

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

Presented by:

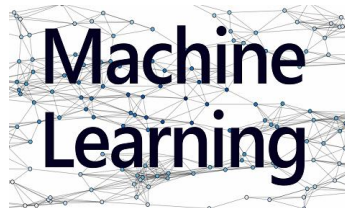
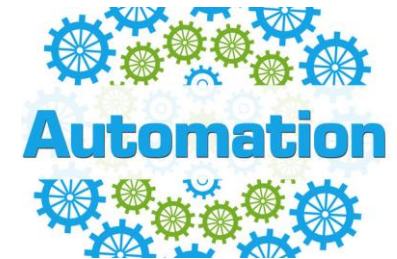
Dan Romary

VP, Data Analytics

MAKE YOUR BUSINESS
 **FUTUREPROOF.**



Getting beyond the “Buzz” in Supply Chain



Agenda

- ✓ Notes and Terms
- ✓ The Smart Warehouse
- ✓ Measurable success
- ✓ Tools and roadmap
- ✓ Looking Ahead



Notes and Terms



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.

Notes and Terms

- 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

IoT, Data Analytics

Meeting Agenda

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Key Terms

IoT Rapid Expansion

The Smart Warehouse

Measurable Success

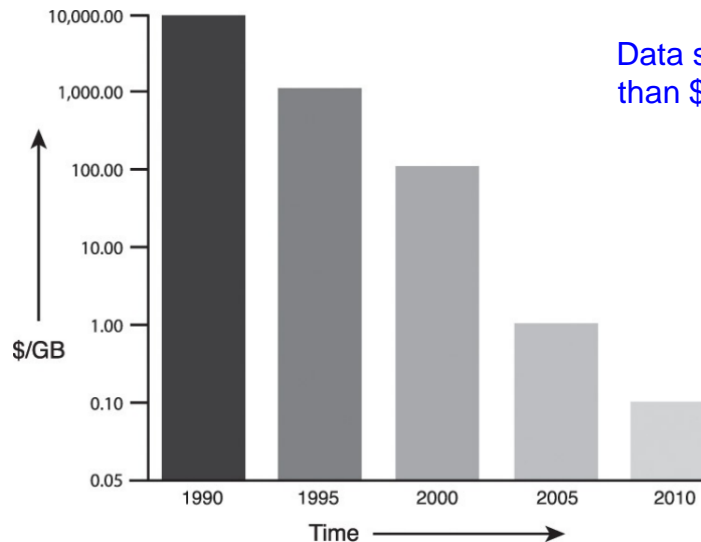
Tools and Roadmap

Looking Ahead

In Summary



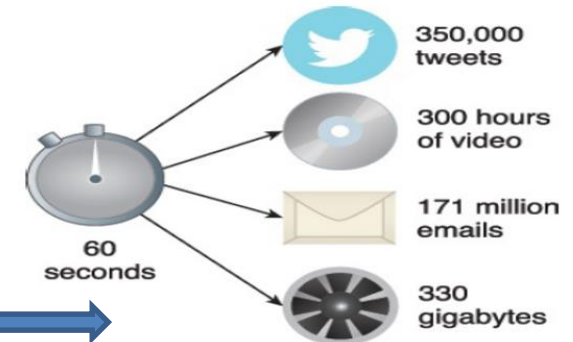
Notes and Terms



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

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 = 1million terabytes = 1 billion gigabytes (more than doubling annually)

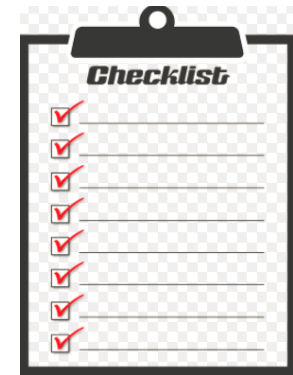
Fleet Management: *Measurable Success*

- ✓ 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



IoT, Data Analytics

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Fleet Management: *Efficiency, Productivity*

