

# FIND WHAT'S NEXT.



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## Once upon a time, in 2025, ...



This is VERY possible!  
If it does, the status quo is going to be  
disrupted ... **big time.**



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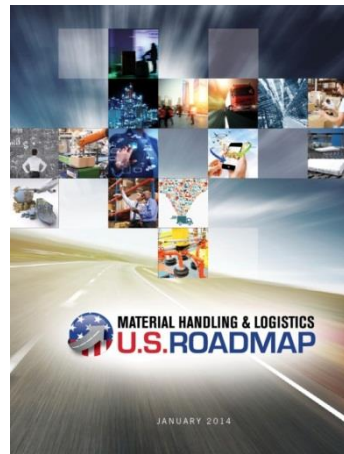
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**To not get blindsided ... look at the future!**

## **Material Handling & Logistics – U.S. Roadmap**



**<http://www.mhlroadmap.org/>**



## Motivation

Create a roadmap that identifies key issues that must be resolved to successfully compete in the future

- Document our importance to the US economy
- Start an ongoing discussion
- Stimulate industry direction
- Encourage government policy and funding

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# Material handling & logistics is **very** important

48 MILLION TONS OF  
FREIGHT, VALUED  
AT MORE THAN \$46  
BILLION, ARE  
MOVED EVERY DAY  
OF THE YEAR

# \$46 BILLION





## It is a significant economic driver

- 7.5 million businesses
- 300 million consumers
- Second largest employment sector in the U.S
- 6 million people working
- 270,000 new jobs annually through at least 2018
- A 10% reduction in transportation costs reduces the total operating costs for companies by 1%
  - US Department of Commerce



## Strategy to develop the Roadmap

- Collect ideas of thought leaders from government, industry, and academia
  - Identify *trends* that could *disrupt* the industry
- Extrapolate to what these might induce in 2025
- Speculate about key capabilities required to get there

**These are not answers ...**

**Spark your imagination and get you thinking**





## One way to think about this

### Current

- Distribution inefficient
- Congestion bad
- Same day delivery unusual
- Large factories at remote sites



### Trends

- Growth of ecommerce
- Mobile & wearable computing
- Mass personalization
- Relentless competition



### In 2025 ...

- More MTO small orders
- Order from anywhere
- Deliver to current location
- Deliveries within hours
- High density demand
- Small “factories” everywhere



### Need: A New Distribution System

- Common unit load sizes
- Shared transportation containers
- Single minute loading/unloading
- Small footprint warehouse
- Quick retrieval/storage
- New material handling strategy

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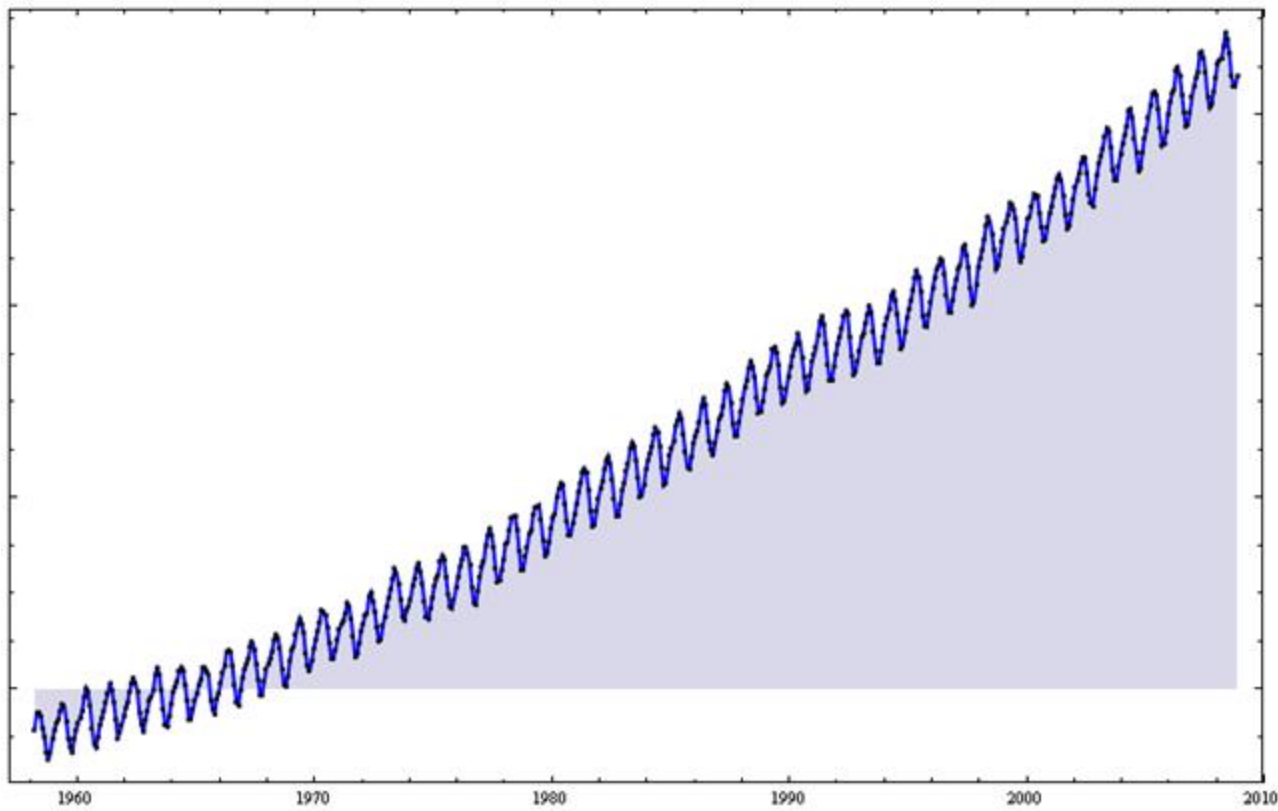
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## Trends that could create major disruptions





