



How is “Big Data” Redefining the Industry Considerations for Transportation Agencies

Presentation Map



What is “Big Data”

What do “Big Data” allow us to do

Challenges of using “Big Data”

Opportunities for the Future

Discussion

Big Data Definition

“Big Data is a term that describes large volumes of high velocity, complex and variable data that require advanced techniques and technologies to enable the capture, storage, distribution, management, and analysis of the information.”

Demystifying Big Data – TechAmerica Foundation

Big Data Challenges 4 V's

- **Volume** — how to capture, store, analyze?
- **Variety** — many types, many sources, how to reconcile?
- **Velocity** — real-time availability, how to harness?
- **Veracity** — how to validate to make sure it's right?

Adapted from Mayer-Schonberger and Cukier, 2013

Big Data Proliferation

- Why do we have big data?
 - More sources (instrumented world)
 - Storage is inexpensive
- Data proliferates very quickly
 - 90% of data was created in the last two years
- Databases are getting bigger
 - Average size of a database has increased from 2TB in 2006 to 2000TB in 2012

Source: Isaac Porche, Rand; DBMS Survey (2006); RDBMS Industry and Technology Trends (2007); Independent Oracle Users Group Survey (2012)

What is Big Data: Underutilized or Just Starting?

- 8% of shippers and 5% of 3PLs surveyed have implemented “Big Data” initiatives involving the supply chain.

From Jim Taylor “Fusing Big Data and the Supply Chain: The Future is NOW.” *Inbound Logistics* April 2014.) Source: 2014 18th Annual Third-Party Logistics Study produced by Dr. C. John Langley and Capgemini Consulting.