IoT, Data Analytics

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Fleet Management

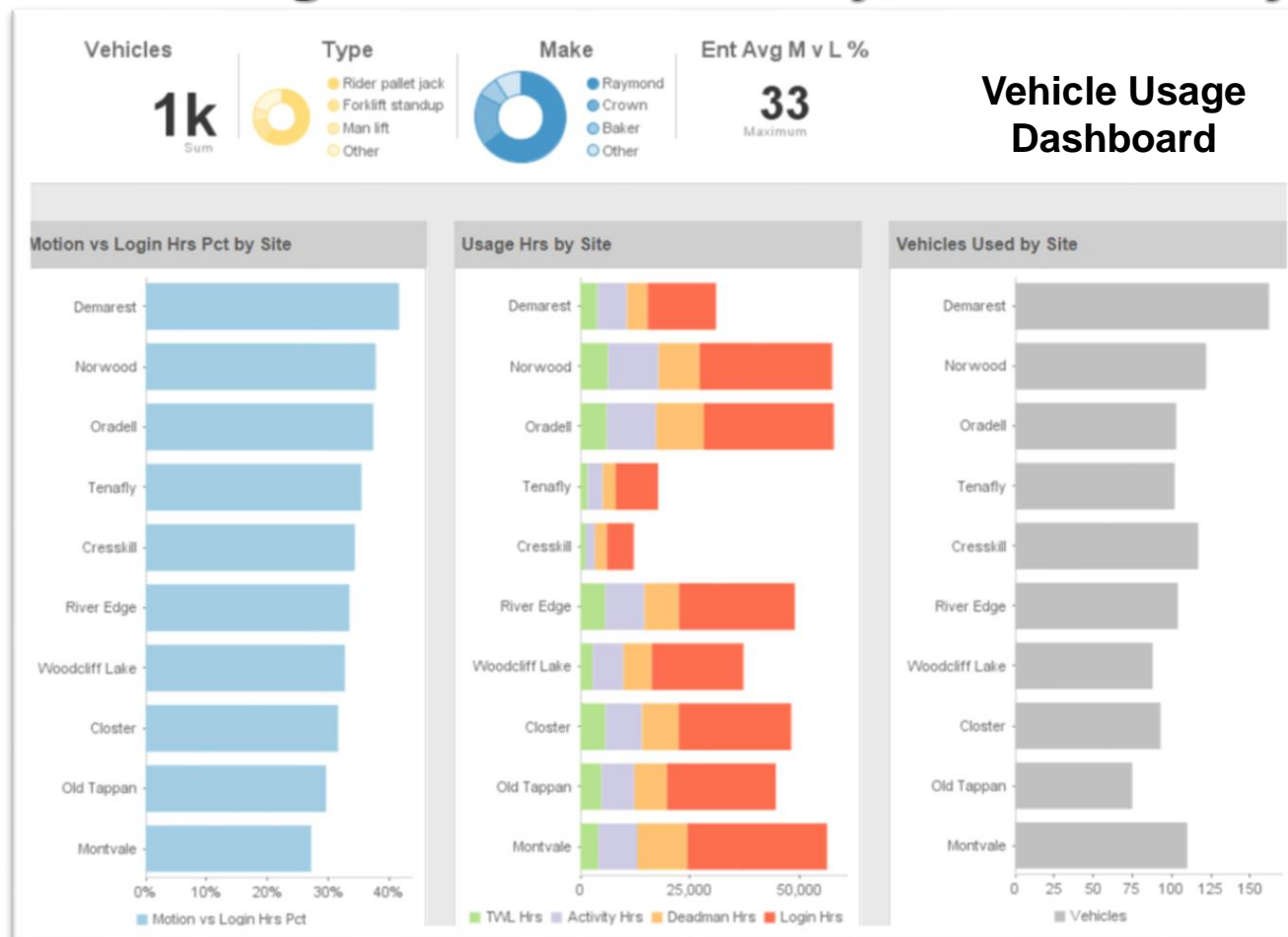
Materials Tracking

Integration, Reporting

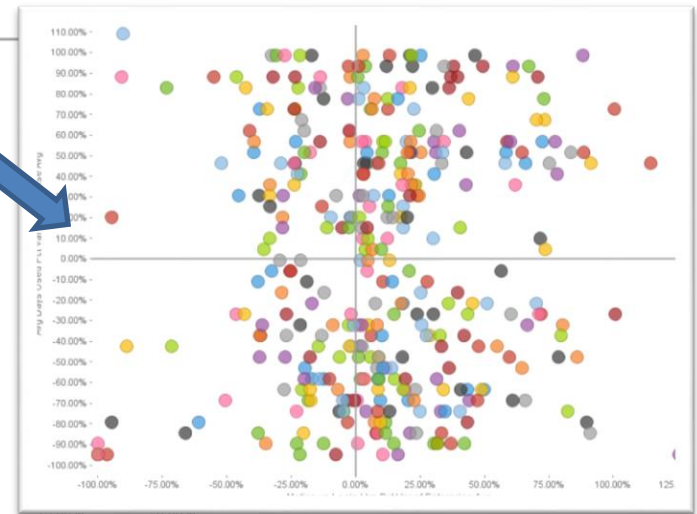
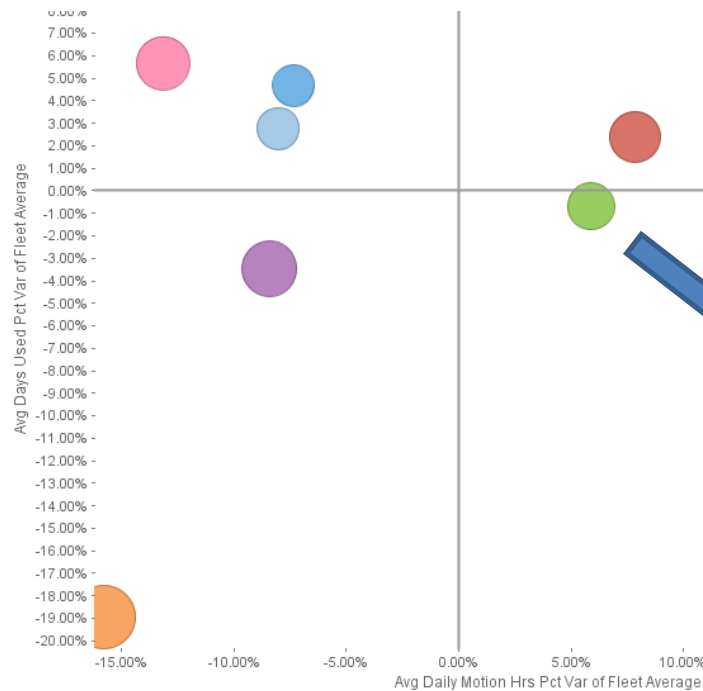
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Fleet Management: *Efficiency, Productivity*



