Digital Connectivity and the Future of Supply Chains & Logistics

Dr. Don Ratliff

don.ratliff@gatech.edu
Digital connectivity creates a totally new playing field for logistics
We must fundamentally change the way we think
Big companies have more capability to adapt but much more complexity
Countries are having great difficulty adapting
Only those that successfully adapt can compete
“Big 3” Technology Enablers

- **The internet**
  - Enables global movement of data and information almost everywhere

- **The internet of things (i.e., devices and sensors connected to the internet)**
  - Enables data capture from and provide information to various entities of supply chains

- **Cloud computing**
  - Enables almost unlimited data storage and computing power
Internet

- 16 million users in 1995
- More than 3 billion users currently
  - About 2 billion smart phones currently
  - About 7 billion people in the world currently
- Internet access is increasingly available anywhere, particularly to businesses
Internet of Things (IoT)

- Currently 15 billion devices connected to the internet
- By 2020 and estimated 50 billion devices will be connected to the internet
- More than 1.5 trillion devices could benefit from being connected to the internet
Cloud Computing

- **Global communication networks**

- **Cloud computing services**
  - “Infrastructure as a service" (IaaS)
    - Servers and operating systems
  - “Platform as a service" (PaaS)
    - Databases and runtime engines
  - “Software as a service" (SaaS)
    - Application software

- **Distinguishing features**
  - Remote networked servers
  - Virtualization
  - Shared resources
  - Public or private

- **By 2018 Cisco predicts that 78% of workloads will be processed by cloud data centers**
Industrial Internet of Things
January 2015


- Survey results – 88% of respondents say that they do not fully understand the underlying business models and long-term implications to their industries.

- Global Council on Future of Supply Chains and Logistics
  - Don Ratliff council chair
  - 2 year project
  - Develop a set of use cases
  - Develop a framework for analyzing the value of implementation
  - Joint effort of Georgia Tech Panama Center and Hull Logistics Institute
WEF White Paper: Framework for analyzing Internet of Things Innovation in the Supply Chain

**Delivery Route Planning**
Completely automates by replacing the manual planning process through an optimization engine that evaluates huge numbers of possible loads, routes and schedules and selects the most efficient one that satisfies all requirements.

**Values**

<table>
<thead>
<tr>
<th>Value</th>
<th>Customer</th>
<th>Provider</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost Efficiency</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Capital Reduction</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Customer Satisfaction</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Supply Chain Visibility</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Risk</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Regulatory compliance</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Environmental Impact</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

**Barriers**

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Customer</th>
<th>Provider</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of Standards in process</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lack of Technical Standards</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Lack of Stakeholder Acceptance</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lack of Technical Expertise</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Lack of Infrastructure</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Scalability</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Implementation Complexity</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Implementation Costs</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Operating costs</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Privacy &amp; Data Security Concerns</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Requirement for Collaboration</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Regulations</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Innovation**
- Process
- Customer Experience
- Technology
- N/A

**Domain**
- Domestic Freight
- Last Mile
- Shipping
- N/A

**Enablers**
- Visibility Platform
- Control Tower
- Optimization Engine
- Mapping Platform

**Drivers**
- Optimizing
- Automating
- Controlling
- N/A
Cases

- 1. Non-traditional delivery
- 2. Centralized and automated planning
- 3. Global supply chain monitoring
- 4. Shipment monitoring
- 5. Operator monitoring
- 6. Connecting businesses (facilitating collaboration)
- 7. Facilitating international trade
- 8. Transportation asset optimization and control
- 9. Measuring performance
- 10. Centralized supply chain services
Values

- Monitoring
  - Shipments, assets, employees, requirements, risks

- Measuring
  - Performance, resource utilization

- Planning
  - Integrated across entities

- Controlling
  - Routing, scheduling

- Automating
  - Transactions, regulatory compliance

- Optimizing
  - Transportation and inventory plans, forecasts

- Learning
  - Opportunities for improvement
Barriers

- Massive amounts of data
- Uncertainty regarding what data exists
- Lack of standards
- Uncertain value
- Lack of technical expertise
- Lack of analytics
- Privacy & data security concerns
- Requirement for collaboration
Control Tower Concept

