Logistics Collaboration and the Physical Internet

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Logistics Today: The Opportunity

We are shipping air and packaging
- 9 Billion tons of freight transported per year
- 25% of all miles are empty!
- 57% “full” when not empty!
- 42% average utilization
- $60B opportunity in the US alone!

CO₂ emissions are growing
- 40 Billion gallons of fuel/year
- 500+ Tg CO₂
- 200 Tg CO₂ emissions reduction opportunity!

Industry is segmented
- 75% of freight moved using dedicated resource

Logistics drives large EOQ’s
- Truckloads for commodity items
- Large regional DC’s with relatively infrequent deliveries

Truckers have become today’s modern cowboys
- 100%+ turnover rate in the industry!
- Demonstrable negative health benefits!
Logistics Today: At a Crossroads

We simply must do something different if we are to meet various reduction goals for CO$_2$ emissions.

The Global Logistics Sustainability Grand Challenge

Design a system to move, handle, store, realize, supply and use physical objects throughout the world in a manner that is efficient and economically, environmentally and socially sustainable.

Horizontal Logistics Collaboration

Sharing Warehousing, Distribution, Trucking Capacity
Grew from business collaborations

Similar origins and destinations
Joint truckload, rail
Coordination of shipping quantities
Neutral intermediary

Christmas 2009
Coordinated pickups from factories, deliveries to Tesco's warehouse
Coordinated by Tesco

Collaborated on deliveries with pet food, candy, condiment manufacturers
Built around collaborative logistics campus
Managed by third party provider
Why Horizontal Collaboration?

Fuller trucks, lower trucking costs, and energy savings are just the start…

Ultimately, the network will start to change

Current flow in a CPG-Retailer supply chain
Why Horizontal Collaboration?

Horizontal collaboration moves the cost/service curve
Lower EOQ’s, higher densities will increase numbers of facilities, frequency of smaller deliveries
Initial studies with partner data: Higher fill rate, 8% reduction in miles, 30% reduction in highway miles, 30% retailer inventory reduction, 5% network cost reduction, more DC’s closer to customers, 3% increase in on-time deliveries
Logistics Campuses & Intermediary Firms

Intermediary Firms

Collaborative Warehousing + Outbound Logistics

Logistics Campuses

TRI = VIZOR
THE WORLD’S FIRST CROSS SUPPLY CHAIN® ORCHESTRATOR™

Kane
Dependable People. Exceptional Logistics

Weber Logistics
The West Coast Logistics Leader

Americas Gateway Logistics Center

Wilmington Air Park

Logistics Hub UK
88% of firms believe in collaboration
Most companies who are using some form of collaboration see benefits
Benefits include lower costs, lower inventories, reduced carbon footprint, better service

But...

Only 10-30% use any form of collaboration, many report “failed collaboration projects”

Barriers & Research

- Efforts are limited to a small number of firms
- Efforts are limited to a single industry
- Efforts are built around static, long-term commitments
- Efforts limited to non-competitors
- Efforts don’t take full advantage of “changing the network”

Research effort built around IT, contracts and incentives, standards, and material handling technologies to overcome these limitations
The Potential: Load Planning and Collaboration

What’s the impact as we ... increase collaboration? increase network visibility? consider service requirements? strive to get drivers home?
Trailer Fullness Modeling Results

Percent of Adoption

Avg Blended Fullness  Container Fullness  % Time Empty
Total Cost per Shipment

Results

<table>
<thead>
<tr>
<th>Percent of Adoption</th>
<th>Total Cost per Shipment</th>
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</thead>
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<tr>
<td>0%</td>
<td>$0</td>
</tr>
<tr>
<td>25%</td>
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</tr>
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<td>$800</td>
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The Physical Internet Vision
The Physical Internet (PI) is an open global logistics system founded on physical, digital and operational interconnectivity through encapsulation, interfaces and protocols.