Site	Operator	Days Used	Avg Days Used Pct Var of Enterprise Avg	Enterprise Avg Days Used	Motion vs Login Hrs	Motion vs Login Hrs Pct Var of Enterprise Avg	Enterprise Avg Motion vs Login Hrs	Quadrant Indicator
Norwood	BADGE 9402891	13	-32.04%	19.13	34.05%	1.24%	33.63%	4
Norwood	BADGE 4431345	7	-63.41%	19.13	48.21%	43.34%	33.63%	4
Norwood	BADGE 5343215	7	-63.41%	19.13	24.30%	-27.73%	33.63%	3
Norwood	BADGE 1872334	38	98.65%	19.13	40.71%	21.04%	33.63%	1
Norwood	BADGE 5975851	13	-32.04%	19.13	32.74%	-2.65%	33.63%	3
Norwood	BADGE 9835414	37	93.43%	19.13	32.69%	-2.80%	33.63%	2
Norwood	BADGE 9402891	9	-52.95%	19.13	55.33%	64.51%	33.63%	4
Norwood	BADGE 4431345	24	25.47%	19.13	39.77%	18.25%	33.63%	1

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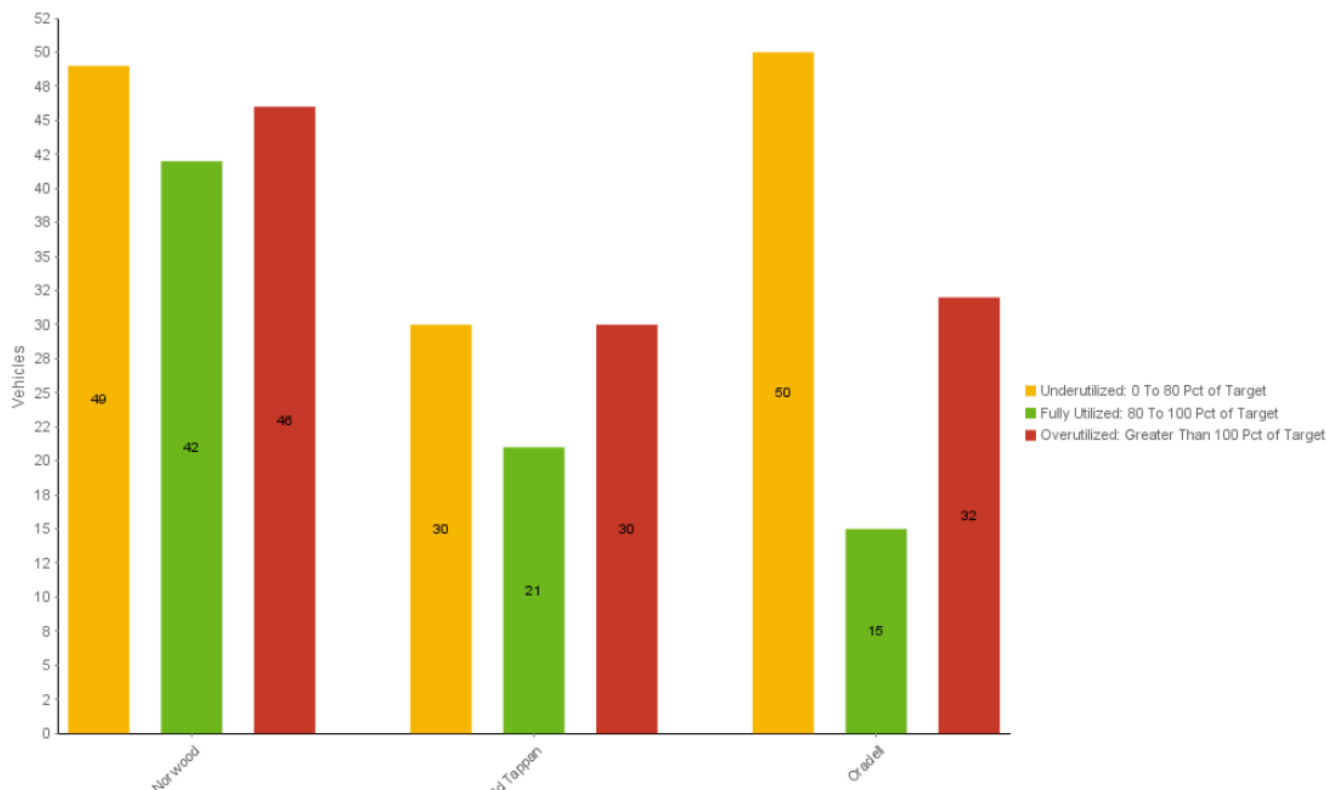
In Summary