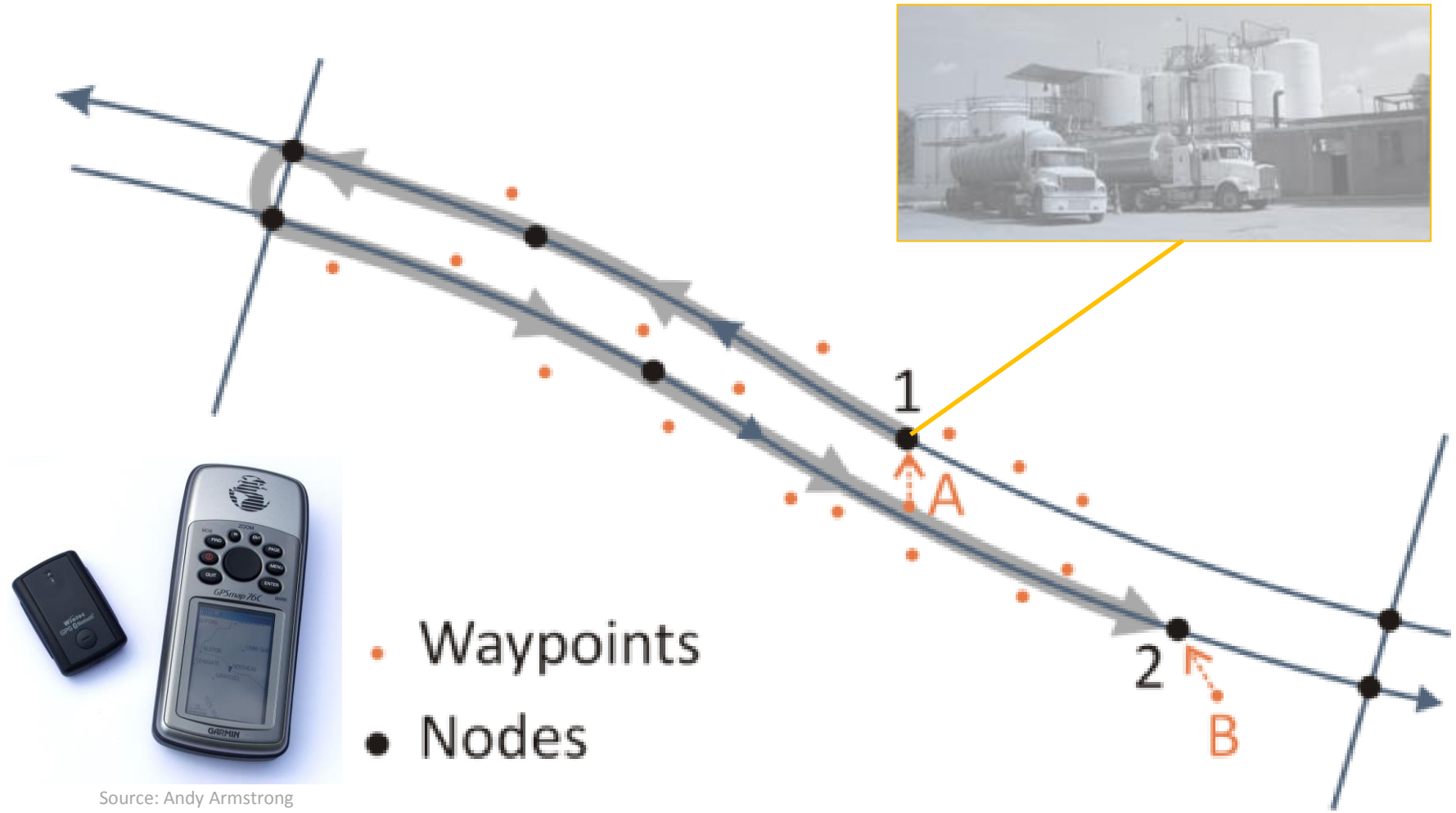


How are big data collected: Images



Source: Intel Free Press (Creative Commons)

How are big data collected: GPS



Source: Andy Armstrong
(Creative Commons)

How are big data collected: RFID



Source: Midnightcomm (Creative Commons)

How are Big Data Collected: Drones



Source: ackab1 (Creative Commons)

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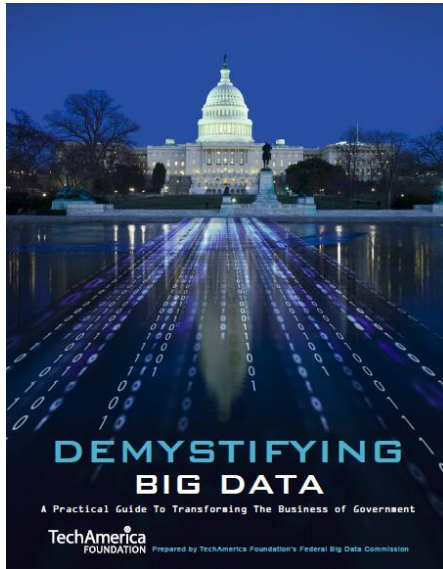
Big Data Allow us to...

- Capture and analyze vast amounts of data
 - In lieu of surveys and traditional data collection
 - Instrumented supply chain
 - Vehicles, vessels, operators, cargo
- Find unanticipated patterns, trends



What do data allow us to do?

- Improve decision making



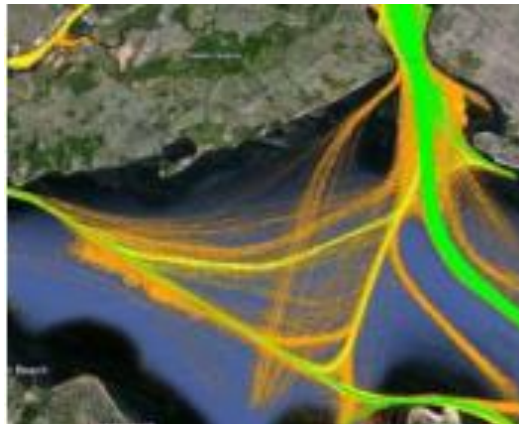
- Replace or supporting human decision-making with automated algorithms
- Reduce inefficiencies
- Create transparency
- Improve performance by enabling experimentation to discover needs and expose variability
- Improve ROI for IT investments
- Improved decision-making and operational intelligence
- Provide predictive capabilities to improve mission outcomes
- Reduce security threats and crime
- Eliminate waste, fraud, and abuse
- Innovate new business models and stakeholder services

