



Logistics and Supply Chain Management

What does the future hold for us?

Prof. Dr. J. Rod Franklin, P.E.
19 June 2019

Introductions

Prof. Dr. J. Rod Franklin, P.E.

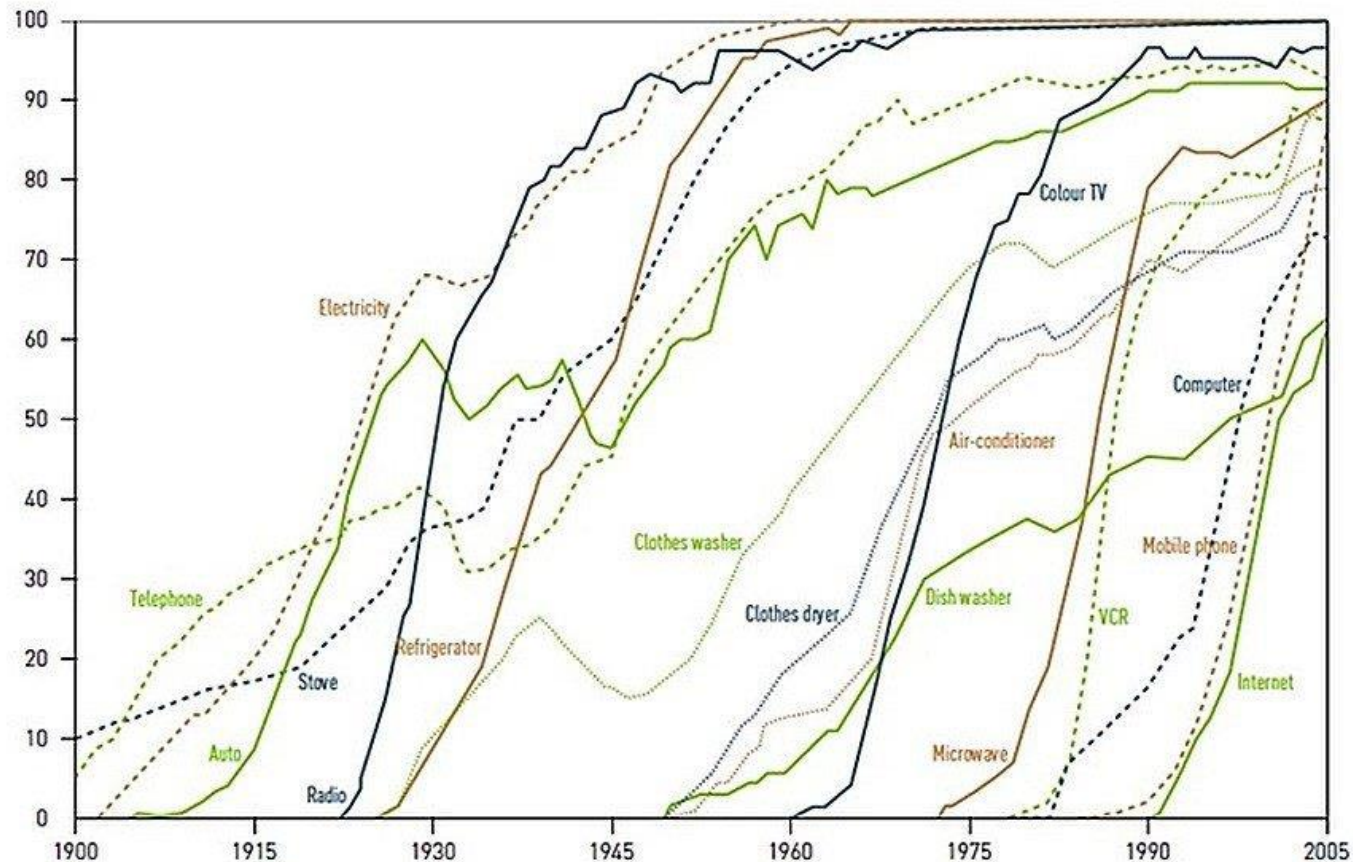
- Academic Background
 - BSME Purdue University
 - MSME Stanford University
 - MBA Harvard Business School
 - PhD Case Western Reserve
- Industry Background
 - General Motors
 - Cameron Iron Works
 - Booz-Allen & Hamilton
 - Arthur Young & Company
 - Digital Equipment Corporation
 - Entex Information Services
 - Viacore
 - Kuehne + Nagel



Agenda

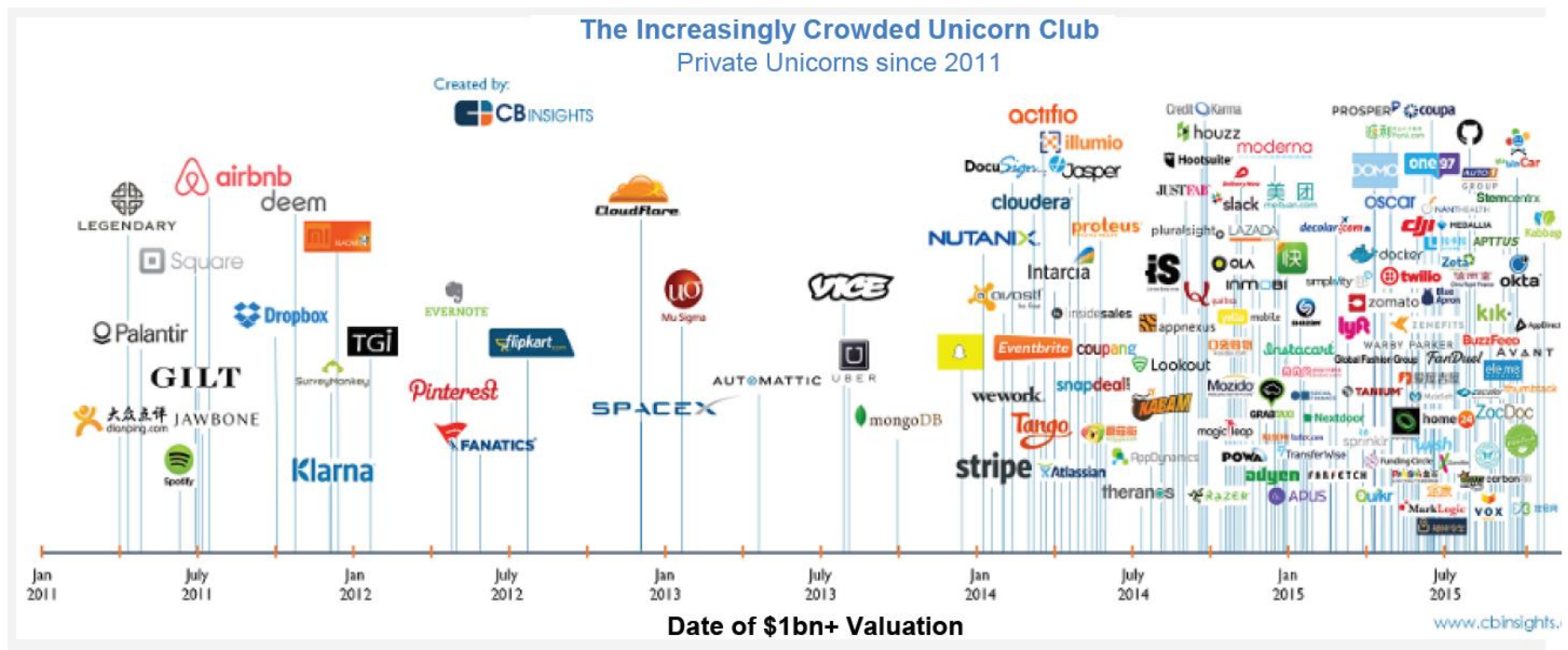
- Introductions
 - Digital challenges for the logistics industry – your view
 - Digital implications for transport and logistics operations
 - Automation
 - Autonomy
 - Information
 - The “Cloud”
 - Collaboration
 - A potential future? A “Physical Internet”
 - Your challenge – what should you do?
 - Summary and questions
-

The pace of technological change is accelerating



Technology adoption curves for a range of modern innovations. Victorian Government

This can clearly be seen in the explosion of “unicorn” startups focused on digital technologies



These new technologies promise to revolutionize how the industry operates. . .

Technological and consumer megatrends plus the regulatory environment will pave the way for new players and business models

Next-generation commercial transport and logistics



-  Set of features enabling the partial or complete automation of driving functions
-  Set of services and features enabling communication and data transfer of vehicles with drivers, other vehicles, and infrastructure
-  Future technologies with potential to complement today's technologies
-  Solutions reducing emissions of trucks/LCVs (especially electrification)
-  Consumer demands becoming more sophisticated, increasing required service levels for the logistics industry
-  New players and new business models entering the logistics industry

Technology, regulatory, and consumer-driven megatrends

Compound effect

SOURCE: McKinsey

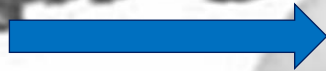
. . . and these trends are leading to a highly connected world



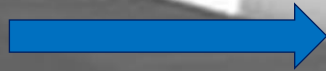
Technological advances are driving significant change in the transport and logistics industry

T&L Trends

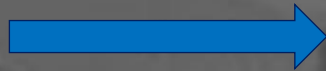
Automation



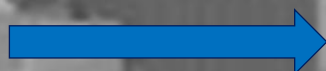
Autonomy



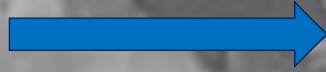
Information



The “Cloud”



Collaboration



Market Drivers

- Aging populations, unattractive work, cost pressures, velocity requirements, volumes all are driving a push to logistics automation
- Smart infrastructures, scarce labor, regulations, costs, asset utilization, etc. are driving the development of autonomous logistics tools
- IoT devices, instrumented infrastructures, M2M/V2V communications, cloud computing, etc. are driving predictive and prescriptive analytics
- Scale and scope economies, standards, regulation, environmental requirements are all driving logistics operators to integrate activities
- Regulations, integration, information, autonomy and automation are costly and will require industry players to collaborate in their operations and business models

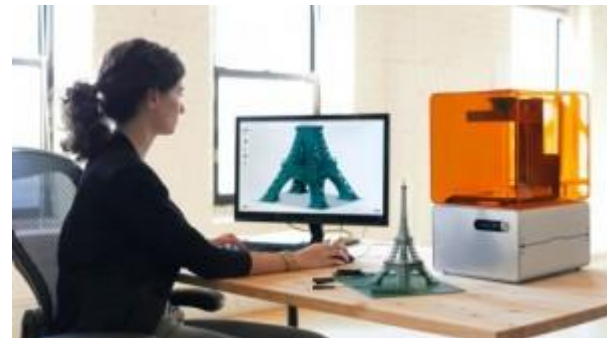
The need to increase velocity, lower unit costs, and address workforce scarcity is driving advances in automation

- Automated Guided Vehicles – while not the newest form of automation, AGVs are gaining in popularity as software improves and new applications are developed
- Warehouse operations (work to worker systems)
- Ports (automated container handling)
- Production (intra-logistics operations)
- Healthcare (inter-facility logistics)
- Chemicals (automated filling and tanker movement)
- Etc.