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1. Growth of eCommerce
2. Relentless Competition
3. Mass Personalization
4. Urbanization
5. Mobile and Wearable Computing
6. Robotics & Automation
7. Sensors & “The Internet of Things”
8. Big Data & Predictive Analytics
9. The Changing Workforce
10. Sustainability

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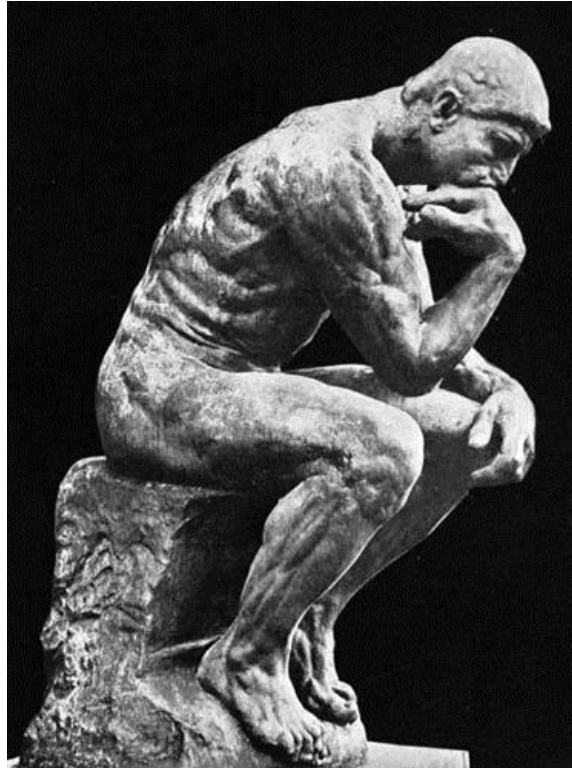


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# What could these mean to us?



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## Mass Personalization Relentless Competition Growth of eCommerce

### Pressure on producers

- High degree of customization *and* low cost
- Order anywhere
- Quick delivery *and* package finds customers

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Costs about the  
same as



THE INDUSTRY THAT MAKES SUPPLY CHAINS WORK



## Additive Manufacturing Urbanization

### Infrastructure challenge

- New distribution system in high density urban areas
- Smaller footprint production & storage – go vertical with new material handling



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## Mobile and Wearable Computing Robotics & Automation