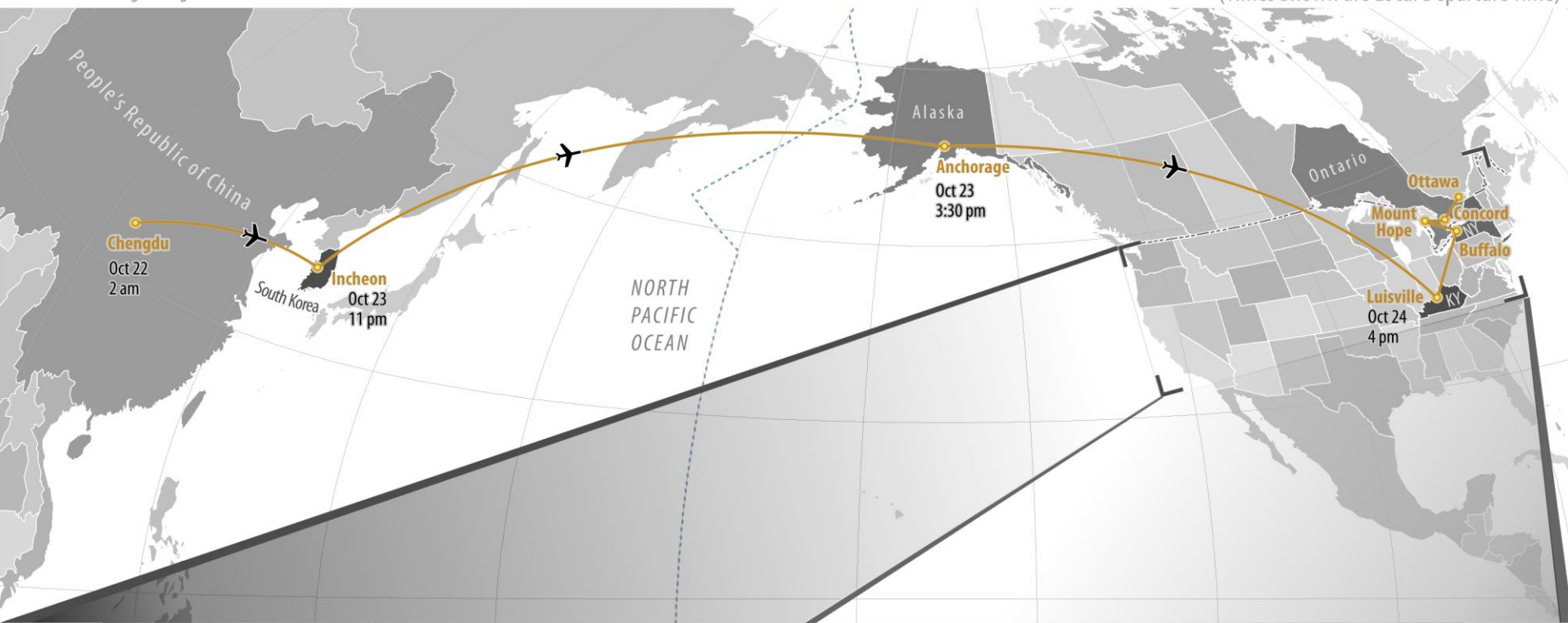
Big Data Applications: Automatic Identification System

AIS Data: Analyzing Maritime and Inland Waterway Movement

- AIS is open source, it's about efficiency of process, routing, and ultimately minimizing time, cost and promoting safe and reliable transport.
- AIS data to monitor waterway performance, and to understand vessel movements
- The Army Corps of Engineers uses AIS data for research and for visualize and inform investment decision making