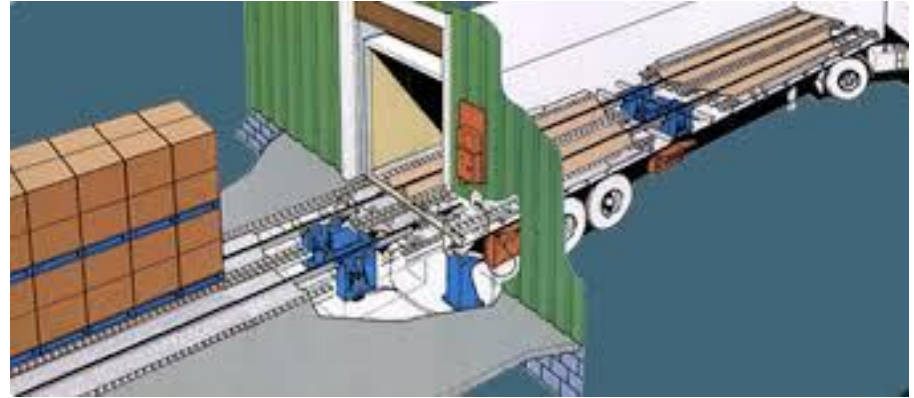
Robotics, one of the oldest forms of automation, is one of the fastest growing areas of innovation in logistics operations

- Robots are used in many applications in logistics
 - Palletization
 - Unloading
 - Layer picking
 - Goods picking
 - Goods carriage
 - Packing
- Robots increase productivity, reduce injuries and improve quality
- Robots today are more flexible than humans and far easier to “program”
- Note: 3D printing or, “additive production,” is nothing but distributed robotic production

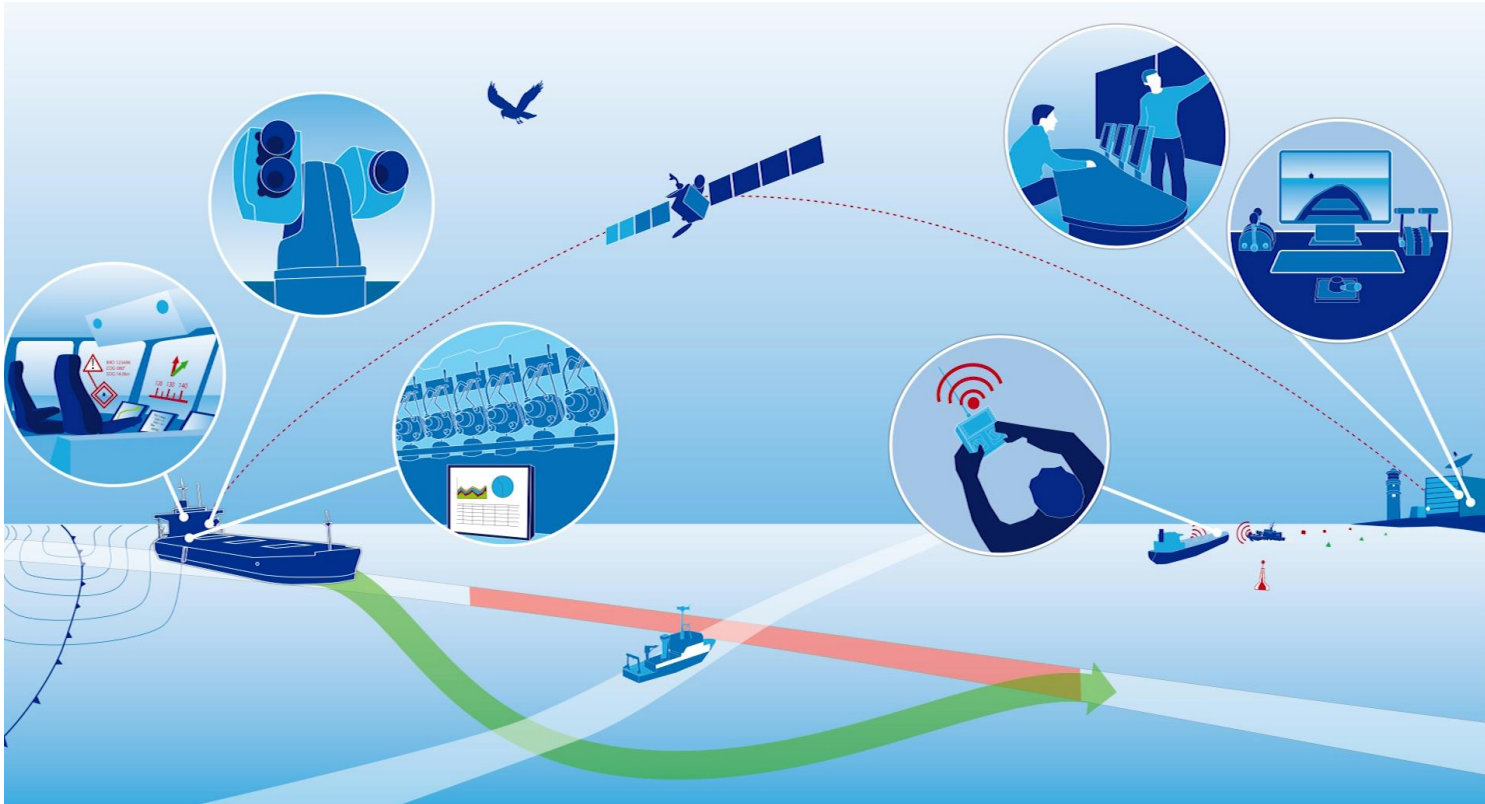


Other areas of logistics are seeing increasing interest in, and use of, automation

- Material handling
- Storage and retrieval
- Packaging
- Conveying
- Sorting
- Loading/Unloading
- Scheduling
- Etc.

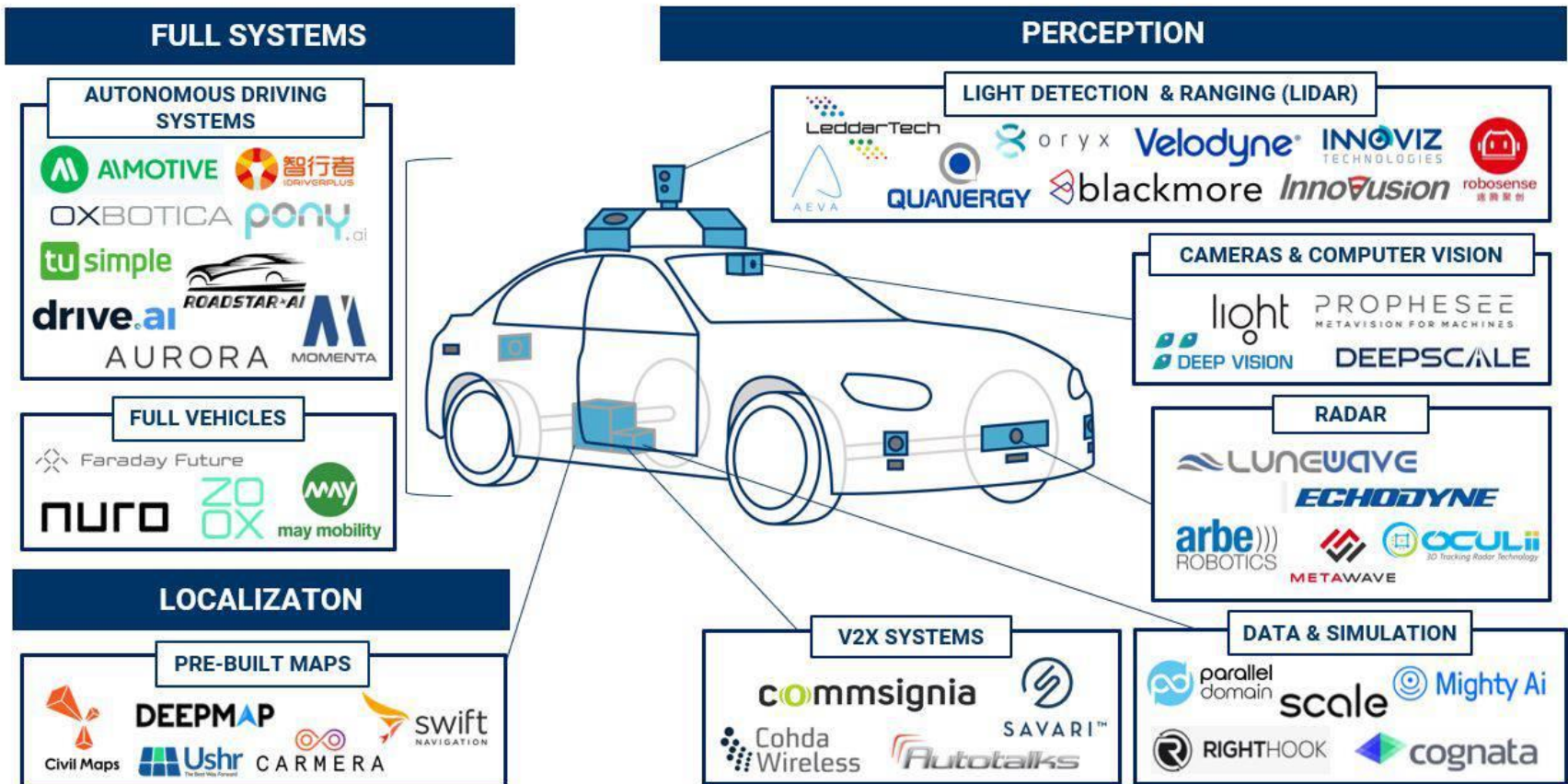


With more intelligence in systems the concept of self organized logistics operations becomes possible. . .



...making the autonomous operation of logistics a reality

UNBUNDLING THE AUTONOMOUS VEHICLE



The benefits of autonomous operations can be significant – for automobiles....

