How the IoT and Data Analytics Will Drive the Future of the Supply Chain

Presented by:

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VP, Data Analytics
Getting beyond the “Buzz” in Supply Chain
Agenda

✓ Notes and Terms
✓ The Smart Warehouse
✓ Measurable success
✓ Tools and roadmap
✓ Looking Ahead
The **Internet of things** is the internetworking of physical devices, **vehicles** (also referred to as "connected devices" and "smart devices"), buildings, and other items, embedded with electronics, software, sensors, actuators, and network connectivity that **enable these objects to collect and exchange data**.

The **Internet of things** is the interconnection via the Internet of computing devices **embedded in everyday objects**, enabling them to **send and receive data**.

**Telematics** is the area of technology that deals with **sending digital information** over long distances using **wireless forms of communication**:

*In vehicles, telematics can be used to monitor **hours used and miles driven**, each of which can be recorded in real time.*
Three basic components make a “thing” part of the IoT

- Sensors track and measure activity
- Internet connectivity contained in the object
- Processors enable the object to have computing power

It is estimated there are approximately 6.4B IoT devices

- Excludes smartphones, tablets, computers

*Gartner, Inc.*
The “Fourth Industrial Revolution”

The IoT will add $4T to $11T in potential economic impact by 2025

McKinsey Global Institute

<table>
<thead>
<tr>
<th>Nine settings where value may accrue</th>
<th>Size in 2025, $ trillion¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factories—eg, operations management, predictive maintenance</td>
<td>Low estimate&lt;br&gt;High estimate&lt;br&gt;1.2–3.7&lt;br&gt;0.9–1.7</td>
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<tr>
<td>Cities—eg, public safety and health, traffic control, resource management</td>
<td>0.9–1.7</td>
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<td>Human—eg, monitoring and managing illness, improving wellness</td>
<td>0.2–1.6</td>
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<tr>
<td>Retail—eg, self-checkout, layout optimization, smart customer-relationship management</td>
<td>0.4–1.2</td>
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<td>Outside—eg, logistics routing, autonomous (self-driving) vehicles, navigation</td>
<td>0.6–0.9</td>
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<td>Work sites—eg, operations management, equipment maintenance, health and safety</td>
<td>0.2–0.9</td>
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<tr>
<td>Vehicles—eg, condition-based maintenance, reduced insurance</td>
<td>0.2–0.7</td>
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<tr>
<td>Homes—eg, energy management, safety and security, chore automation</td>
<td>0.2–0.3</td>
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<tr>
<td>Offices—eg, organizational redesign and worker monitoring, augmented reality for training</td>
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Total $4 trillion–$11 trillion
Data storage prices have dropped dramatically from more than $10,000 to less than $0.10 per GB over the decades.

Examples of data collected every one minute:

- 350,000 tweets
- 300 hours of video
- 171 million emails
- 330 gigabytes

Jet engine sensor data
The Smart Warehouse: Roadmap

- Fleet Management
- Materials Tracking
- Warehouse Management System
- Data Integration and Reporting
- Advanced Analytics
- Looking ahead
The Smart Warehouse: *Driven by IoT, Analytics*

- **Automated**
  - Eliminate manual processes of labor and input (costs)
  - Increase accuracy, speed
  - Savings generally exceed costs 2:1 within 24 months

- **Nimble**
  - Flexibly adapt, manage staffing, software, environment

- **Scalable**
  - Handle changes in demand, seasonality

- **Real-time**
  - Fully integrated, fully transparent, real-time by task

- **Customer-centric**
  - Real-time web access, enabled by a robust WMS
The Smart Warehouse: Measurable Success

- Operator efficiency, productivity
- Asset optimization
- Warehouse space optimization
- Safety improvement
- Overall visibility increased
- Foster data-driven culture
Fleet Management: VMS

✓ Standard VMS features, including:
  - OEM inclusive
  - Access control – by group, asset, location
  - Checklists/compliance
  - Text messaging
  - Current status, speed, warnings
  - Driver productivity
  - Lift weight
  - Location within facility

✓ Wireless:
  - Wi-Fi (enterprise mode) standard
  - Cellular (optional)

Connected cars and vehicles will generate nearly 300k Exabytes of data by 2020
1 EB = 1 million terabytes = 1 billion gigabytes (more than doubling annually)
Fleet Management: Measurable Success

- Operator efficiency, productivity
- Asset optimization
- Visibility, route optimization
- Safety improvement
Fleet Management: Efficiency, Productivity

✓ Automated OSHA checklists

✓ Operator efficiency by vehicle
  - Time, distance required to perform work
  - Motion vs login time ratio

✓ Operational profiling
  - By OEM, vehicle type, conditions, facility

✓ Identify opportunities for automation

✓ Monitor vehicle abuse, wear and tear by operator
Fleet Management: Efficiency, Productivity

Vehicle Usage Dashboard

- Efficiency, Productivity
- Vehicle Usage
- Dashboard

Motion vs Login Hrs Pct by Site

Usage Hrs by Site

- Demarest
- Norwood
- Oradell
- Tenafly
- Cresskill
- River Edge
- Woodcliff Lake
- Closter
- Old Tappan
- Montvale

Vehicles Used by Site

- Demarest
- Norwood
- Oradell
- Tenafly
- Cresskill
- River Edge
- Woodcliff Lake
- Closter
- Old Tappan
- Montvale
Fleet Management: Efficiency, Productivity