Routing / Performance





Big Data Applications: Supply Chain Visualization

Satellite imagery as a secondary source of data

- Spire uses low-level tracking satellites to provide information on ocean vessels
 - Engages when AIS is disabled (covers 75% of earth)
 - In the future Spire will offer analytics, but now customers (e.g. governments) must buy the unprocessed (fire hose) of big data themselves

Security

Big Data Applications: Connected Port

Port of Hamburg is trying to optimize the port with data

- Goal of almost tripling container transshipment volumes by 2025
- Highly instrumented port
 - Trucks, trains, sensors embedded into bridge
- Goal: “Totally interconnected, intelligent port, a Smartport”
 - Sensors reporting current condition, container movement times, predicting future maintenance needs, real-time control (e.g. drawbridge)

7,200 hectare (28 square miles)
200 trains a day on 186 miles of track

Source: Muller et. al. *Spiegel Online. Living by the Numbers: Big Data Knows What Your Future Holds.* May 17, 2013

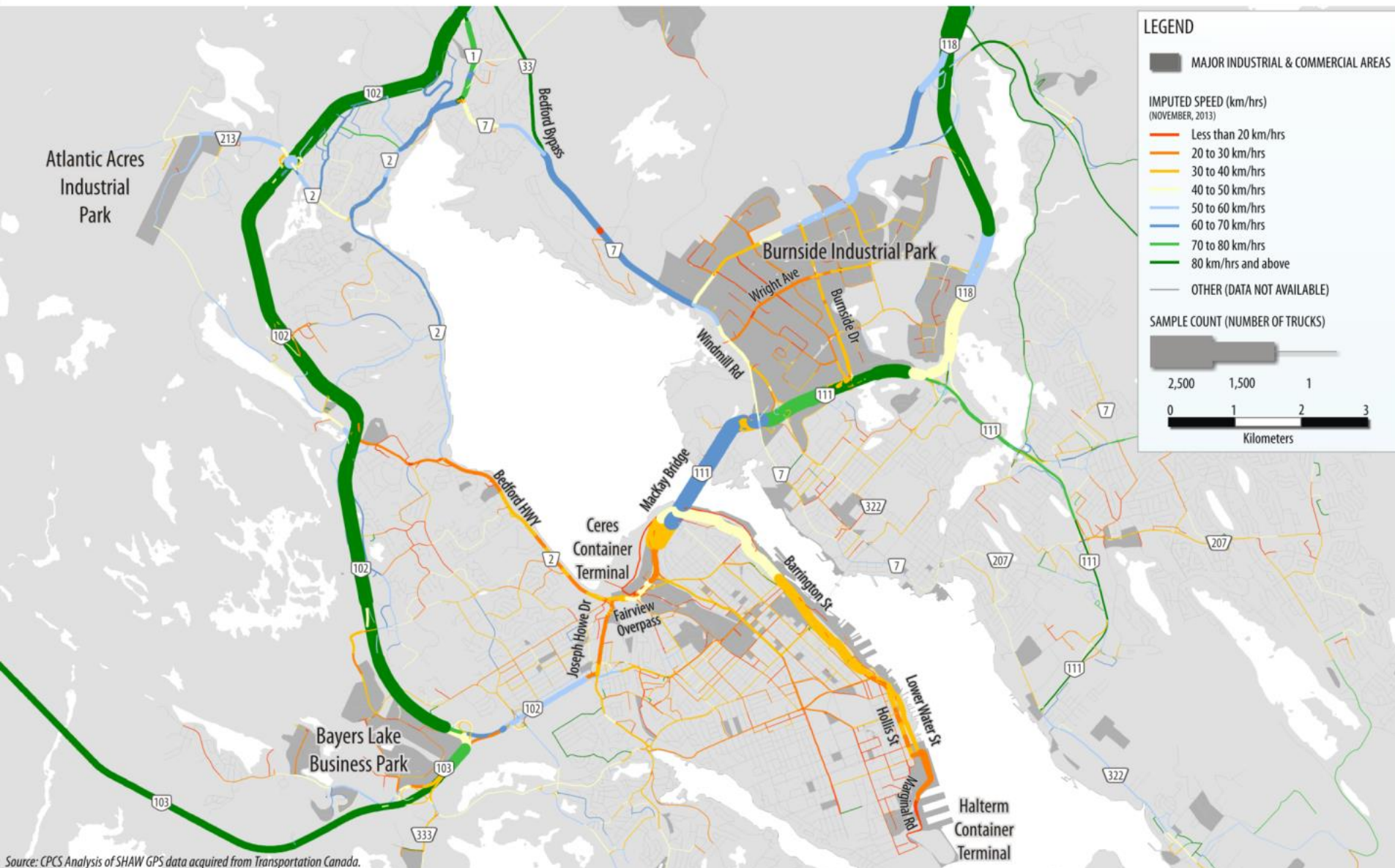


Big Data Applications: Truck GPS Data

Truck GPS data to assess / visualize congestion

- Truck GPS data utilized for regional port performance
 - Carriers conduct their own analysis of movements (for their customers) to examine inventory, and highway performance
 - Data available from vendors

Performance



Source: CPCS Analysis of SHAW GPS data acquired from Transportation Canada.