### Opportunity to assist workers

- Provide workforce real time instructions
- Assist manual tasks improves safety

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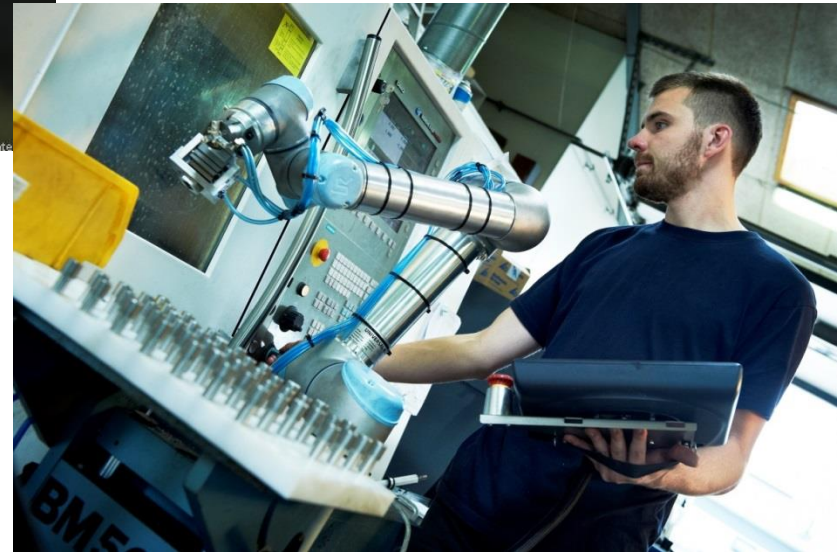
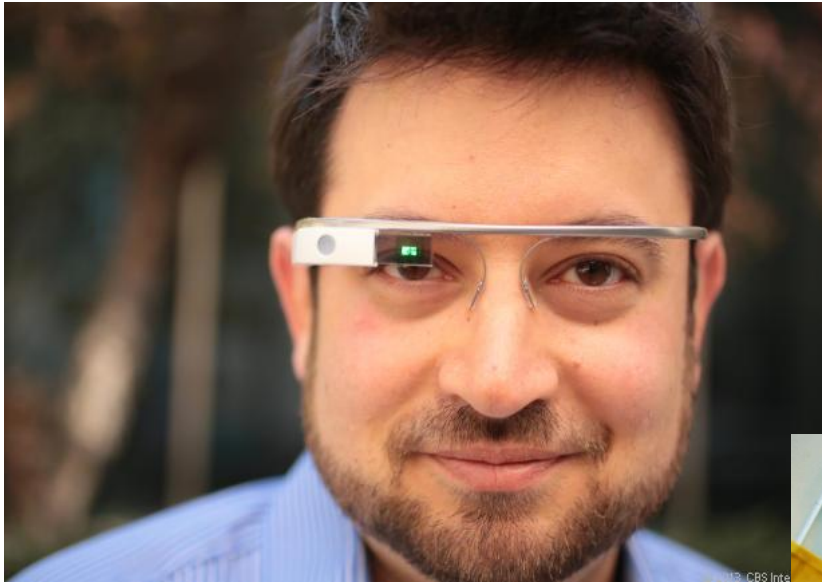


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# Sensors Big Data & Predictive Analytics

## Intelligent systems

- Anticipate consumer's needs
- Real time control without human intervention

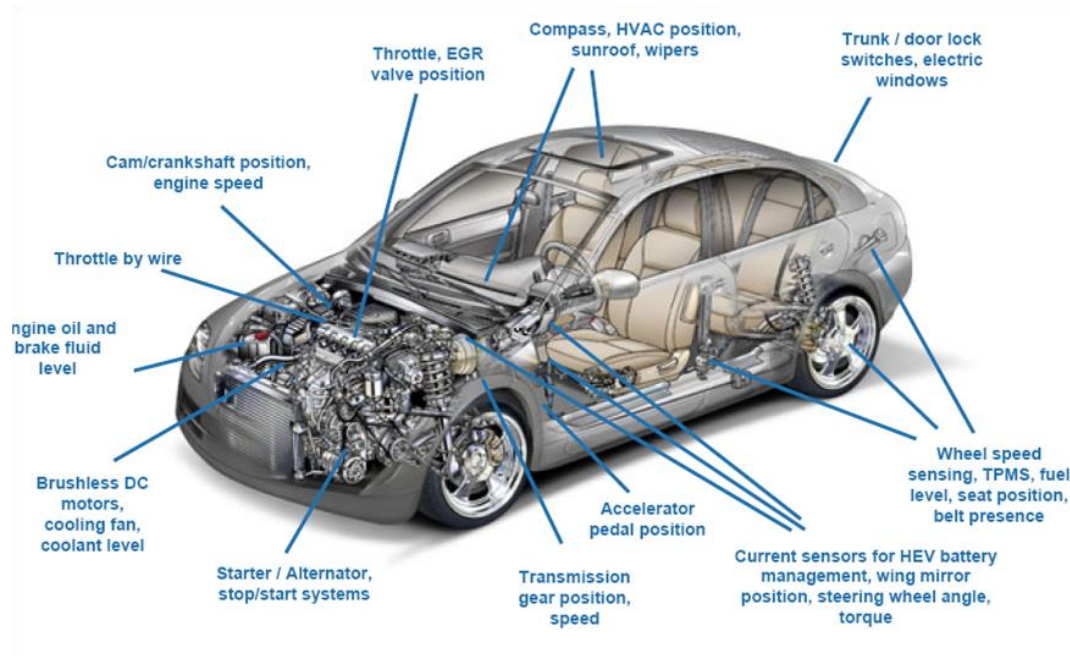
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## Putting this together leads to three core capabilities that will need to be developed

