Varying Levels of Collaboration Complexity

- Combining containers on trains
- Balancing loads
- Complex routes optimization (shuttles, Triangles etc)
- Combining loads to obtain game changing scale (e.g. creation of new trains)
- Sharing Storage Space
- Combining Pallets in a trailer
- Combining Stackable Pallets in a Trailer
- Combining deadpile loads
- Collaborative pallets
Way forward...?

Solo
1 Company optimization

P&G Supply Chain
Tupperware Supply Chain

In Partnership
Tupperware + P&G

Expand partnership
Multi-lane collaboration

Multi Party collaboration
3+ partners (CO3 framework)
TRUSTEE

Future Market Place
Physical Internet
10-30+ partners
Limits of collaboration?

Too many players?
Is there a breakpoint when it is best to move from active Collaboration to a market opportunity?
Speakers workshop Horizontal Collaboration:

• Synchronization of intermodal freight shipments in the sharing economy, Joren Gijsbrechts KU Leuven

• Facilitating Horizontal Collaboration in transportation Maria Jezus Saenz Director Zaragoza Logistics Center

• Microzoning: A grid based approach to facilitate last-mile delivery, Boukje Schellens Analyst ARGUSI
Synchronization of intermodal freight shipments in the Sharing Economy*+

Chuanwen Dong – Kühne Logistics University
Joren Gijsbrechts – KU Leuven

Introduction

- State-of-the-art of logistics is not sustainable

- Vision: the Physical Internet Initiative
  - Horizontal Collaboration
  - Synchromodality

- KUL and KLU develop practical models and tools to support the business decision-making process
Research Questions

1. How can one shipper maximize its modal shift to intermodal rail transport and obtain cost savings?
2. How can multiple shippers collaborate to achieve additional modal shift and cost savings?
Our Model

**Input Parameters**
- Demand Pattern
- Road Transport Cost
- Intermodal Transport Cost
- Inventory Holding Cost
- Service Level

**Decision Variables**
- Re-order Points
- Intermodal volume commitment
  - Individual
  - Aggregate

**Output Variables**
- the modal split
- the pre-commitment of intermodal volumes
- the resulting impact on logistics costs.
Current standard industry practice

- Ship the stable demand via intermodal rail
- About 20-30% of freight volume intermodal
Our synchromodality model to maximize modal shift

By looking at the total logistics costs perspective (transportation and inventory), it is possible to increase the share of intermodal rail from 20-30% to 60-70%.
Behind individual optimization

- From Individual to Group Commitment (of the intermodal volume)
- Daily Synchronization directs shippers towards same days of stock
- Example:
  - Daily Group Commitment of 6 Intermodal 45 ft Containers

Days of Stock at DC

- 1 day
- 2 days
- 3 days

Company
Numerical Study

**Input Parameters**
- 3 shippers
- Consumer goods sector inspired costs and demand pattern
- Synchronization Policy used

**Results**
- More possible solutions can be found
- Slight additional Cost Savings (-1%)
- Increased modal shift (+5-10%)
Numerical Study – impact transport price
Numerical Study – impact inventory holding
Numerical Study – impact demand variability
Conclusion and next steps

- Significant Modal Shift is possible when integrating a holistic view
- Collaborative commitment of intermodal volume enhances a modal shift
- Integration of models into data sharing platforms is needed
- Integration machine learning algorithm to allow qualitative feedback practitioners

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Facilitating Horizontal Collaboration in Transportation

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- 10+ Educational Programs
- 80+ Researchers & Faculty

150+ Corporate Partnerships
117+ Current Students
1000+ Alumni worldwide

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“The MIT Global SCALE Network is an international alliance of leading research and education centers dedicated to supply chain and logistics excellence through innovation.”

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Publications on Horizontal Collaboration


Article, Supply Chain Management Review, 2017

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Physical Internet: Re-imagining Logistics?