Benefits of Autonomous Car



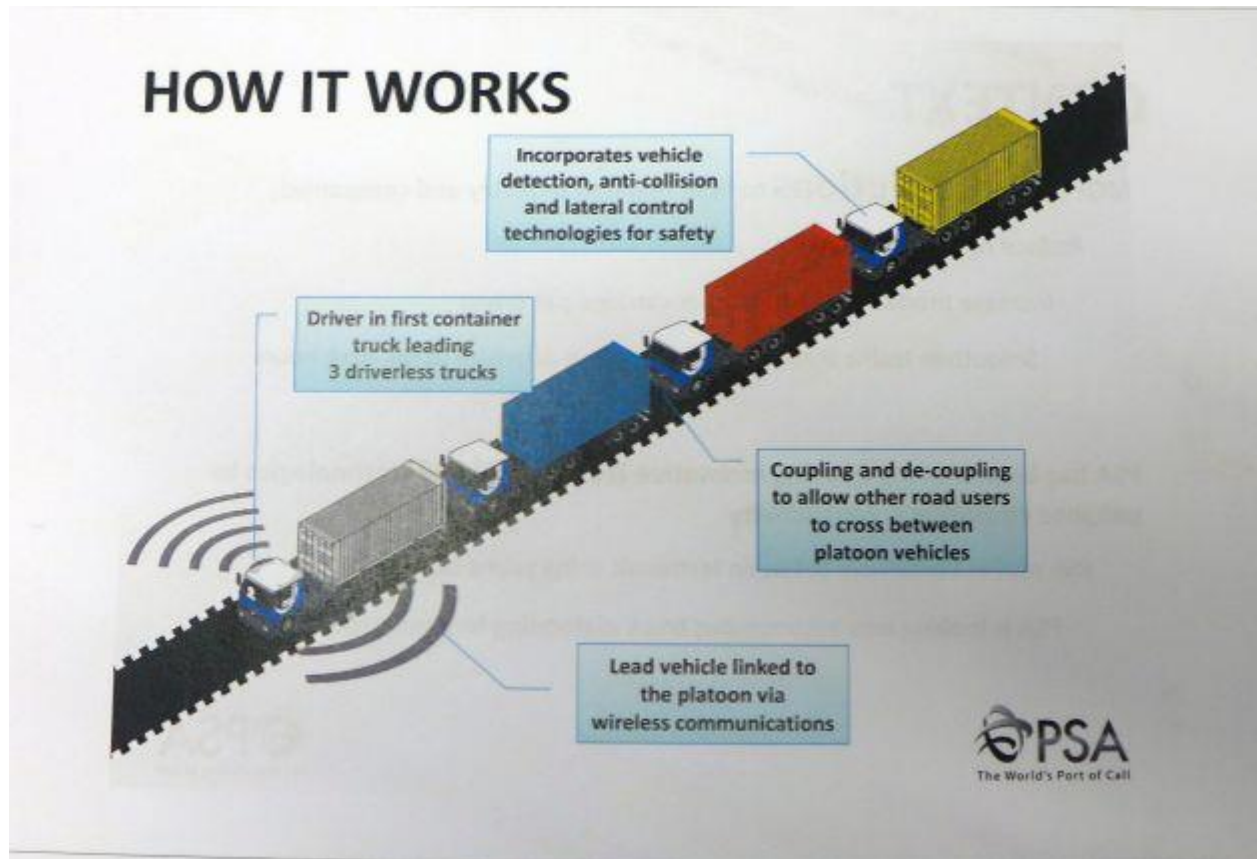
Ref: <http://www.carloan4u.co.uk/infographics/the-ultimate-car-of-the-future/>

Google, US NHTSA, AAA, Texas A&M Transportation Institute, Columbia University Earth Institute and Devil's Advocate Group's analysis

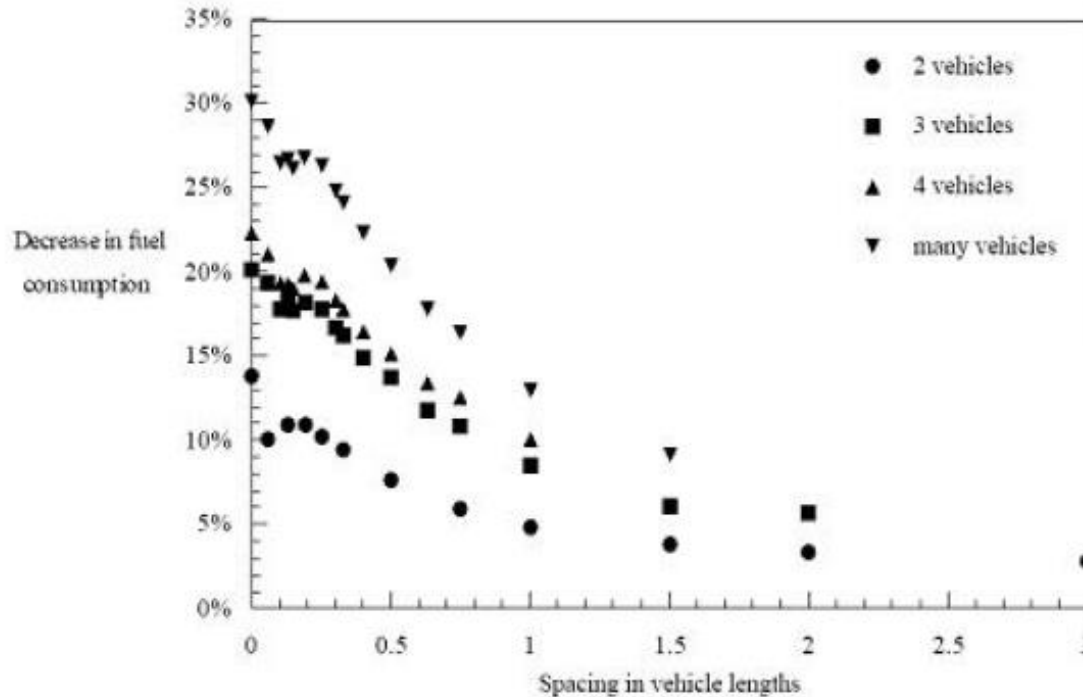
... and trucks too😊

Hours-of-Service	Allows for driver rest and productivity to occur simultaneously.
Compliance, Safety, Accountability	Will decrease raw SMS scores, though percentile scoring needs to change.
Truck Parking	If "productive rest" is taken in the cab during operations, less time will be required away from home at truck parking facilities and fewer facilities will be needed.
Driver Shortage	Driving more attractive with higher productivity, less time away from home, and additional logistics tasks; fewer driver may be needed.
Driver Retention	Companies with autonomous technology may attract and retain drivers.
Electronic Logging Device Mandate	Modifications will be necessary depending on level of autonomy
Driver Health and Wellness	Driver could be less sedentary; injuries could be reduced.
The Economy	Carriers that use AT may see productivity and cost benefits.
Infrastructure / Congestion / Funding	Urban congestion could be mitigated through widespread use of autonomous vehicles (including cars).
Driver Distraction	Drivers will not be distracted from driving if vehicle in autonomous mode

Truck platooning is one example where autonomous operations can provide significant benefits



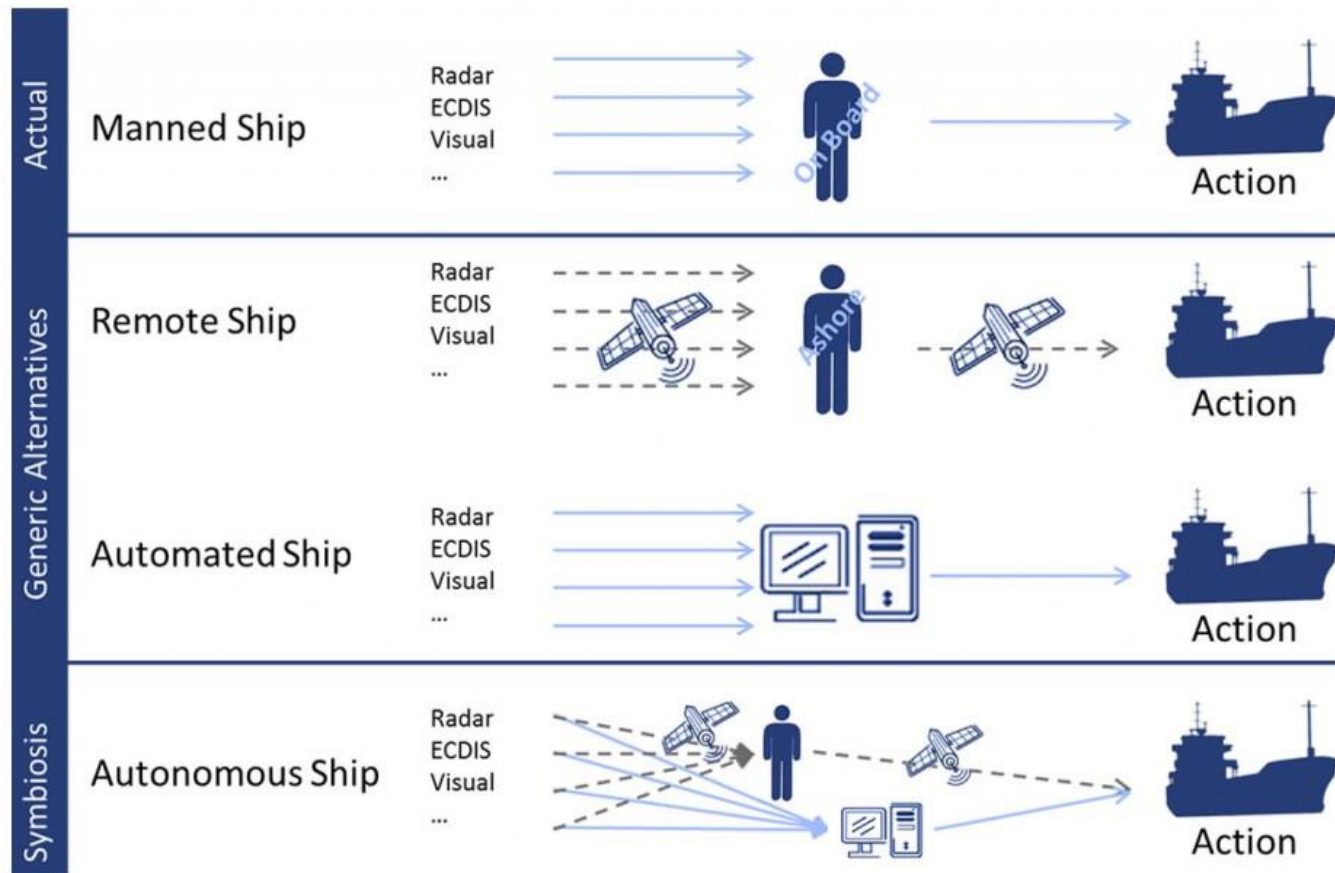
These benefits have been understood for many years, but only now can technology facilitate their realization



Source: Partners for Advanced Transit and Highway Program (1992)

The maximum length of a US tractor + trailer is 75 ft. Best fuel economy arises at approximately $.15 \times 75 \text{ ft.} = 11\text{-}12 \text{ ft.}$ (approx. 3.5 meters) between vehicles.