- High speed, high value material handling and logistics
- Low cost, low impact material handling
- Workforce of tomorrow



## High speed, high value material handling and logistics

- Total supply chain visibility
  - GPS, tracking across carriers, arrival time estimation
- Standardization
  - Containers, data protocols
- Sensors and the Internet of Things
  - Sharing data, real time and secure data
- Planning and Optimization
  - Anticipatory logistics, supply chain assessment tools
- eCommerce
  - Support rapid order fulfillment (hardware & software), central repositories with consumer information
- High speed delivery
  - High density storage, high throughput retrieval, personalized delivery





## Low cost, low impact material handling

- Collaboration
  - Shared resources to reduce empty truck miles and increase utilization of storage
- Urban logistics
  - Last mile using crowdsourcing, dynamic vehicle routing and scheduling w/ predictive traffic information
- Technology & automation
  - Flexible and scalable material handling, robotics, wearable computing, rapid truck loading and unloading
- Sustainability
  - Life cycle assessment impact, original intent (people, planet, profit)



## Workforce of tomorrow

- Demographics
  - National, online employment center, career development, outreach to new demographics (including older folk as well as robot-assisted employees)
- Skills
  - Material handling & logistics educational consortium
  - Funding for university research
  - Addressing skills gap and formal, recognized job classifications

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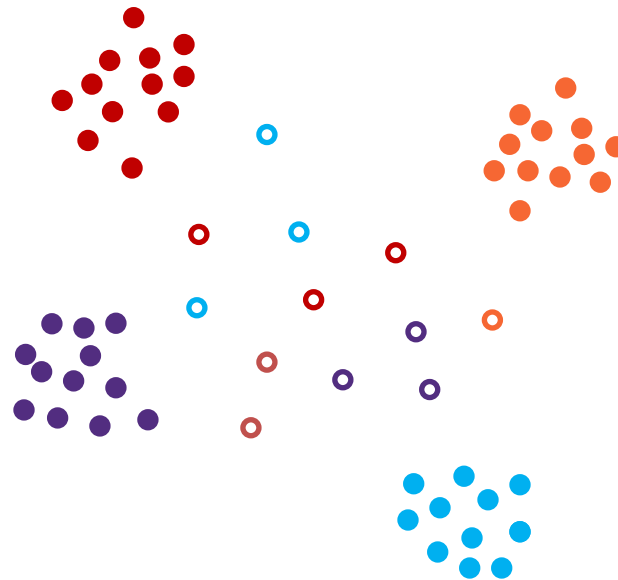
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## In the end, the ideas coalesced into four main areas in which we must build capabilities





### New methods and technology

- Distribution
- Storage & retrieval

### People, People, People

- More technical skills at all levels
- Changing workforce

### Collaboration

- Companies must work together
- Shared resources

### Sensors, Data, and Algorithms

- Ubiquitous sensors = big data
- The Internet of Things
- Real time algorithms for decision making and support

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## A vision for the new method of distribution



**Physical Internet**  
Efficient Sustainable Logistics





## Our current logistics system is rather inefficient

- An average trailer is 42.6% full
  - 56.8% full when it has a load
  - 25% of the time no load at all
  - 100% full would mean a \$65.8B opportunity!
- Similar observations for facilities (warehouses, DCs)