Example: Local Truck Route Analysis with GPS

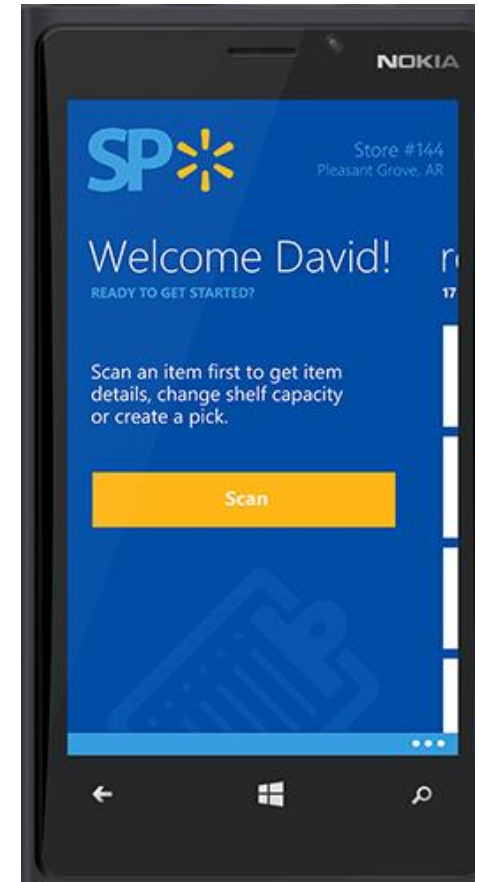


Example: Local Truck Route Analysis with GPS

Big Data Applications: Real-Time Inventory Mgmt.

Wal-Mart Supplier Portal Allowing Retail Coverage (SPARC)

- Real-time app
- Allows vendors to monitor and replace inventory.



Source: Wal-Mart

Inventory

Big Data Applications: Maersk Real-Time Monitoring

Global Voyage Centre monitors real-time data on 200 ships

- Ship's position, speed, direction and even the weather conditions
- Global conditions, earthquakes, etc.
- Compares real-time stream of data to best in class voyages in database and make immediate corrections
- Saved \$8.5M in bunker fuel and improved crew safety



Source: Monika Canty, "The Data Drive" 07 July, 2014, *Maersk Post* #3, July 2014

Tracking

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Transportation Agency Challenges

Common challenges and approaches to overcome

- Data maintenance and reliability over time warrants program commitments
- Internal capacity to support vast datasets can be an issue however
- Costs associated with databases and servers to manage data can be overcome by turning to open source tools
- Sharing with other agencies who can benefit from that work, preferably as open tools

Open / Share

Transportation Agency Challenges

Asking the Right Questions

- What are major operational challenges?
- Can big data solve the challenges?