1. Open, flexible value networks
2. Machine Learning, IoT, Big Data, Blockchain
3. Collaboration to the maximum exponent: HC
4. Dynamic and resilient value networks

Saenz, 2016. Supply Chain Management Review. The Physical Internet: Logistics Reimagined
Facilitating Horizontal Collaboration in Transportation

“In the long history of mankind...those who have learned to collaborate and improvise most effectively have prevailed.

– CHARLES DARWIN
Facilitating Horizontal Collaboration in Transportation

About our Research

• Material Handling Industry (MHI)
• Interviews and cases studies with HC companies
• Survey N = 347
  • 57% Europe, 38% America, 5% Asia and Australia
  • 29% Executive level position, 50% Management level, 21% non-management level
Horizontal Collaboration Today

HC around the world
FIGURE 2
Barriers to horizontal collaboration

- Capability and skills of personnel
- Legal restrictions regarding competition
- Fear of losing competitive advantage
- Lack of cross-network visibility
- Fear of the unknown
- Increasing operational complexity

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Types of Alliances in Horizontal Collaboration

• Shippers HC or Suppliers HC

• Customer HC

• 3PL HC - 4PL HC

• Inverse needs HC

• Multidimensional Collaboration: Vertical + Horizontal + Diagonal
Shippers Horizontal Collaboration
Suppliers Horizontal Collaboration

- Saving of 150,000 km of truck for eliminating trucks on the road
- Improvement in occupancy (volume & weight) 55% to 85% by the mixing heavy and light goods
- Reduction > 200 Tons CO2
- Intermodal Solutions

17% saving
3PL Horizontal Collaboration
Multidimensional Collaboration: Vertical + Horizontal + Diagonal

Open, flexible and dynamic value networks: Amazon-DHL-Audi
Multidimensional Collaboration: Vertical + Horizontal + Diagonal
Collaboration between Walmart, Uber, Lyft and Deliv

Supply Chain 24/7, 2016. Walmart Partnering With Uber, Lyft and Deliv to Test Grocery Delivery Service
FIGURE 4

Instruments for horizontal collaboration and its benefits

New business models

Joint value propositions

Value co-creation
How Horizontal Collaboration can happen

1. Establishing a Central Trustee
2. Identifying Potential for VALUE (improvements or savings)
3. Cross-engineer routes:
   – Dynamic Pricing
   – Incentives: adapt current structures + bring new partners
   – Smart-Recognition of possible partners: Analytics
4. Micro-Pair with partners
5. Developing Trust
6. Reaching Efficiencies

CRITERIA:
- origins, destinations, delivery time-windows, frequencies of deliveries and their variabilities, compatibility of freight and handling, KPIs, information systems available or percentage of returns.
FIGURE 5
Natural horizontal collaboration system

[Diagram showing the flow of logistics and cross-engineering, involving joint decisions and neutral trust.]

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Moving from Supply Chains .... ... to VALUE Networks

Moving from Profit Sharing .... ... to VALUE Sharing in a collaborative environment
Zaragoza Logistics Center

Facilitating Horizontal Collaboration in Transportation

Maria Jesus Saenz, Full Professor
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Microzoning: A grid based approach to facilitate last-mile delivery

International Physical Internet Conference 2017

Boukje Schellens (MSc)
Dr Frans C.A.M. Cruijssen
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<th>Method</th>
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<th>Microzoning in Practice</th>
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<td>Description of the developed method and the heuristics used</td>
<td>Overview of the obtained results and the conclusions which can be drawn based on the conducted research</td>
<td>Results of a project which has been conducted for a parcel delivery company in the Netherlands</td>
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Introduction & Definition
What is microzoning?
- Dividing a geographical area in smaller zones
- Territory design or districting
- A service zone consists of multiple basic units

Why microzoning?
- Overcome inefficiency of last-mile transport
- Easier to reschedule similar microzones
  → Stimulates horizontal collaboration

Example of inefficient PC5 regions in the Netherlands
Microzoning & Physical Internet

- Physical internet uses automated planning and combines deliveries of multiple suppliers in one truck. This requires standardization of all elements of the supply chain process including standardized delivery zones.
- Microzones can become the π-containers for last mile delivery: modular, smart and standardized
- More efficient movements of physical objects
- Improves interconnectivity
Hard Criteria (Constraints)