## It might also be called unsustainable

- Total annual CO<sub>2</sub> emissions in the US are 6,103.4 trillion grams (Tg)
  - 94% generated by fossil fuel combustion
- Transportation generates 31% of the CO<sub>2</sub> emissions
  - 1,877.4 Tg
- The freight transportation sector alone (trucks, ships, and trains used to deliver freight) contributes approximately 9%
  - 517 Tg
  - This is 5x greater than the second-leading emitter, China

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## Trucks offer an opportunity

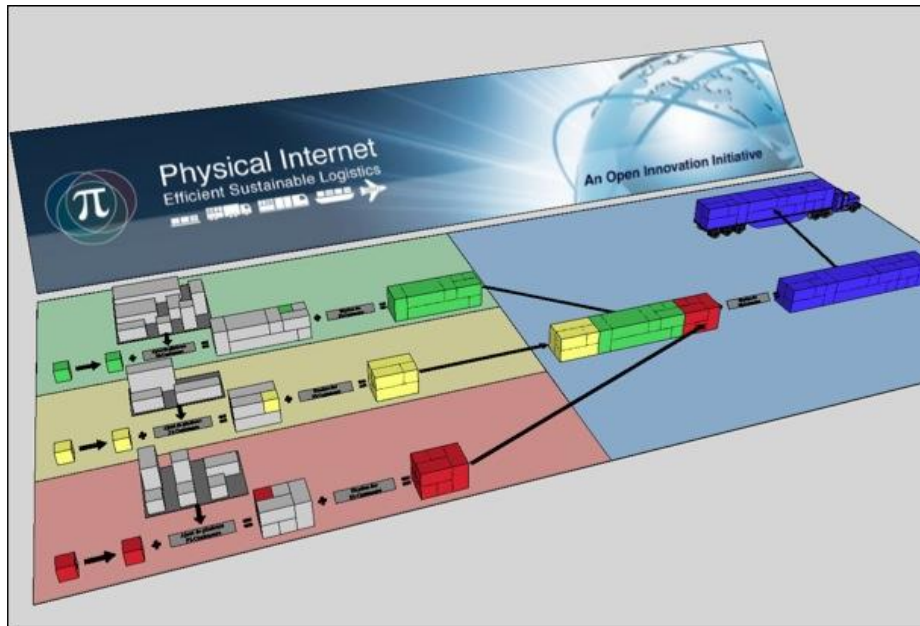
- 71.5% of the total value of freight in the U.S.
- 8.96B tons of freight
- 145B miles
- 28.7B gallons of diesel fuel costing \$114B at \$4/gal



## The Physical Internet

- Open, global logistics system
  - Uses physical, digital, and operational interconnectivity
  - Operates using a standard set of modular containers, collaborative protocols, and smart interfaces
- 
- Goal is to increase efficiency and sustainability

## Simplified Concept of the PI



Montreuil, B., "Physical Internet," 2011.

- Open and shared transportation and distribution network
- Handles "black box" modular containers
- Vast community of users
- Freight transportation "auction"
- Supplier ratings to drive logistics performance

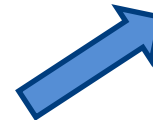
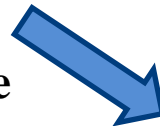
## Why this might work – role of modular containers

1057 case sizes



Retailer  
1715 CPG  
products

If the PI reduces the choices, how much additional volume is shipped?



What impact is there at the pallet level?

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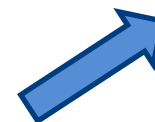
**80 case sizes**