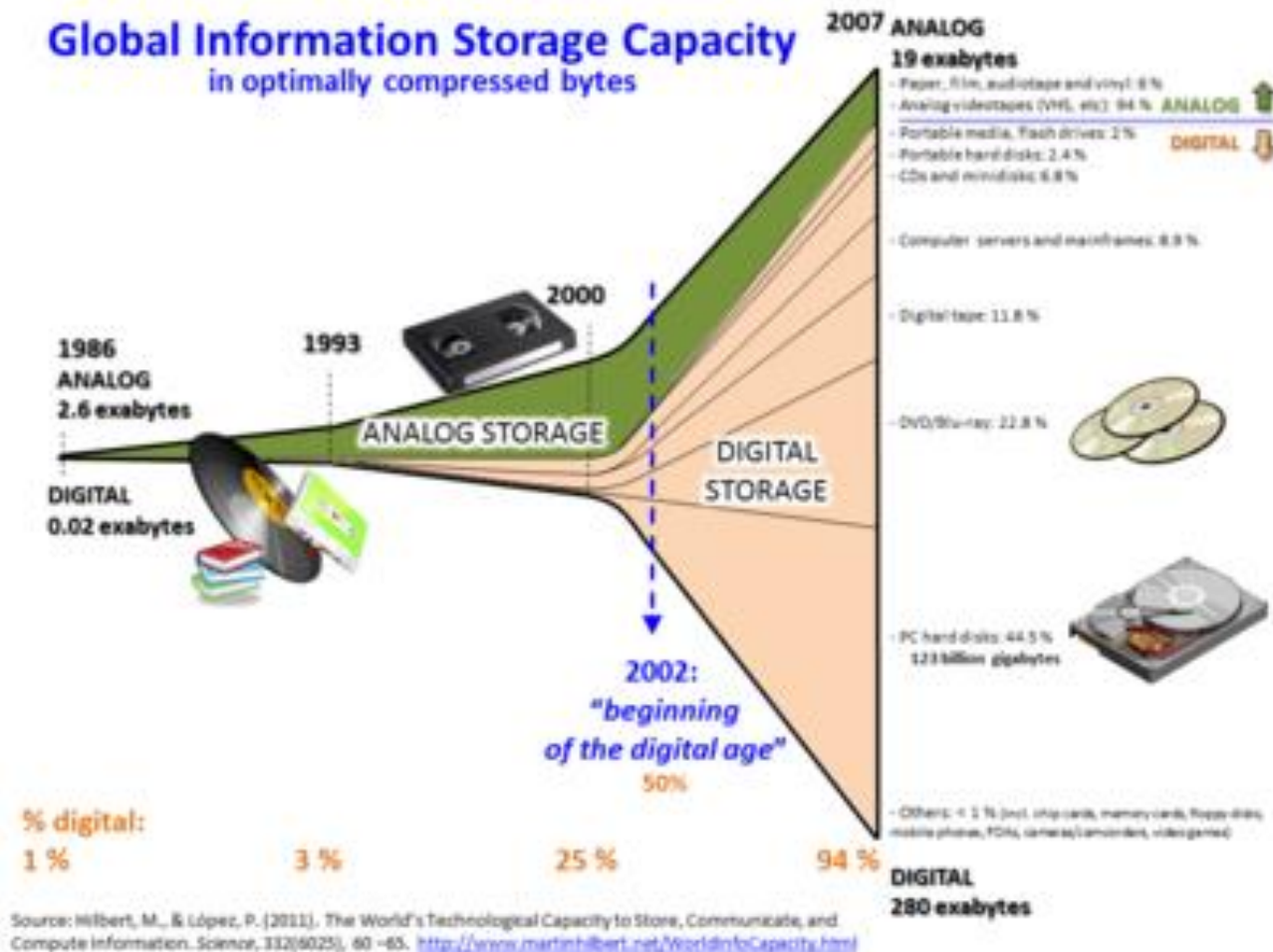
Autonomous ships are also being examined...



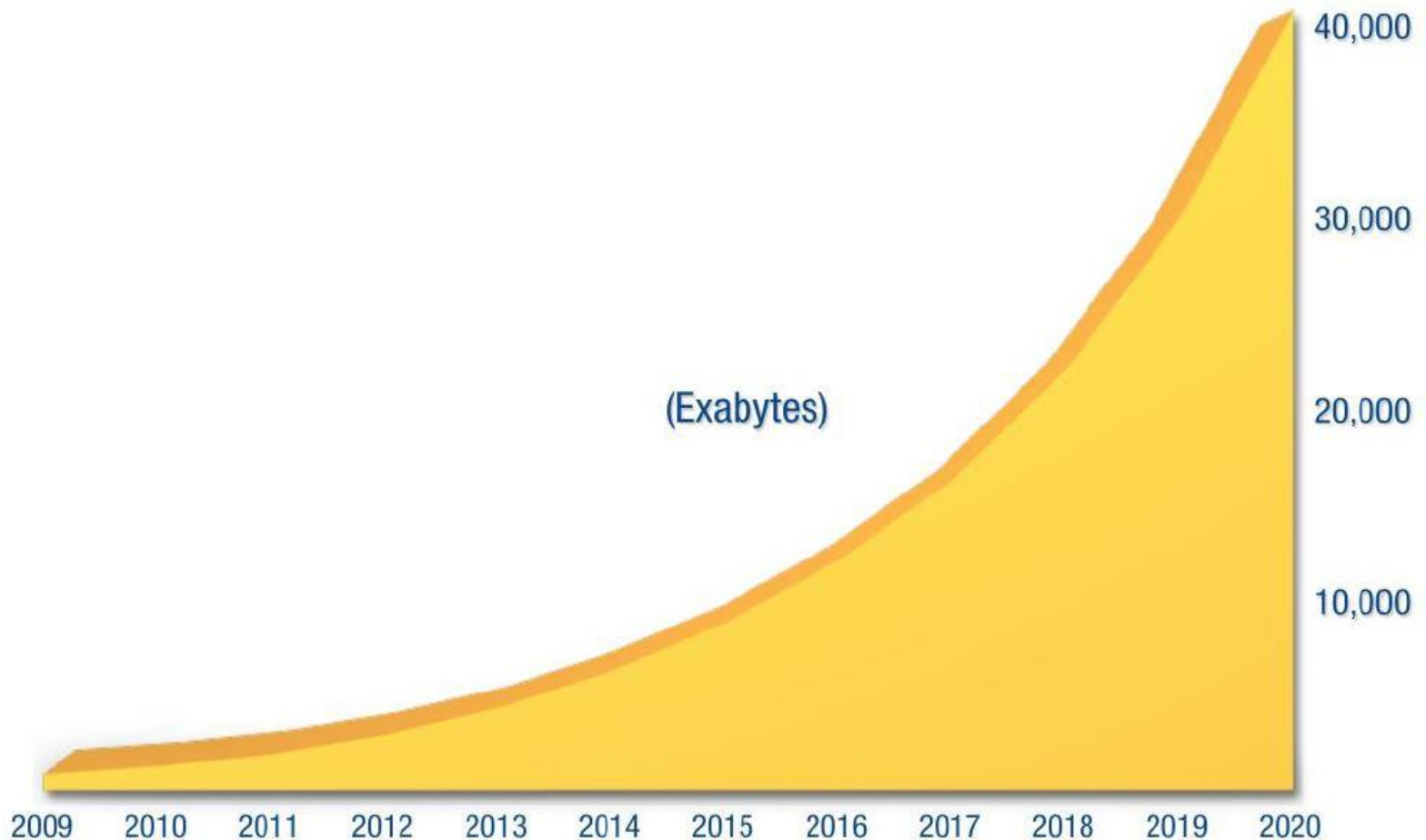
...as are autonomous aircraft



The amount of data that is being stored in various media has been growing exponentially since the turn of the century



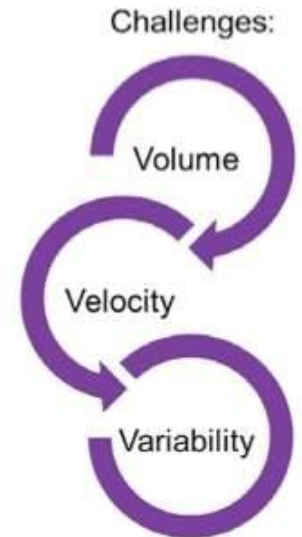
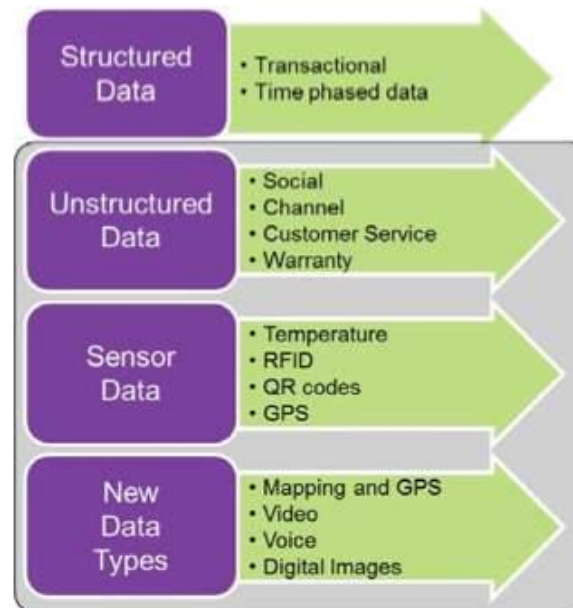
IDC projects that the generation of storable data will grow to approximately 40,000 exabytes (40,000 x 10¹⁸ bytes) by the end of this decade