1. Complete and exclusive assignment: Every piece of land should belong to exactly one microzone.
2. Contiguity: A microzone should consist of a connected aggregation of land.
3. Compatible with natural and physical barriers.
4. No holes: A microzone can not be located completely within another microzone.
Contiguity

Contiguous

Discontiguous
No holes

cluster completely within other cluster

cluster with 'no holes' constraint satisfied
Soft Criteria (objectives)

1. Compactness: a microzone should be spatially compact
2. Minimize workload
3. Minimize the number of microzones
Method
Three phase Approach

1. Pre-processing phase
   - Obtain the right input for the initiation phase
   - Create a grid of the area

2. Initiation phase
   - Generates an initial solution which fulfils all constraints
   - Starts with every grid cell as unique microzone and merges them in an iterative approach

3. Optimization phase
   - Optimizing the initial solution to obtain the best possible solution
   - Move grid cells from one microzone to another to obtain best possible objective value
Heuristics

- **Simulated Annealing** *(S. Kirkpatrick, C.D. Gelatt & M.P. Vecchi, 1983)*
  - Slow cooling process, the probability of accepting a solution with a worse objective value decreases when the method comes closer to termination

- **Tabu Search** *(F. Glover 1989, 1990)*
  - Local Search algorithm which stores last found solutions in a Tabu List
Data

- 1 month of historical demand data of a parcel delivery company (consisting of 22 workdays)
- 2 regions in Belgium are considered:
  - 1 densely populated area around Liege
  - 1 rural area in the Ardennes
Research Results
4 different scenarios have been tested:

Overview of the four different scenarios with corresponding priorities

<table>
<thead>
<tr>
<th>Scenario</th>
<th>$\rho_1$</th>
<th>$\rho_2$</th>
<th>$\rho_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. equal priority</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2. priority minimizing number of microzones high, priority minimizing workload low, priority compactness low</td>
<td>2</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>3. priority minimizing number of microzones low, priority minimizing workload high, priority compactness low</td>
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<tr>
<td>4. priority minimizing number of microzones low, priority minimizing workload low, priority compactness high</td>
<td>0.5</td>
<td>0.5</td>
<td>2</td>
</tr>
</tbody>
</table>
Microzones

Scenario 1

Scenario 2

Scenario 3

Scenario 4
Service zones & Routes

- Assumption: A service zone can have a maximum workload of 480 minutes on average per day
- In total 6 service zones were created:
  - 4 in the dense area and 2 in the rural area
  - The routes were pretty robust with a coefficient of variation between 0.1 and 0.17 for every route
Conclusions

- Developed method is able to generate a solution which satisfies all predefined properties
- Stakeholders preference can be incorporated
- Method generates compact microzones for each scenario
- Robust routes can be created based on the developed service zones
Microzoning in Practice
Scope of the project

- A project conducted for a parcel delivery company in the Netherlands
- Initial version of the microzoning approach based on Thiessen Polygons
- A microzone map for the whole Netherlands was developed
- Characteristic: a microzone should have a workload of approximately 30 minutes
Workload microzones compared to PC5
Results Rotterdam Area

<table>
<thead>
<tr>
<th></th>
<th>Average WL (mins)</th>
<th>Standard deviation</th>
<th>Coefficient of variation</th>
<th># regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microzones</td>
<td>27</td>
<td>4</td>
<td>0.15</td>
<td>54</td>
</tr>
<tr>
<td>PC4</td>
<td>58</td>
<td>39</td>
<td>0.67</td>
<td>25</td>
</tr>
<tr>
<td>PC5</td>
<td>5</td>
<td>7</td>
<td>1.40</td>
<td>274</td>
</tr>
</tbody>
</table>

Workload per Microzone (mins)

Workload per PC4 (mins)

Workload per PC5 (mins)
How to incorporate microzones in the system of Physical Internet

- Create a microzoning system for the whole world
- Create multi-layer microzones, like the NUTS system
- Incorporate public data such as land use and population density
Questions?