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



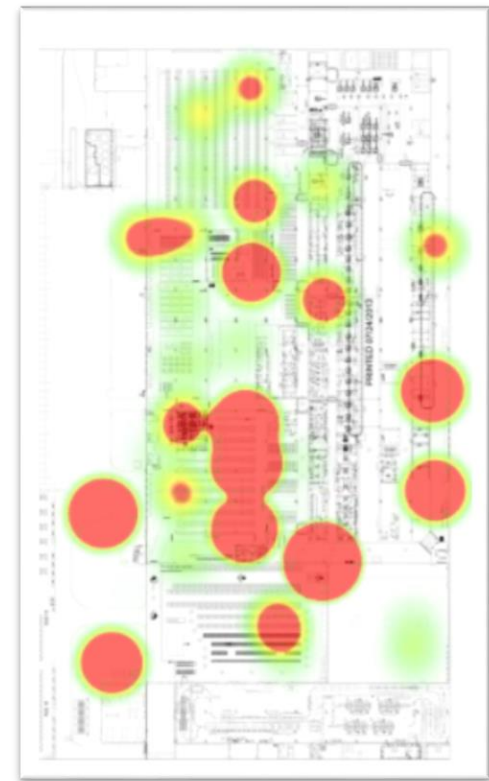
Fleet Management: Asset Optimization



Client	Site	Vehicle	Vehicle Ext ID1	Custom Vehicle Type	Vehicle Type	Date Added	Days in Sample	Days Used	Login Hrs	Motion Hrs	Login Hrs Annualized	Motion Hrs Annualized	Annual Hours Target	Login Hrs Pct of Target
Bergen Distribution	Norwood	5120-RVAN-SUCB-A-45	1A513384	To Be Defined	Forklift Standup	01/13/2018	56	1	0.12	0.02	0.76	0.10	2,000.00	0.04%
Bergen Distribution	Norwood	5120-RVAN-SUCB-A-39	1A513130	To Be Defined	Forklift Standup	01/05/2018	56	1	0.12	0.02	0.77	0.10	2,000.00	0.04%
Bergen Distribution	Norwood	5120-RVAN-WRAP-03		To Be Defined	Automated Wrapper	10/24/2014	56	1	0.17	0.00	1.11	0.00	2,000.00	0.06%

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



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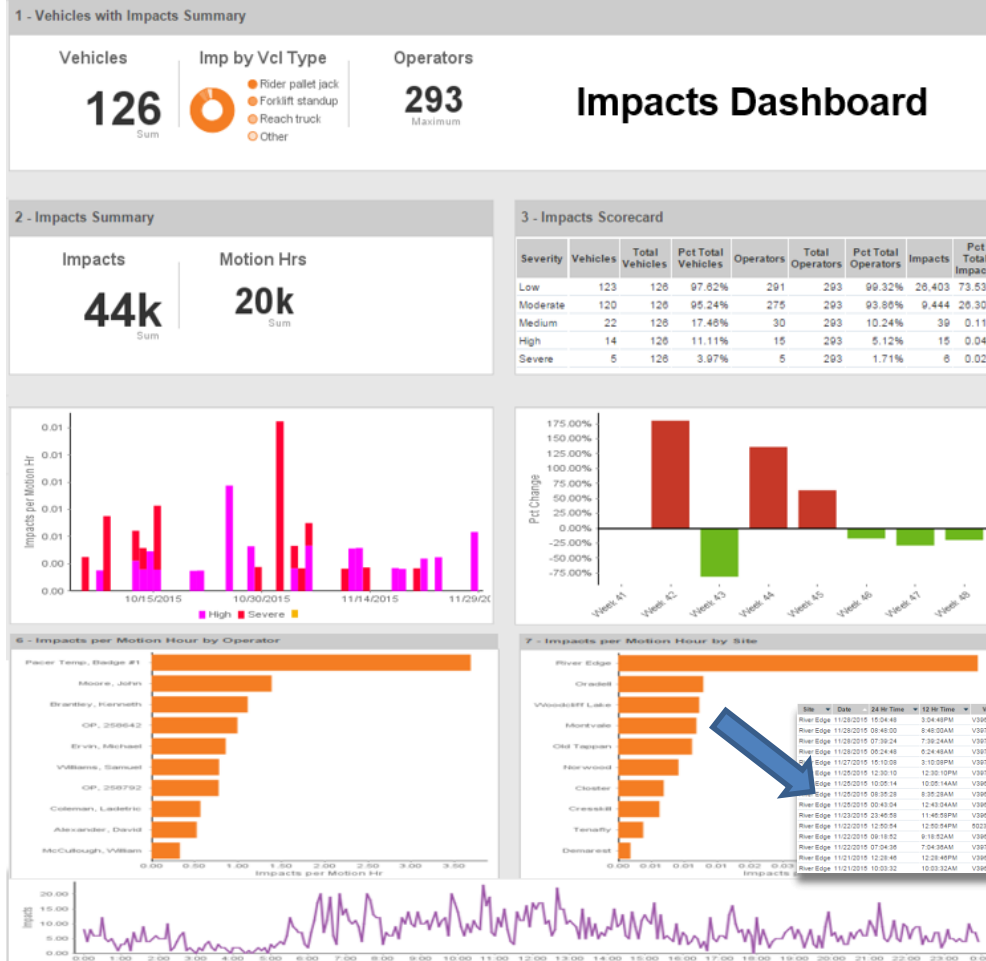
Fleet Management: *Safety Improvement*

