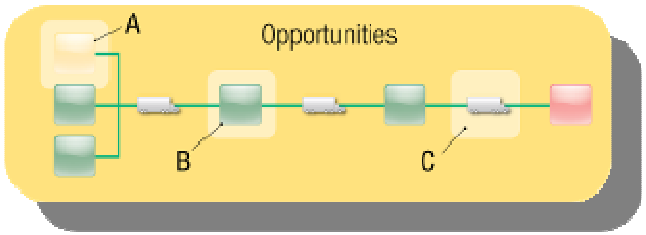


9 Plan smaller routes

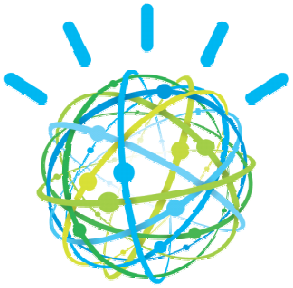


10 Coordinate with partners

11 Take a life-cycle view



12 Start now: define a green strategy



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