Source: IDC's Digital Universe Study, sponsored by EMC, December 2012

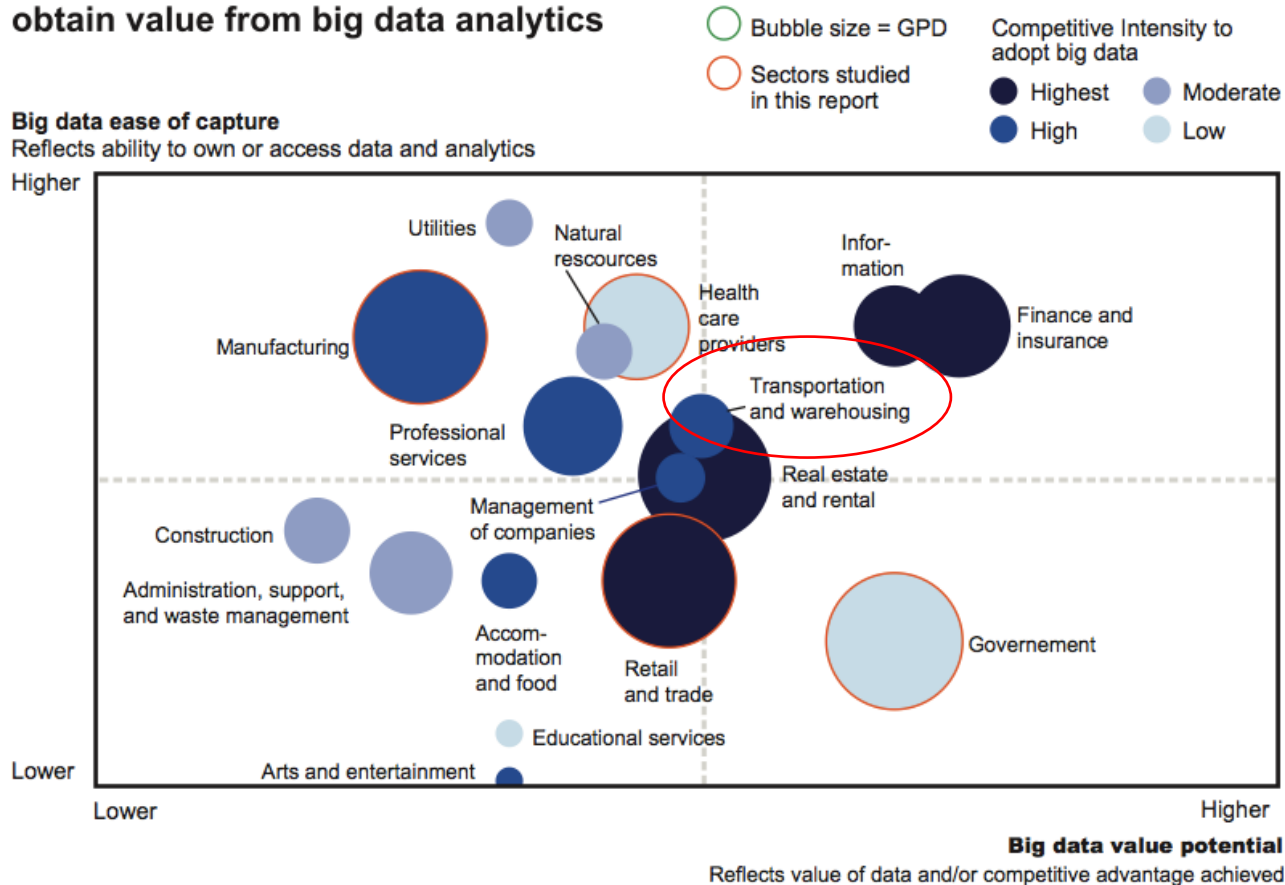
Big data results from the increased use of the internet to buy, interact with, report on, monitor, visualize and store things

- The majority of data generated today is the result of electronic image creation, video streaming, surveillance images, blogs, email, online catalogues, etc.
- Autonomous data sources (i.e., the Internet of Things), such as autoID tagged items, automobiles, mobile telephones, webcams and sensor networks are also adding to the electronic data that is generated
- All of these sources of data create vast amounts of unstructured and difficult to process data that form what industry calls “Big Data”



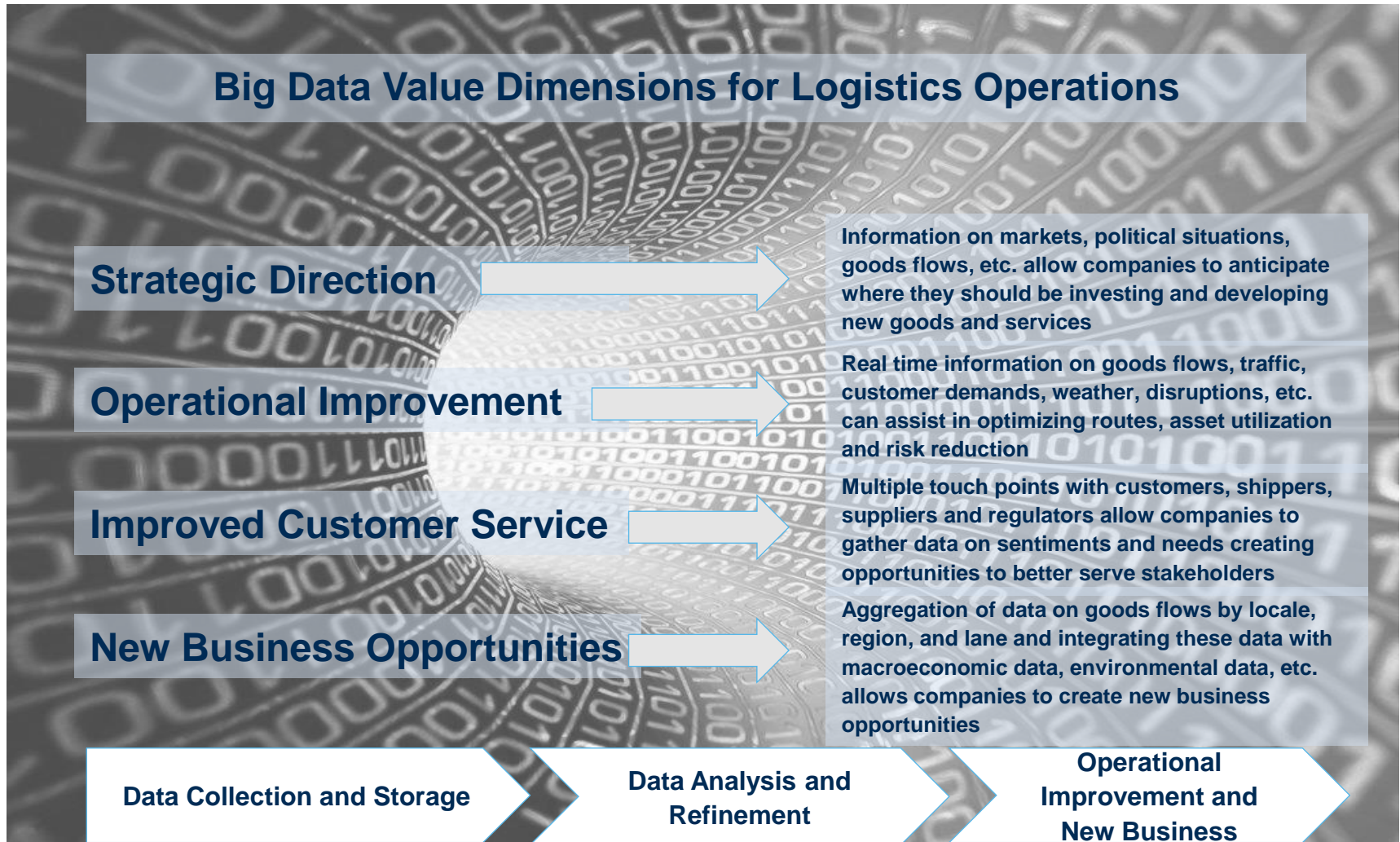
Value from data, whether big or small, only arises when it is used to inform decision makers

Sectors differ in their ability to use and obtain value from big data analytics

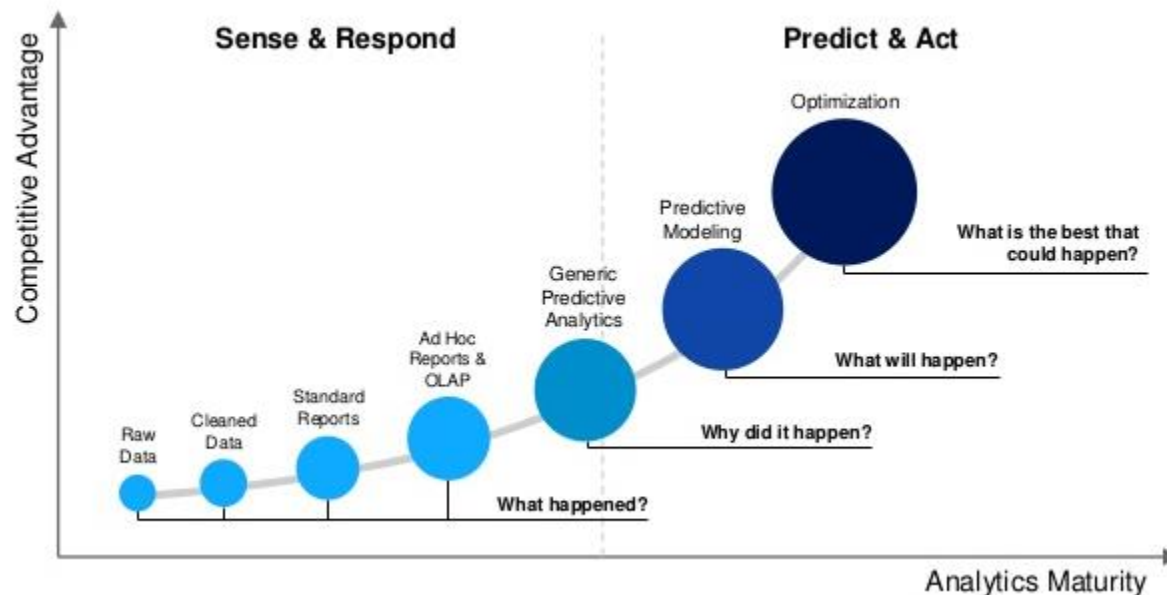


SOURCE: US Bureau of Economic Analysis; McKinsey Global Institute analysis

For logistics operations, value from data arises in four primary areas



Integrating both operational and third-party data can provide management with extremely powerful predictive tools



Better use of internal operational data can identify opportunities for improvement and operational competitive advantage

Air Cargo Weight Analytics Study 1/2

Background and Motivation

- Air freight constitutes a primary channel for shipping perishable and expensive goods
- Improved management of air transport significantly reduces cost and carbon emissions
- Key issues hampering supply chain efficiency:
 - No Shows / Late Cancellations
 - Hi / Lo Shows, i.e. discrepancy between booking and actual (e.g., weight\volume\#items)