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



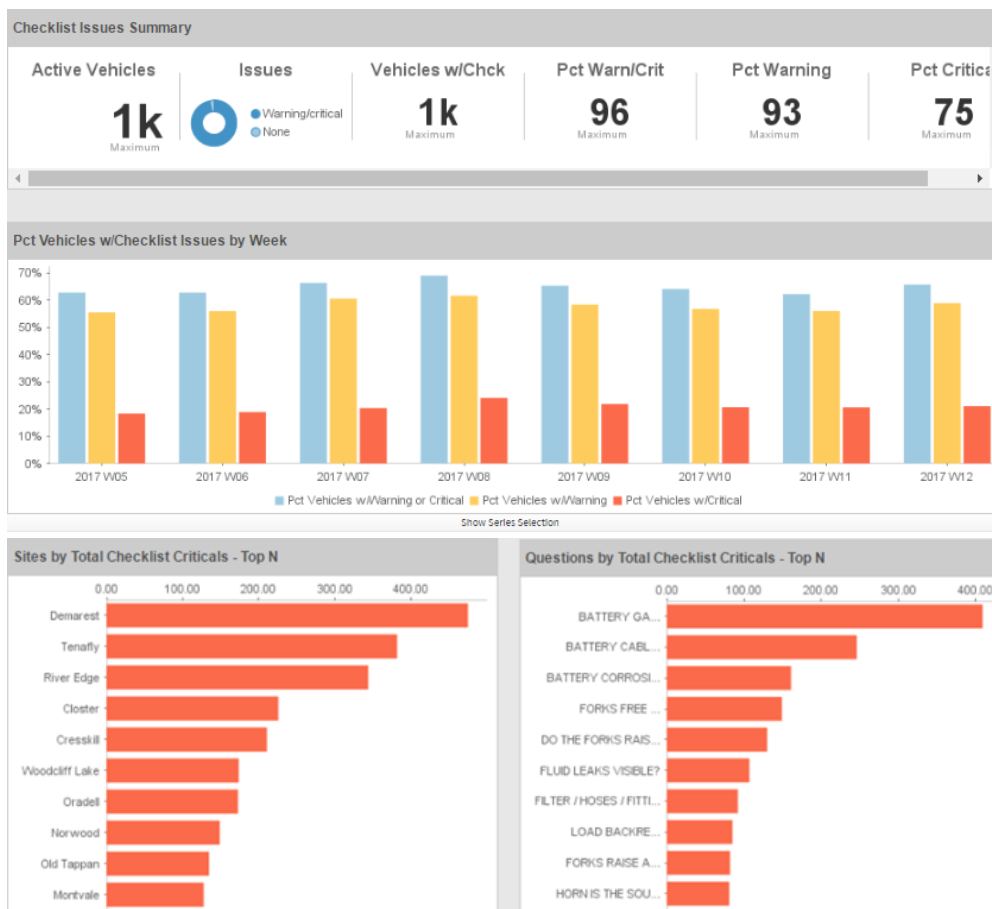
OSHA statistics from 2013 report that there are approximately 85 forklift fatalities and 34,900 serious injuries yearly

Fleet Management: Safety Improvement



Fleet Management: Safety Improvement

Checklist Dashboard

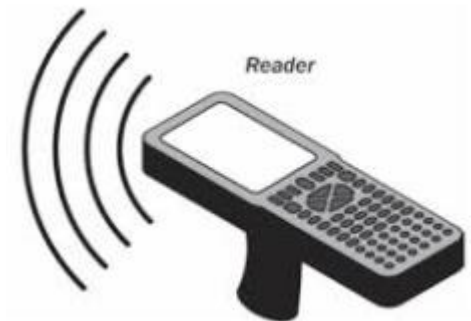
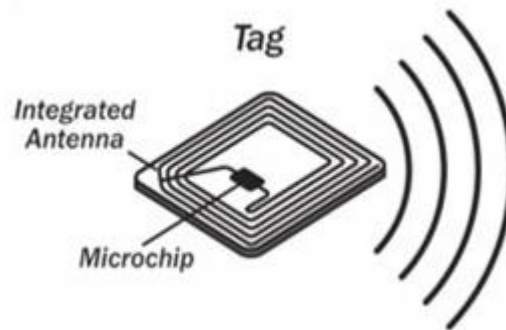


Materials Tracking: *Tools and Technology*

Handheld devices, scanners, barcodes

GPS and RFID technologies: *The “backbone” of the IIoT*

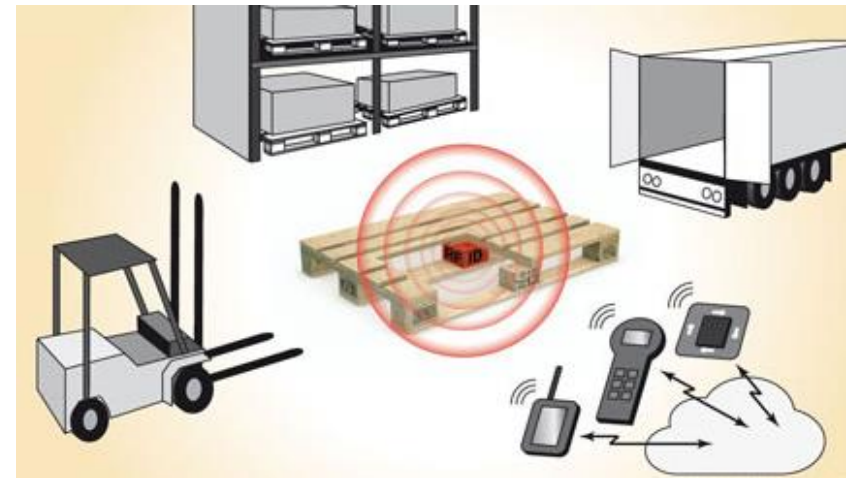
- Provide identity, location and other tracking information
- Tracking from manufacturer to retailer
- Automates shipping, delivery, accurately predicts time of arrival
- Monitors details like temperature control, which impact quality



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:

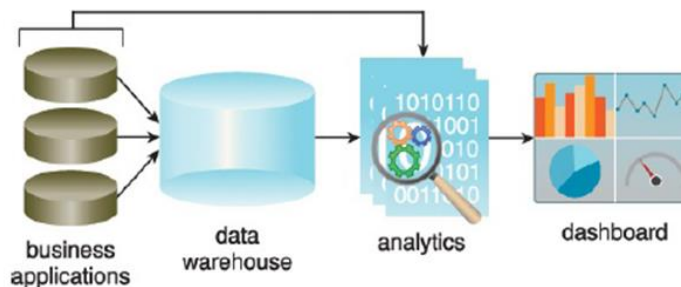
- Proactive replenishment
- Reduce asset loss
- Save fuel costs
- Monitor the cold chain
 - About one third of food perishes in transit every year
United Nations Food and Agriculture Organization
- Manage warehouse stock
- Create fleet efficiencies