**Retailer  
1715 CPG  
products**



**At container level,  
additional volume  
shipped is 13%.**



**At the pallet level, there  
is a net savings of 15%!**

Meller and Ellis, 2013



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## Why

Develop  
that cons

Co-lc  
Conti  
Back  
Relay

Analyzed

Cost/  
Empt  
Blenc  
Drive



on

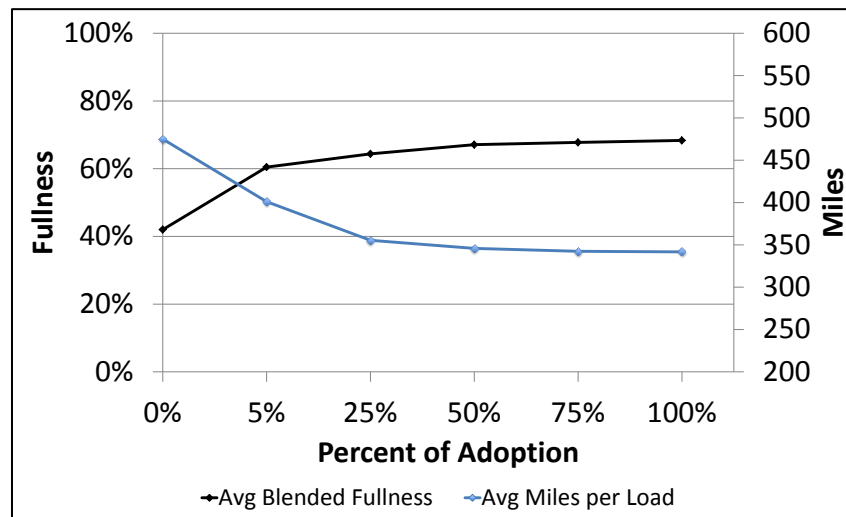


THE INDUSTRY THAT MAKES SUPPLY CHAINS WORK™



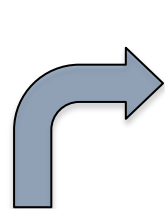
## With the Physical Internet (at 25% adoption)

- cost per load decreases 29%
- average fullness increases 34%
- drivers can return home every 2-4 days at approximately the same cost as today.



## It actually forms a “virtuous cycle”

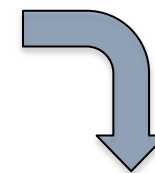
TSP: trailers more full, less empty miles, higher asset utilization, less turnover



Customer pays less!



TSP charges shippers lower rates



Retailers: lower inventory, fewer stock outs, more backhauls



Shippers: lower rates, EOQ from truckload to pallet



Shipper positions inventory closer to retailer, frequent shipments, lower price





## Dynamic Horizontal Collaborative Logistics

- The PI offers opportunities
  - Increased efficiency, reduces costs, drivers home more often, reduced emissions, less fuel burned to reposition assets
- The PI creates challenges
  - How is the system coordinated?
  - Is government regulation required?
  - Can we realize the benefits of the PI within a free market economy?

Dynamic Horizontal Collaborative Logistics

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**But more questions remain than are answered**



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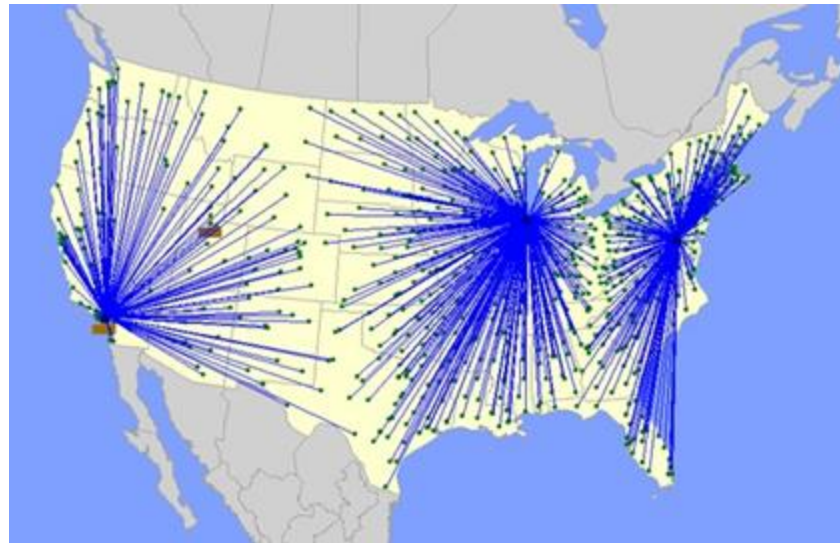
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## How is the network established ... and grown?





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## How will routes and modes be determined?



Multimodal  
Hub



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# How will carriers be assigned to routes?



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## How are packages routed?





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## How do the multimodal hubs operate... and what new technologies are needed?



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## Who benefits and who assumes the risk?



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These problems are hard ...

... there will be successes



... and failures



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But they are *ours* to solve ...



... and I think it's going to be a fun ride!