Proactive discrepancy management approach

- Exact weight cannot be pre-determined by shippers may only be observed upon acceptance at airline
- Discrepancies can be found in ~50% of shipments, inducing high costs or delays
- Prediction model:

$$\text{Predict: } p^{Hi} := P \left\{ \underbrace{\sum_{r \in R_f} W_r^A}_{\text{Significant weight discrepancy}} > \underbrace{\sum_{r \in R_f} W_r^P}_{\text{Everything known so far}} + \tau \mid \left\{ W_r^A \right\}_{r \in R_f^A}, \left\{ W_r^P \right\}_{r \in R_f}, I \right\}$$

W_r^A - Actual weight of RouteMap r

W_r^P - Planned weight of RouteMap r

R_f - Route maps scheduled on flight f

R_f^A - Accepted Route maps scheduled on flight f

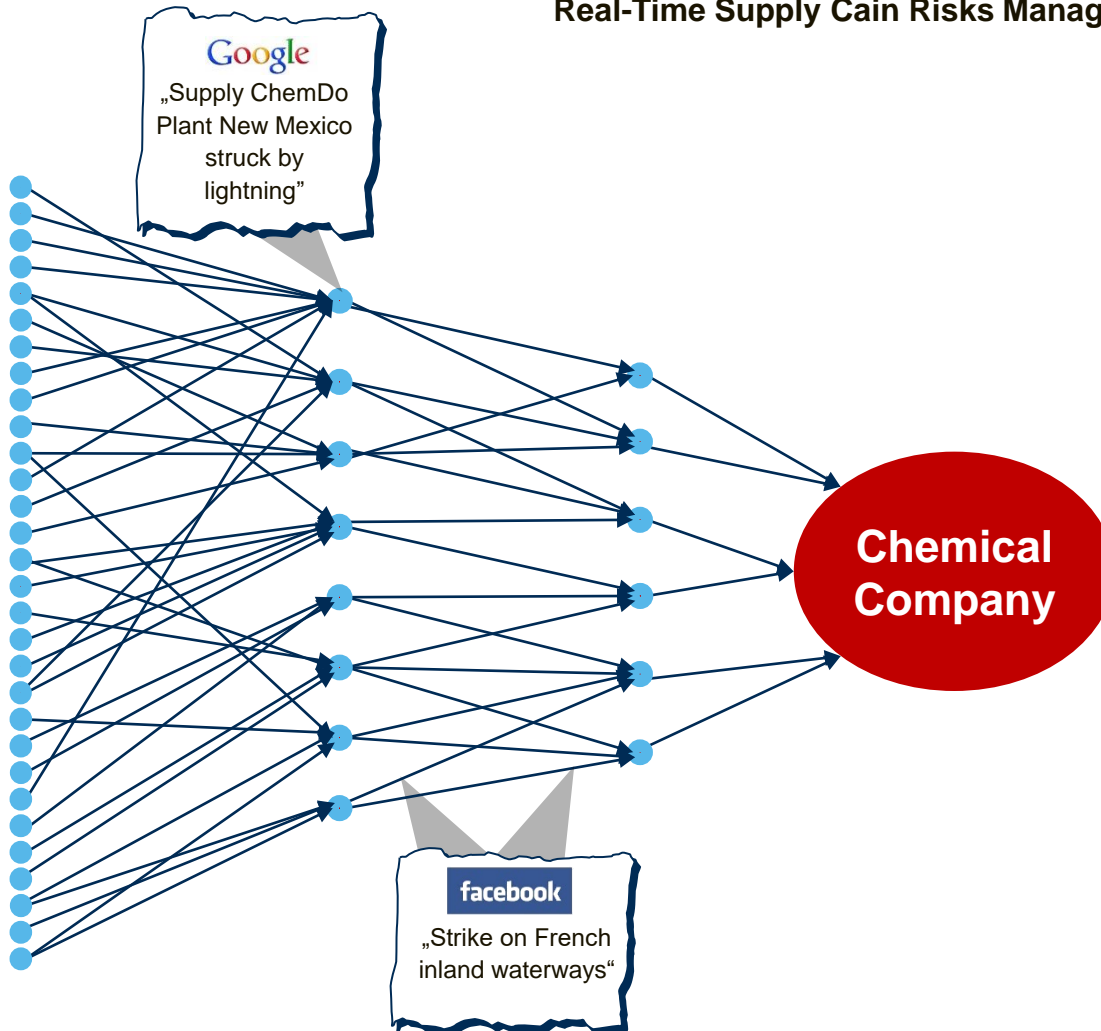
Additional information:
airports, airlines,
sources, destinations,
etc.

Alert: IF $p^* > \delta^*$ THEN alert about “*-load”

* = Over\Under

Supply disruptions can be anticipated early by using big data and data analytics

Real-Time Supply Chain Risks Management



Challenge

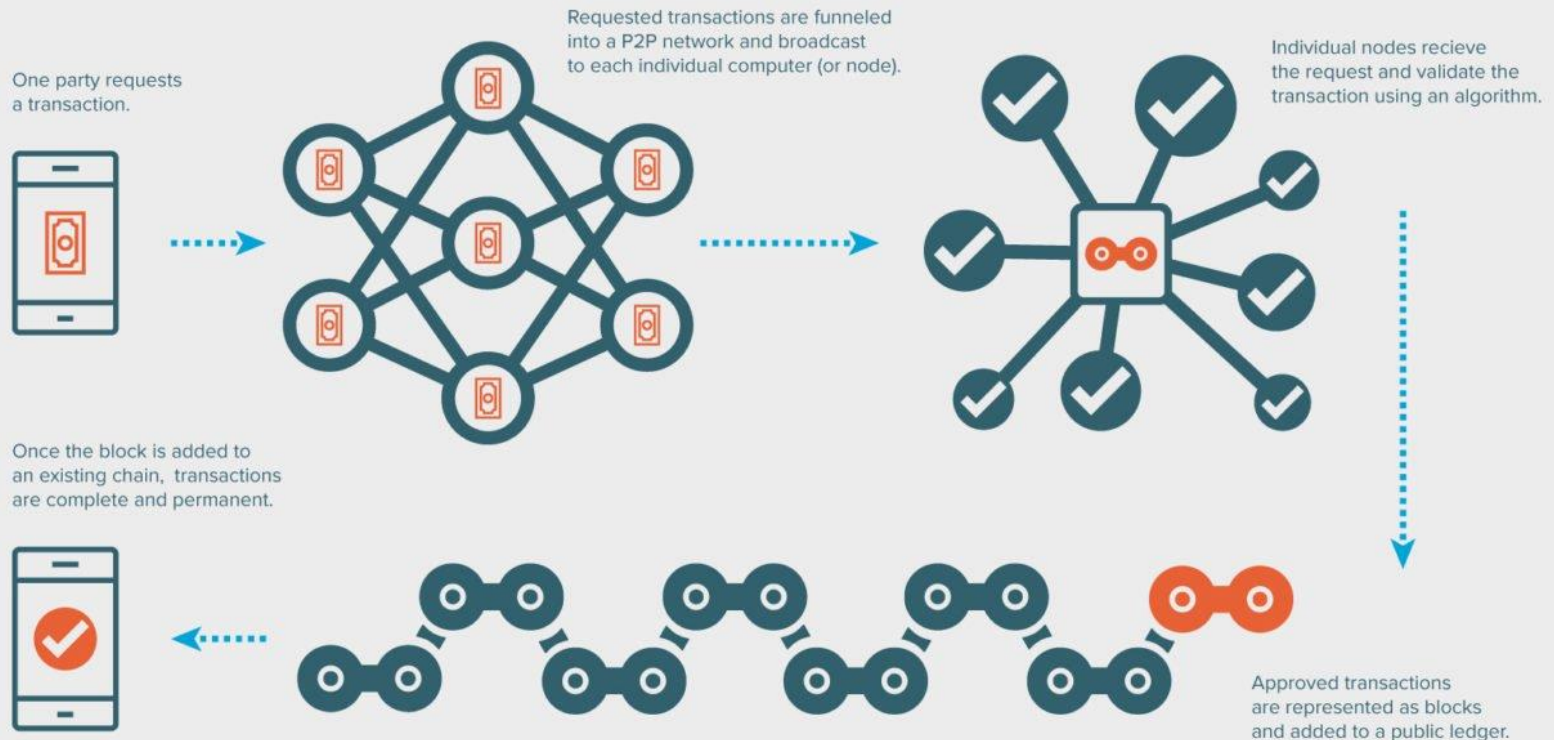
- Chemical company with **1000s of suppliers** would like to understand when certain **suppliers face challenges and disruptions**
- **Create short-term transparency** against supply disruptions based on Internet chatter

Approach

- **Leverage supply chain maps** to identify impact of activities of 2nd and 3rd tier suppliers
- Use **real-time text mining procedures** to **tap data-rich Internet news** and social media chatter
- **Define response scenarios** as required
- **Identify trade-off** between true-false and false-true alerts based on pilot performance and criticality of suppliers

The Internet is leading to more and more interesting opportunities for logistics as disintermediation continues

HOW DOES BLOCKCHAIN WORK?



Unfortunately, the disaggregated nature of logistics operations today leads to inefficient operations