IN BIG DATA, SHEPHERDING COMES FIRST

BY STEVE LOHR

NY TIMES DEC 15, 2014

“Aspiring big data software companies find themselves training, advising and building pilot projects for their customers, acting far more as services companies than they hope to be eventually.”

What do you need to harness big data?

The framework approach

- A framework for decision making
 - A problem (something that needs improvement)
- A data source that can help
 - A means of collecting the data
 - You might already be collecting the data
 - Assess current data assets
 - A means of tagging / identifying the data
- A means of integrating the data sources
- People who know what the data mean
 - Content experts + big data analysts
- Benchmark data for comparisons and decisions

What do you need to harness big data

The discovery approach



“The major benefits from data come from answering unanticipated questions.” - Peter Kivestu, Teradata

- Ford Motors example
 - Analyzed supply chain big data from carriers and 3PLs to improve inventory planning
 - Discovered that they were carrying excess inventory
 - Back orders dropped 20%
 - Safety stock inventory levels were reduced 20%
 - Cycle time decreased 30%

Source: <http://www.teradata.com/customers/manufacturing-Ford/#sthash.Tki98IJd.dpuf>

Persistent Freight Data Gaps

- Inland movements of import / export flows
 - Example: Lack of information about location of transloading activities for imported containers, which is needed for defining "secondary" truck trip tables (e.g. to warehouse or rail yard)
- Local delivery and short haul not accounted
 - Better means to developing in-region traffic flows, including DC to/from local delivery point
- Quality of linked trips across modes (through supply chains)
 - Example: Intermodal moves
- Granularity of data for local planning
- Lack of information on vehicles
- Difficult to obtain / estimate freight cost data
- Scarce data on private trucking carriers

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What are trends in big data: Artificial Intelligence

Computer Learning (Artificial Intelligence)

- Computers are pretty good at recognizing text
- Latest research focused on recognizing, tagging, classifying audio and video
- Computers starting to learn how to tell vehicles apart



Final Thoughts

- “This convergence of IT and transportation means that we should be talking to people, sometimes new people we haven’t dealt with before.”
- “The impact of Big Data has the potential to be as profound as the development of the Internet itself.”

Dan Morgan, USDOT Chief Data Officer

TechAmerica Foundation Demystifying Big Data Report

Final Thoughts

- “With too little data, you won’t be able to make any conclusions that you trust. With loads of data you will find relationships that aren’t real... Big data isn’t about bits, it’s about talent”

Douglas Merrill (Former CIO of Google in Forbes May 2012)

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- What are your persistent data gaps?
- How are you approaching your data gap issues?
- Are you using “big data”?
- Do you plan to use “big data” in the future?

Questions and Discussion



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Introduction to CPCS

Global management consulting firm (formerly consulting arm of Canadian Pacific Railway, est. 1969)

- Strategy, economic analysis, policy, specific to transportation and energy sectors
- Multimodal transportation practice (road, rail, air, marine, pipeline)
- Global presence and experience
- Over 1000 projects in more than 90 countries

Recent North American project experience:

- TRB - Multi-modal Freight Transportation Within the Great Lakes-Saint Lawrence Basin (NCFRP 35)
- TRB - Guidebook for Assessing Evolving International Container Chassis Supply Models (NCFRP 43)
- Comparative Land Transport Cost for OSOW/Project Cargo from US Mid-West
- Dozens of multimodal freight studies

CPCS countries of work experience (shaded) and offices



Summary of Recent CPCS Experience



Freight Rail

100+ Strategy projects

8 Transactions

\$3+ billion in deals



Port & Terminals

35+ Strategy projects

30+ Transactions

\$5+ billion in deals



Multi-modal Transport

30+ Strategy projects



Passenger & Transit

10+ Strategy projects

3 transactions

\$3 billion in deals