- Efficiency, Productivity
- Average Daily Motion Hours
- Percent Variance from Fleet Average

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<th>Site</th>
<th>Operator</th>
<th>Days Used</th>
<th>Avg Days Saved</th>
<th>Enterprise Avg Days Used</th>
<th>Motion vs Login</th>
<th>Enterprise Avg Motion vs Login</th>
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Fleet Management: Asset Optimization

- Balance fleet size based on usage, demand
- Manage leases by meter, usage and forecast
- Right-size fleet based on max usage and demand
- Predictive maintenance
- Reduce asset downtime
Fleet Management: Asset Optimization

- Fleet Management: Asset Optimization
  - Fleet Management
    - Asset Optimization

In Summary
Fleet Management:  *Route Optimization*

- GPS, beacons, wi-fi (location-based)
- Integration with public maps, floor plans
- Visibility, tracking, replay
- Identify bottlenecks
- Optimize movement of vehicles, materials
Fleet Management:  Safety Improvement

✓ Vehicle access control
✓ Speed control
✓ Zone access control
✓ Impact sensing
✓ OSHA checklists and reporting

OSHA statistics from 2013 report that there are approximately 85 forklift fatalities and 34,900 serious injuries yearly.
The average direct cost to a company is $38,000 with $150,000 in indirect costs related to a single forklift incident.

*National Safety Council*
An OSHA safety fine can cost a company up to $7,000 for “minor” infractions, and up to $70,000 for repeat offenders.

OSHA
Materials Tracking: Tools and Technology

Handheld devices, scanners, barcodes

GPS and RFID technologies: The “backbone” of the IIoT
- Provide identity, location and other tracking information
- Tracking from manufacturer to retailer
- Automates shipping, delivery, accurately predicts time of arrival
- Monitors details like temperature control, which impact quality
Materials Tracking: Applications

Placed on pallets

- Bring in traffic, weather, driver-specific data (average speed, pattern)
- Brings together real-time sensor data with environmental data
- Identify traffic jams in advance
Materials Tracking: Applications

Key Benefits:

- Proactive replenishment
- Reduce asset loss
- Save fuel costs
- Monitor the cold chain

  - About one third of food perishes in transit every year
    *United Nations Food and Agriculture Organization*

- Manage warehouse stock
- Create fleet efficiencies

Deadhead miles account for up to 10% of truck miles and 28% of truck miles for private fleets

*National Private Truck Council*
Integration, Reporting: Key Benefits

- **Greater efficiency**
  - Singular, consolidated, consistent reporting

- **Context and Filters**
  - Leverage definitions across platforms

- **Comprehensive analysis**
  - Merge metrics from disparate systems to create a holistic picture

- **Enterprise analysis**
  - Evaluate performance across the entire enterprise, by site, group, operator, etc.
Integration, Reporting: Sources

- VMS
- WMS/ERP
- Integrated Reporting
- Timecard
- Location Tracking
- EIS/DSS
- Battery Management
- Maintenance System
Integration, Reporting: **Examples**

**Scorecards**
- **Vehicle Utilization**
- **Pallets**
- **Impacts**

**Dual-axis**
- **Pallets**
- **Impacts**
Integration, Reporting: *Examples*

Rank sites performance by:
- **X-axis**: Pallets moved (WMS)
- **Y-axis**: Motion vs Login Ratio (VMS), or
- **Y-axis**: Motion vs Hours Ratio (VMS / Timecard)
Integration, Reporting: **Examples**

- Heatmaps
  - Timecard
  - Vehicle utilization
  - Pallets
  - Impacts

**Heatmaps**

- Daily Heatmap
- Hourly Heatmap
- 15-Minute Heatmap
Advanced Analytics

✓ Leverage AI, Machine Learning
  – Utilize vast amounts of data from sensors, business systems

✓ Action – beyond insights
  – Recommended course of action based on numerous variables
  – Descriptive > Diagnostic > Predictive > Prescriptive Analytics

✓ Simulation
  – Model affects based on changes
  – Develop intelligent workplans based on numerous variables

✓ Prediction
  – Forecast demand, maintenance, work performed

✓ Variation analysis
  – Characterize typical operations
  – Develop profile “fingerprint” for every operational variable
    • Operator, vehicle, OEM, tasks, environment, demand
Advanced Analytics: Examples

Fleet Optimization
- Optimal fleet size based on simultaneous usage
Looking Ahead: The Digital Supply Chain

- Beyond the warehouse
- Sensors / End-to-end visibility
- Smart Infrastructure
- Real-time
- Machine Learning and prediction
- Optimization / Ongoing adjustments
- Automation
### In Summary

#### Widely Used | Becoming the Standard | Looking Ahead
--- | --- | ---
Vehicle Management Systems | Smart Warehouse | The Digital Supply Chain
Warehouse Management Systems | Automation | Artificial Intelligence
RF-Ild and Scanners | Robotics | Machine Learning
Automated Checklists | Data-driven accountability | Ongoing Optimization
Basic Reporting and Analytics | Advanced and Predictive Analytics | Prescriptive Analytics

80% surveyed believe the Digital Supply Chain will be the predominate model within the next five years

16% saying it’s happening today

2017 MHI Annual Industry Report
For More Information:

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Or visit MODEX Booth #4021