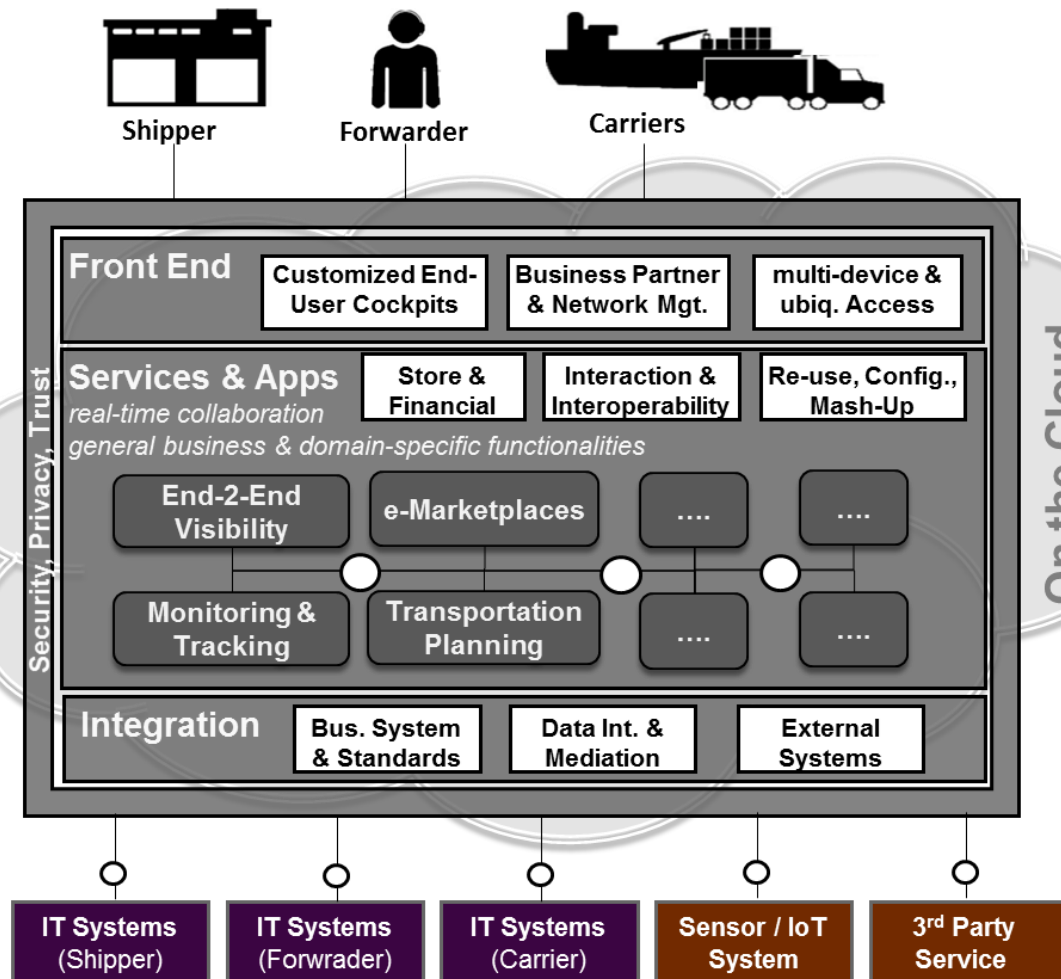
- End-to-end visibility does not exist
- Quality of shipping process is not controllable
- Assurance of deliveries is problematic
- Costs are not transparent
- Border crossings are problematic
- Vendor quality, reliability, capability, etc. is difficult to ascertain
- Risk management is not uniform
- Information sharing is difficult
- Collaboration does not exist



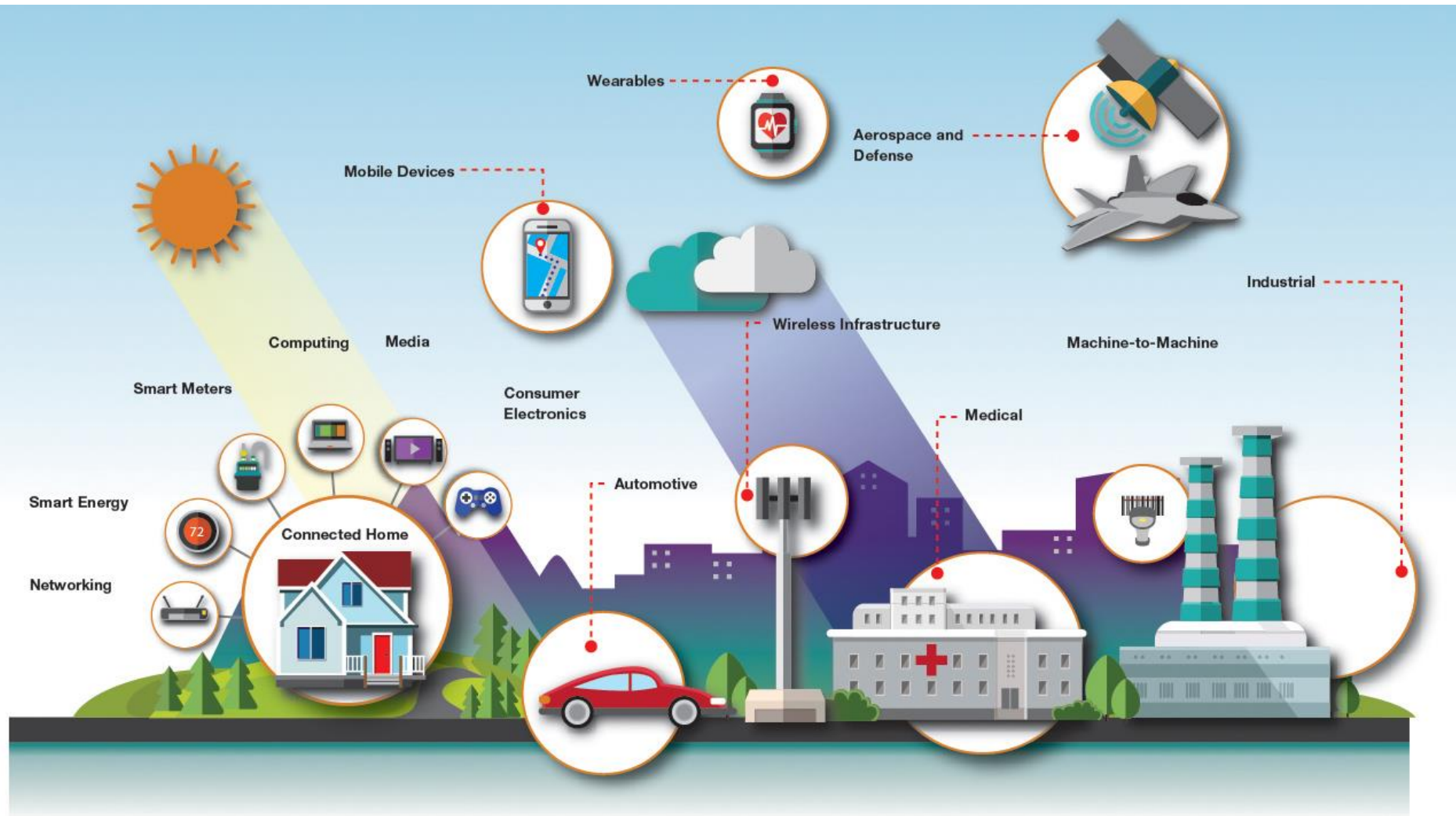
Cloud based logistics services are attempting to attack the disaggregated nature of logistics. . .

Conduct all Business Activities via FISpace
(integrated seamless Business Collaboration)

- ❖ Single point of access
- ❖ Personalized End-User Cockpits
- ❖ Social Networking & Collab. for Bus. Partners & Communities
- ❖ Access anywhere via any device
- ❖ Use On-Demand Solutions for business tasks & collaboration
- ❖ Combine & configure for individual business needs
- ❖ Re-use for rapid development of new Services & Apps
- ❖ Continue using existing IT systems for in-house purposes
- ❖ Import / export relevant information for collaboration
- ❖ Handle heterogeneous data
- ❖ Connect external systems (e.g.: IoT syst., 3rd-party & public services)



...and the “Internet of Things” is also helping to facilitate an “on demand” mode of operations



IoT and the “cloud” have begun to empower a vision of logistics managed through “control towers”

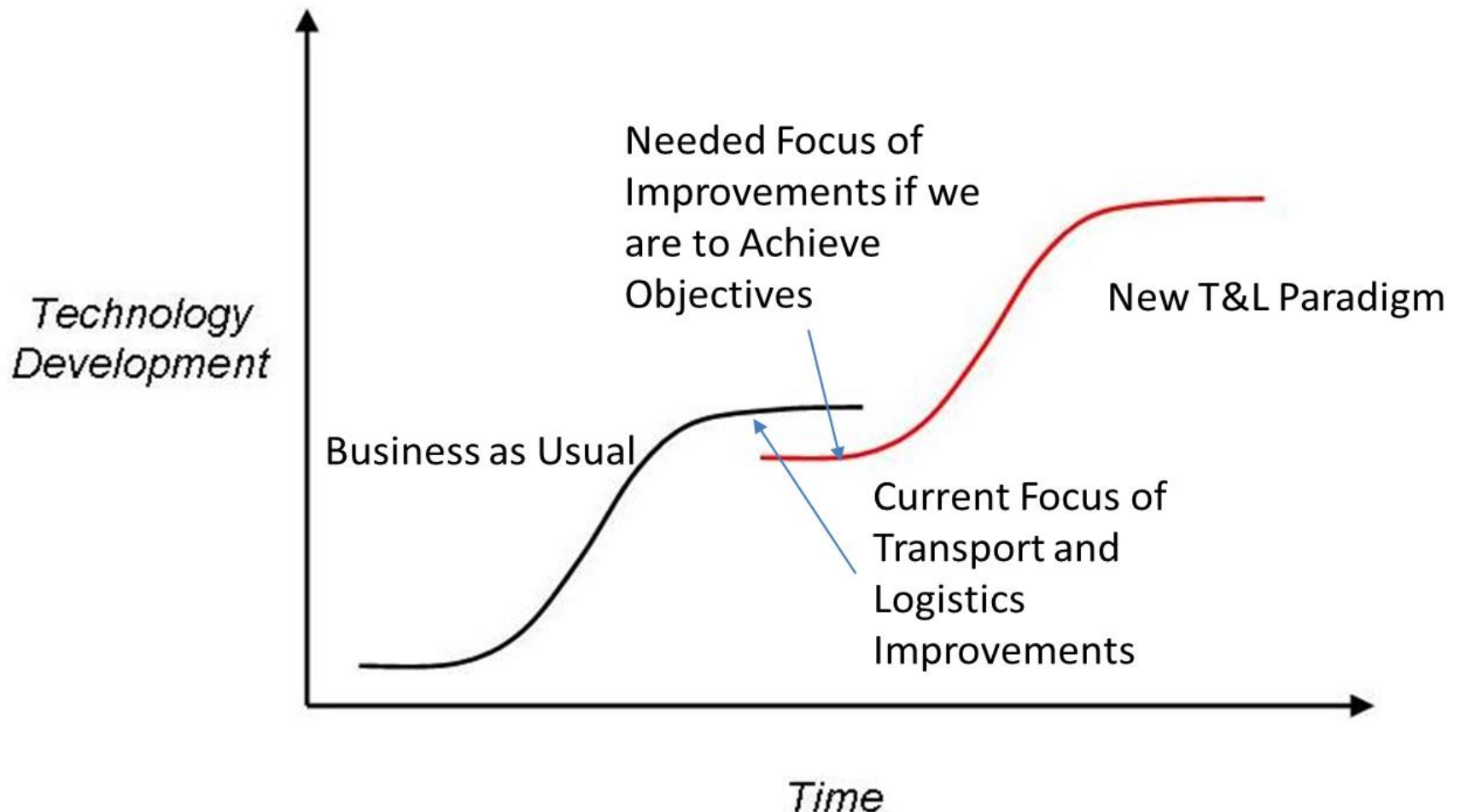
Logistic Services, Control Tower Function



All the world's trends lead to logistics models that differ from today's competitive industry models



Our focus to date has been on how industry can improve current operations, not on whether we need an entirely different approach