- Centralized “master” facilitative control tower
- Multiple “satellite” control towers
- Data repository at master tower
- Common analytics developed at master tower
- Monitoring of end-to-end system at master tower
- Monitoring of component systems at satellite towers
- Plan overlays provided from master tower
### Supply Chain Companies with Global Control Towers

- Flextronics
- Unilever
- Procter & Gamble
- Samsung Electronics
- Cisco
- Colgate-Palmolive
- Coca-Cola
- Walmart
- Lenovo Group
- Kimberly-Clark
- Caterpillar
- Philips
- Scania
Building a network of control towers across the globe
Flextronics
Exploring a Control Tower Network for Panama

- **Step 1: Cataloging existing data**
  - Public sector
  - Private sector

- **Step 2: Acquiring and rationalizing data streams**
  - Harmonization
  - Cleaning

- **Step 3: Develop a control tower network**
  - Master control tower
  - Satellite control towers
  - Control system

- **Step 4: Develop a common set of analytics**
  - Common mapping framework
  - Common business intelligence framework
  - Common modeling framework

- **Step 5: Develop visualization facilities**
New Digital Connectivity Companies

- More than 1000 supply chain and logistic start-ups leveraging digital connectivity
  - https://angel.co/supply-chain-management
  - https://angel.co/logistics
- Marketplace – biggest group
- Centralized monitoring & planning – biggest impact
- Performance measurement – biggest opportunity
  - GPS technology
Conclusions

- Just at beginning of digital transformation
- Massive data will create problems and opportunities
- Customer expectations are being raised
- Huge number of new applications (more than a million iPhone apps)
- Transformation is critical to survival
- Even large companies will struggle with transformation
- Huge opportunities for countries to leverage digital connectivity
- Digital connectivity is fundamentally transforming supply chains and logistics!!
Questions?

Comments?
The Internet of Things:
A Central Axis of the Physical Internet – Promises and Hurdles

Alain Louchez
Managing Director
GT Center for the Development and Application of IoT Technologies (CDAIT)
The Internet of Things?

Jean Broc (1771–1850), The Fortune Teller

Wikigallery.org - Do not use for commercial use. Do not remove this warning.
The Internet of Things (IoT) is about the immersion of almost anything and everything (previously “out of scope”) into the communications space thanks to the timely convergence of scientific, technological, and societal advances and trends.

Nothing will be forever fixed.

Inert will become active; delayed, instantaneous; offline, online; and static, dynamic.

IoT will give rise to a pulsating world (*).

(*) Emerging from things sending and receiving data
What’s so special about the Internet of Things?

PRODUCTION OF “SMART GOODS” IS WEAVING THE IoT FABRIC

“The emergence of smart goods represents a seismic shift in the way IT will be designed, produced, distributed and marketed...the IoT revolution of the next 50 years will be enabled in part by the development of manufacturing platforms capable of delivering higher performance at lower cost” (*)


“The pervasive availability of embedded intelligence will allow the birth and growth of new ecosystems and services to maintain, upgrade and leverage the related capabilities.” (**)


Intelligence will no longer be an “add-on”, it will be “baked in”

Picture source: http://www.burningphone.com/
New York City streets in 1890. Besides telegraph lines, multiple electric lines were required for each class of device requiring different voltages. 


Electric razor in 1926
http://paleofuture.gizmodo.com/tag/electricity-history

1930s: 44% of US pop. in rural areas, only 10% with electricity

https://www.eia.gov/tools/faqs/faq.cfm?id=96&t=3

Est. U.S. residential sector electricity consumption (end use, 2014)

<table>
<thead>
<tr>
<th>End use</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space cooling</td>
<td>13%</td>
</tr>
<tr>
<td>Lighting</td>
<td>11%</td>
</tr>
<tr>
<td>Water heating</td>
<td>9%</td>
</tr>
<tr>
<td>Space heating</td>
<td>9%</td>
</tr>
<tr>
<td>Refrigeration</td>
<td>8%</td>
</tr>
<tr>
<td>Televisions and related equipment</td>
<td>6%</td>
</tr>
<tr>
<td>Clothes dryers</td>
<td>4%</td>
</tr>
<tr>
<td>Furnace fans and boiler circulation pumps</td>
<td>3%</td>
</tr>
<tr>
<td>Computers and related equipment</td>
<td>2%</td>
</tr>
<tr>
<td>Cooking</td>
<td>2%</td>
</tr>
<tr>
<td>Dishwashers</td>
<td>2%</td>
</tr>
<tr>
<td>Freezers</td>
<td>2%</td>
</tr>
<tr>
<td>Clothes washers</td>
<td>1%</td>
</tr>
<tr>
<td>Other uses</td>
<td>28%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100%</td>
</tr>
</tbody>
</table>
INCREASING ATTENTION ON IoT IN U.S. GOVERNMENT CIRCLES