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*



IoT, Data Analytics

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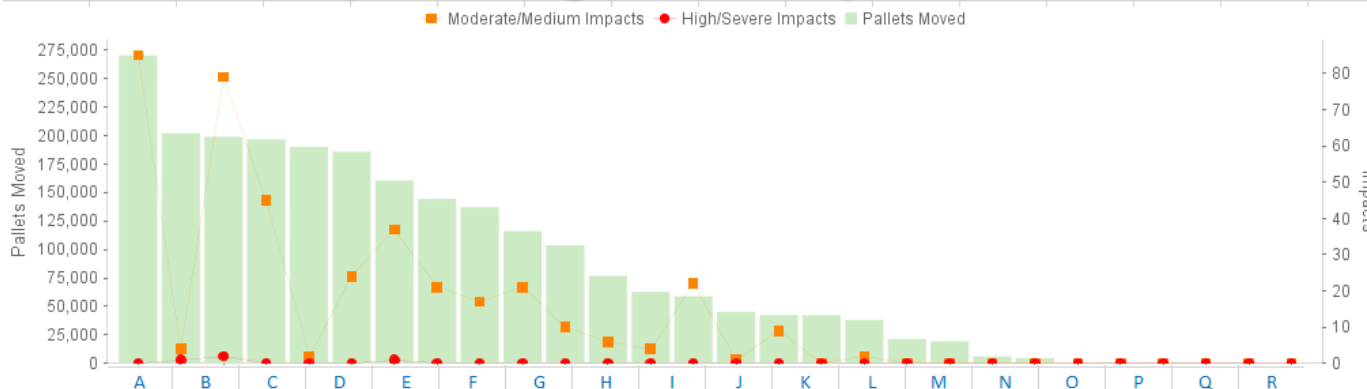
Advanced Analytics

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Integration, Reporting: *Examples*

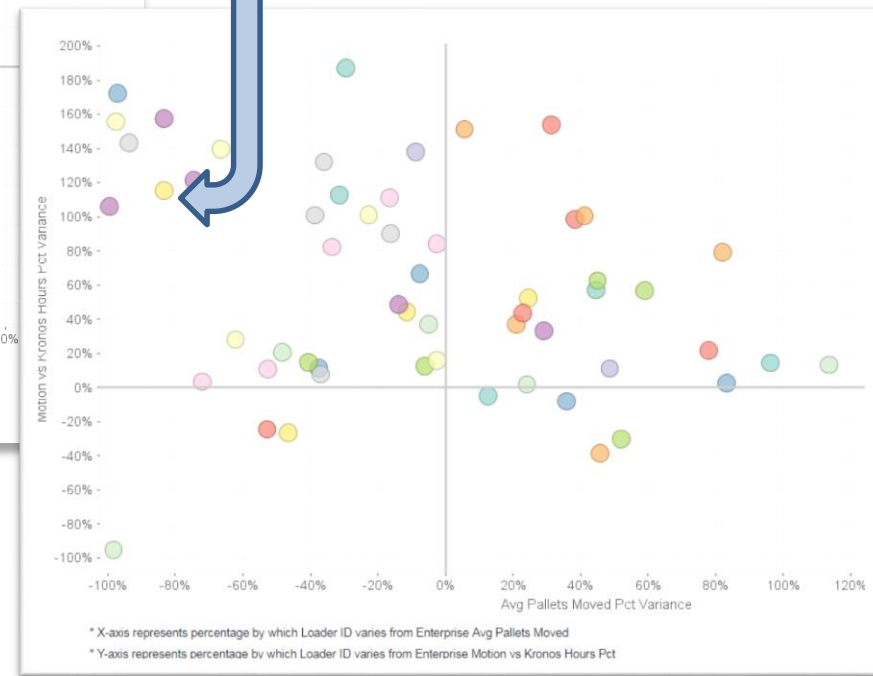
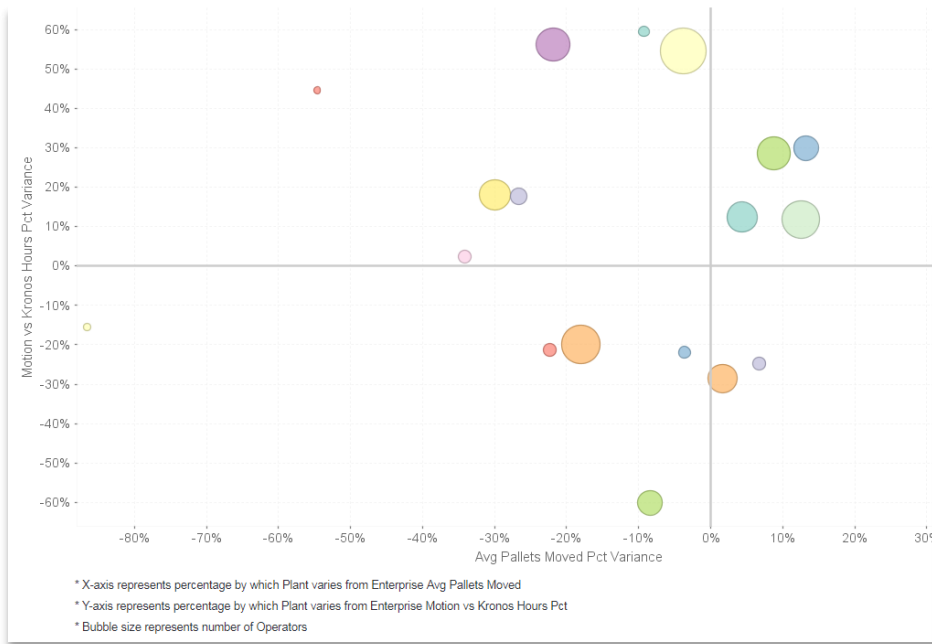
Dual-axis
- Pallets
- Impacts