Our current approach to supply chain operations is not sustainable

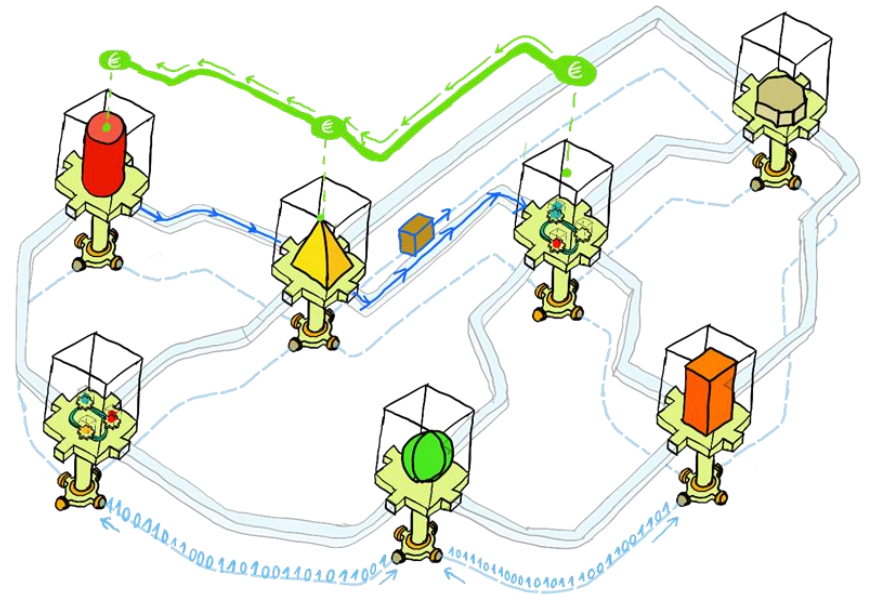
- We ship mostly air and packaging in our non-bulk shipping operations
- Empty travel of vehicles is the norm, not the exception
- Human resources for logistics services (trucking, warehousing, stevedoring, etc.) are becoming scarce
- Products sit idle most of the time, positioned or stored where not need and unavailable to those who need them
- Much of what is sold ends up simply being scraped or not used
- City logistics is becoming increasingly problematic
- Product movements due to repositioning and demand changes provide for product tourism and unnecessary shipping issues
- Integrated inter-modal shipments are not possible due to a lack of common systems, planning approaches, transfer operations, etc.
- Networks are fragile and insecure
- Automation is costly and difficult to implement
- Innovation is limited

What is needed to address logistics' negative impacts is something entirely different from our current approach

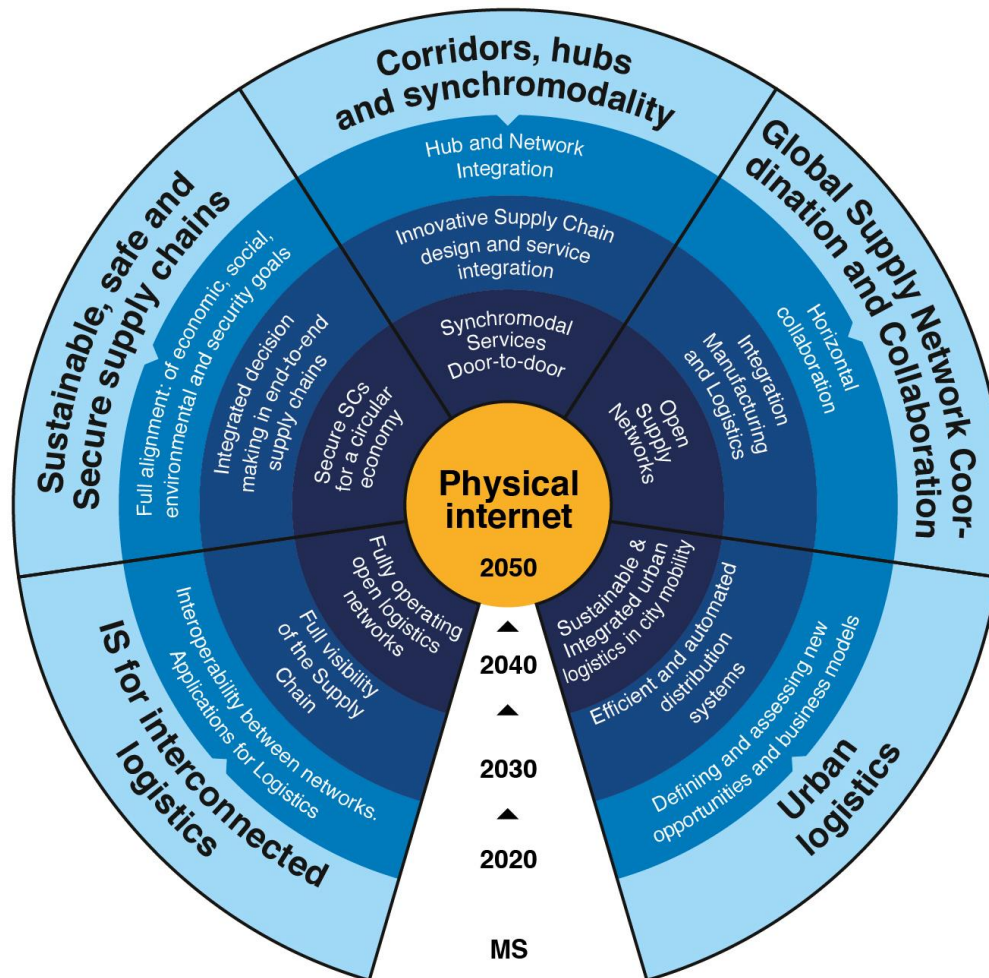


The interesting end point of all the technological advances we are seeing today may be something like the Internet

- Intelligent transport
- Autonomous systems
- Robotic material handling systems
- The Internet of Things
- Collaborative logistics
- Direct-to-consumer deliveries
- Machine-to-machine, vehicle-to-vehicle, vehicle-to-infrastructure, etc. communications
- Artificial intelligence
- The cloud
- Big data
- Etc.



A physical internet, based on standards, could conceivably be in place before the middle of century

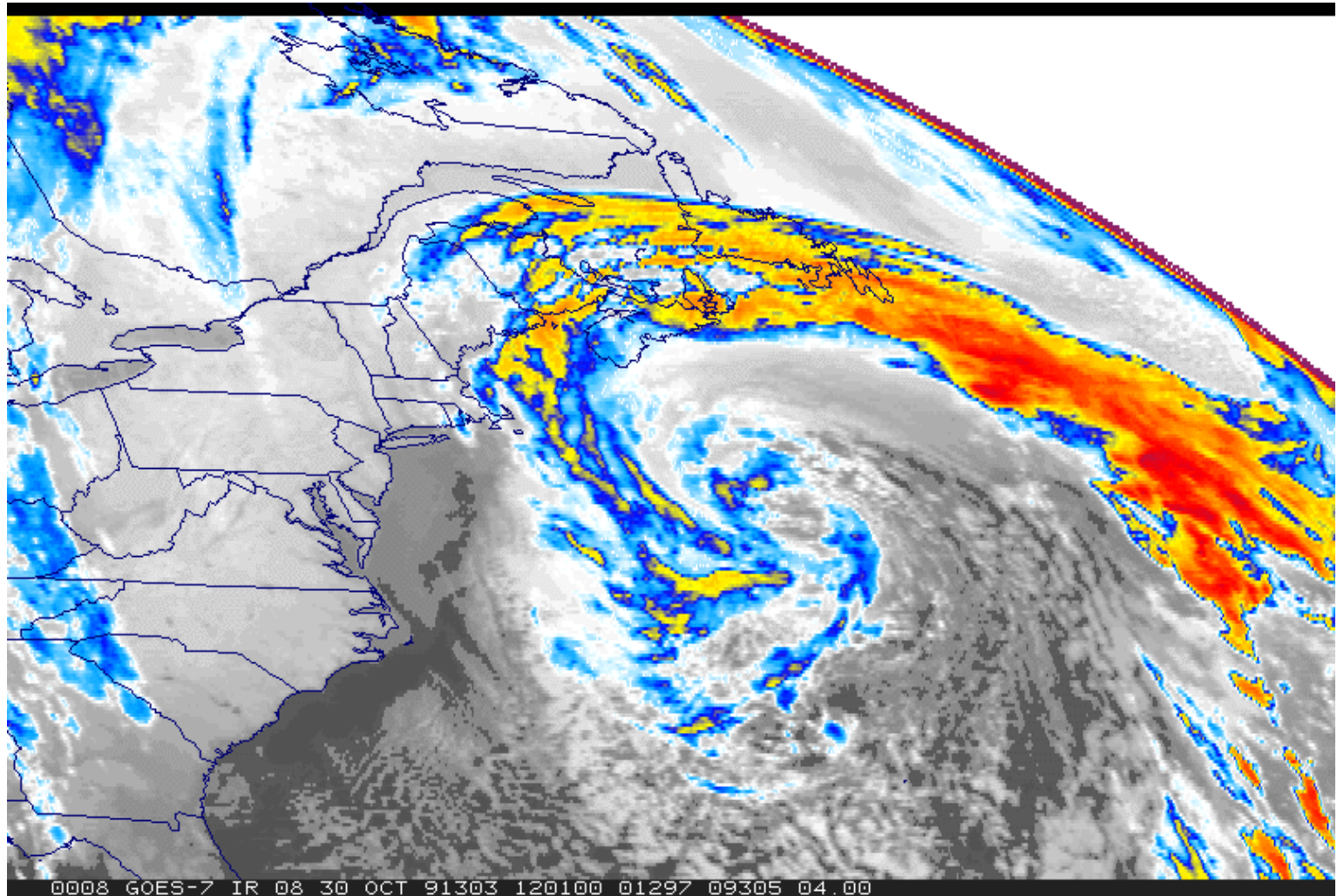


So where do we go from here?



If you don't know where you want to go, well then, any direction will do😊

The world is getting more and more complex creating a perfect storm for logistics service operations



The changes occurring in our world ensure that no matter what we are doing today, operations tomorrow will certainly be different

- Global change is an important topic for all of us
- Global operations and changing market pressures are challenging current “taken for granted” models
- New thoughts and ideas are needed to allow industry to move beyond where it is today
- If we do not take action ourselves governments and non-traditional competitors will make decisions for us
- Creative new approaches, e.g., the Physical Internet, will be required to achieve the goals needed
- It is truly time to “go where no one has gone before”



Thank you for your attention.



As long as I live, I'll hear waterfalls and birds and winds sing. I'll interpret the rocks, learn the language of flood, storm, and the avalanche. I'll acquaint myself with the glaciers and wild gardens, and get as near the heart of the world as I can.

John Muir