The PI enables an efficient and sustainable logistics web that is both adaptable and resilient.
The Power of an Interconnected Network

Interconnect distribution networks into logistics webs to fill trailers and distribution centers
The Speed of an Interconnected Network

To Los Angeles (USA) from Quebec City (Canada)

Distance travelled one-way (km):
- Current: 5055
- Proposed: 5115

Drivers:
- Current: 1
- Proposed: 17

Trucks:
- Current: 1
- Proposed: 17

Trailer:
- Current: 1
- Proposed: 1

One-way driving time (h):
- Current: 64
- Proposed: 66

Total time at transit points (h):
- Current: 0
- Proposed: 8

Total trailer time (h):
- Current: 124
- Proposed: 74

Average driving time per driver (h):
- Current: 64+
- Proposed: 8
Enabled by Standardized Modular Containers

Enabled by Standardized Modular Containers

Securable
Traceable, Routable
Easy-to-dismantle
Reusable
Recyclable

Factory
Customers (retailers)
Snappable

Original drawing by Eric Ballot, Mines ParisTech, adapted by Benoit Montreuil.
In a Unified, Multi-Scaled Network with Universal Interconnectivity
In a Unified, Multi-Scaled Network with Universal Interconnectivity

PI concepts at one level extending to the other levels
Governed by a Vast Network of Users with Standardized Contracts and Supplier Ratings
• eBay-like freight transportation “auction”
• handles “black box” modular containers
• open and shared transportation and distribution network
• vast community of users
• supplier ratings to drive logistics performance
Barriers to Full Interconnectivity

No standardization!
- Shipping containers
- Carton sizes, pallet sizes
- Specifying volume, how to handle, etc.

Smart, re-usable modular containers and technology are difficult to justify.
Barriers to Full Interconnectivity

Multi-modal transport systems greatly underperform

Collaborative distribution takes a lot of effort and does not scale

Logistics networks are neither secure nor robust

There are no standardized contracts or all-encompassing digital exchange
Biggest Barrier of them All?

It is not the technology, it’s inertia and a very real perception of “risk” that it won’t work well.

Need to prove that interconnected logistics will work and that it will save money!

This requires addressing many physical, digital and operational interconnectivity questions.
Ongoing Research Efforts

• What are the potential logistics system gains of the PI?
• The CELDi Physical Internet Project focuses on establishing the impact on the performance of a truck-based supply chain:
  – Mathematical models
  – Real data
  – Load Planning [above]
  – Relay network impacts – speed and driver turnover
  – Distance through network – shorter distances...
  – Inventory – rise or fall...
  – Container sizing – negate other results?

• Simulation and field-based proof of concept
• Testing facilities and containers

Relay Networks
Relay Networks

Average Miles per Load

Average Time per Load

Average CO₂ Emissions per Load
Distance Through a PI Network

Current flow in a CPG-Retailer supply chain
Distance Through a PI Network

Current flow in a CPG-Retailer supply chain
Distance Through a PI Network

Flow in a CPG-Retailer PI supply chain

Distance decreases (~20%)

Inventory impacts?
Inventory Changes

- **CPG:**

<table>
<thead>
<tr>
<th>Increase in # of DCs Used</th>
<th>% Total Inventory Increase</th>
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<tr>
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<td>22%</td>
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<td>36%</td>
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- **Retailer:** 33%+ decrease
Cases → Pallets → Mboxes → PI → Unit Loads

Example PI Possibility: 5 (All)
Modular Container Use in the Physical Internet

What’s the impact as we ...

- limit the number of case sizes?
- allow the number of items per case to change?
- allow item dimensions to change?

Modular Container Selection for the PI

Retailer
1715 CPG products
850 shelf packages

1057 case sizes

If the PI reduces the choices, how does it affect how much volume is shipped?

What impact is there at the pallet level?
Modular Container Selection for the PI

1057 case sizes

At the case level, there is a net increase of 8%.

Retailer
1715 CPG products
850 shelf packages

At the pallet level, there is a net savings of 20%!
Virtuous Cycle

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

Customer pays less!

Retailers: more backhauls, lower inventory, less stock outs

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

Shippers: lower rates, EOQ from truckload to pallet

TSP charges Shippers lower rates

Customer pays less!
Sizing the Prize, in the U.S.

- Economic: $100B+ annually
- Environmental: 200+ Tg of CO$_2$ annually
- Social: turnover down from 100%+ to 24%
Collaboration is Key!

• Horizontal collaborative logistics – how can we grow this from the bottom up?
• Standardized containers, contracts, and systems – how can we grow this from the top down?