Scorecards
- Vehicle Utilization
- Pallets
- Impacts

Plant	Login Hours	Motion Hours	Pallets Moved	Moderate/Medium Impacts	High/Severe Impacts	Motion vs Login Hours Pct	Pallets per Login Hour	Moderate/Medium Impacts Safety Rate	High/Severe Impacts Safety Rate	Score	Score Decil
A	14.57	9.41	6,225	0	0	64.63%	427.34	100.00	100.00	291.10	1
B	45.92	26.92	19,497	0	0	58.62%	424.61	100.00	100.00	288.56	1
C	203.68	108.15	58,948	22	0	53.10%	289.42	79.66	100.00	204.58	2
D	160.46	104.91	42,348	0	0	65.38%	263.92	100.00	100.00	193.16	2
E	844.42	550.19	196,576	45	0	65.16%	232.79	91.82	100.00	173.63	3
F	654.39	421.97	137,026	17	0	64.48%	209.40	95.97	100.00	159.91	3
G	962.05	649.81	190,053	2	0	67.54%	197.55	99.69	100.00	153.63	4
H	251.47	191.93	45,246	1	0	76.32%	179.93	99.48	100.00	144.35	4
I	1,590.31	1,191.33	270,195	85	0	74.91%	169.90	92.87	100.00	137.46	5
J	388.43	259.74	62,851	4	0	66.87%	161.81	98.46	100.00	131.96	5
K	289.93	144.43	42,440	9	0	49.81%	146.38	93.77	100.00	119.68	6
L	1,534.33	994.64	201,845	4	1	64.83%	131.55	99.60	99.90	113.60	6
M	1,472.01	858.03	185,759	24	0	58.29%	126.19	97.20	100.00	109.18	7
N	1,602.76	982.17	198,800	79	2	61.28%	124.04	91.96	99.80	107.78	7
O	311.88	162.13	38,179	2	0	51.99%	122.42	98.77	100.00	106.13	8
P	1,446.22	587.91	160,391	37	1	40.65%	110.90	93.71	99.83	96.99	8
Q	1,473.55	939.93	144,164	21	0	63.79%	97.83	97.77	100.00	93.05	9
R	1,280.75	756.44	103,687	10	0	59.06%	80.96	98.68	100.00	82.30	9
S	2,390.18	471.29	116,005	21	0	19.72%	48.53	95.54	100.00	56.63	10

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*

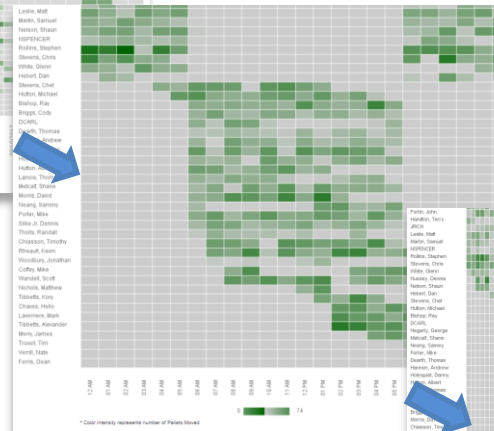


Heatmaps

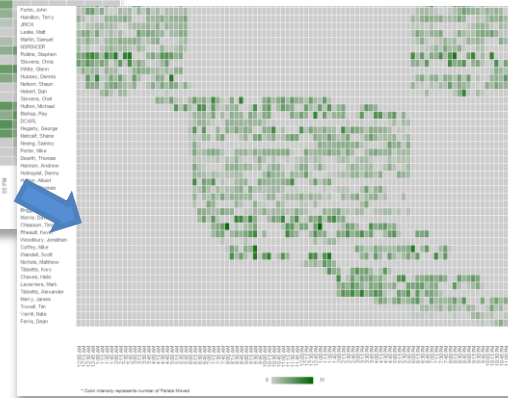
- Timecard
- Vehicle utilization
- Pallets
- Impacts