U.S. SENATE: See S. 2607 Bill introduced in Senate, Developing Innovation and Growing the Internet of Things Act or the DIGIT Act, March 1, 2016, available at: http://www.commerce.senate.gov/public/_cache/files/52aad6c5-837c-47b8-ab60-490263ccb5a6/73AE8EEFC07D2B3C154B48BF3C6146D8.bills-114s2607is.pdf (*)


INCREASING ATTENTION ON IoT AROUND THE WORLD

Fourth Industrial Revolution

“Made in China 2025”, “Digital Silk Road” & “Global Internet of Things Innovation Union Advocacy” [“One Belt One Road”]

“La Nouvelle France Industrielle (NFI)”

“Industry 4.0” & “Digital Strategy 2025”

“La Fabbrica del Futuro”

“Robot Revolution Initiative Council” & “Industrial Value Chain Initiative”

“Manufacturing Innovation 3.0”

“High Value Manufacturing (HVM) Catapult”

“National Network for Manufacturing Innovation” & “Smart Manufacturing Leadership Coalition”
Physical Internet: Transforming the way physical objects are:

- Moved
- Stored
- Realized
- Supplied
- Used

in a manner that is economically, environmentally and socially Efficient and Sustainable
TECHNOLOGICAL HURDLES TO IoT DEVELOPMENT

- Scale and scalability (modeling & simulation, etc.)
- Energy (reduced power [LPWA], enhanced battery life, energy harvesting, etc.)
- Standards (interoperability, ontology, etc.)
- New architectures (memory and system levels, computing at the edge and/or in the cloud, etc.)
- Impact on data centers (storage, UPS, etc.)
- Miniaturization and cost-effectiveness of sensors & actuators
- Digital printing
- Design tools to support the development of intelligent things
- Antenna technologies
- Frequency availability (licensed vs. unlicensed spectrum)
- Integration (complex value chain, data-driven decision making)
- Link between the past and the future (re. legacy systems)
- System trustworthiness (cybersecurity, privacy, safety, reliability and resilience)
NON-TECHNOLOGICAL HURDLES TO IoT DEVELOPMENT

- Ethics («we can but should we?»)
- Education (future workforce) & training (current workforce, i.e., « re-skilling ») – broad range of expertise
- Enterprise management (e.g., business models; marketing; etc.)
- Enterprise organization (e.g., merger of IT and OT)
- Advocacy (what is IoT, its potential, its benefits; how to overcome inertia? etc.)
- Technical trade-off management (value judgment), e.g., security vs. speed; power consumption vs. features, etc. – Who makes the choice/decision?
- Access to financing, favorable tax environment
- Policy (e.g., digital development), laws (e.g., liability and IP) and regulations (e.g., bandwidth allocation) – Role of government (too much or not enough?, regulatory silos?)
- Expectations («Amara’s law», long-term transformation vs. short-term demands)
- International cooperation (e.g., standards, cross-border traffic) and competition
- Social acceptability (e.g., net job destruction? vs. solution to demographic challenges?; « surveillance society », etc.)
- Existence of « domestic/global digital divide » (pertaining to age, disability, gender, income, ethnicity and location)
IoT and PI: A TIGHT RELATIONSHIP

“A global hyperconnected logistics system, the Physical Internet is a leading example of a vast Cyber-Physical System integrating ‘computation, communication, sensing, and actuation with physical systems to fulfill time-sensitive functions with varying degrees of interaction with the environment, including human interaction’ (*). The Internet of Things and the Physical Internet’s symbiotic relationship is unquestionably bound to grow and tighten sooner rather than later” (**).

Thank You!