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

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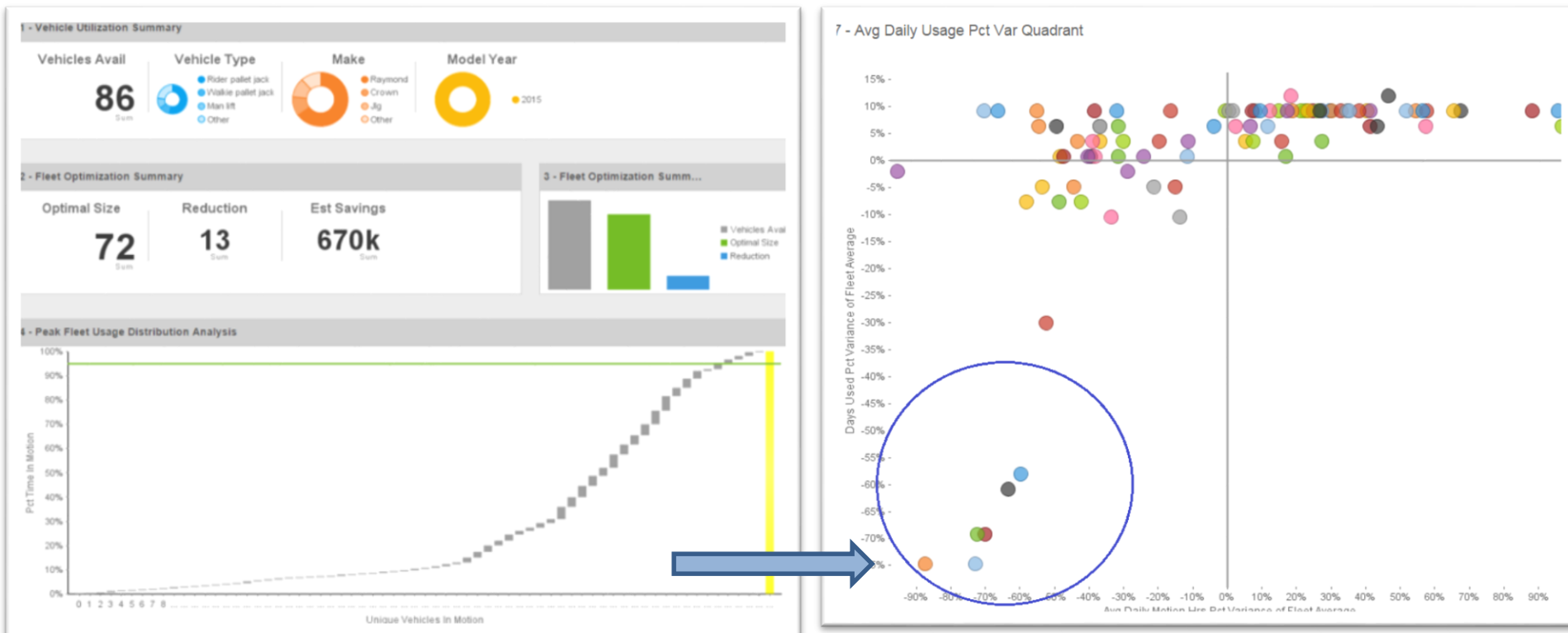
Looking Ahead

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Advanced Analytics: *Examples*

Fleet Optimization

- Optimal fleet size based on simultaneous usage



Looking Ahead: *The Digital Supply Chain*

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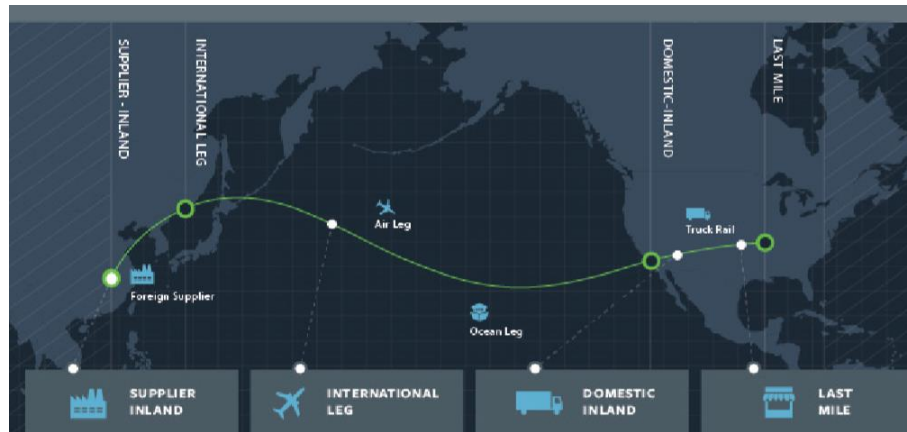
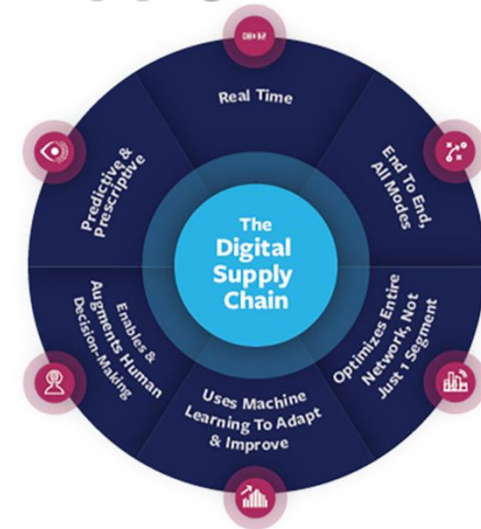
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Digital Supply Chain

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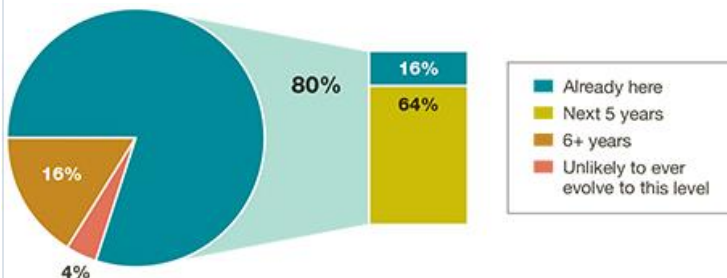
- ✓ Beyond the warehouse
- ✓ Sensors / End-to-end visibility
- ✓ Smart Infrastructure
- ✓ Real-time
- ✓ Machine Learning and prediction
- ✓ Optimization / Ongoing adjustments
- ✓ Automation





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-Id 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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